SURFACE VEHICLE STANDARD

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Superseding J2735 NOV2009

(R) Dedicated Short Range Communications (DSRC) Message Set Dictionary

RATIONALE

This standard amendment is motivated by a European, Japanese, and US need to support early pilot deployments using the MAP and SPAT messages which will occur in 2014. The committee wishes to reflect in this standard various improvements determined by developing requirements and field testing over the past 3 years. In this amendment, we therefore incorporate a number of additional desired features into the message structures which these trials have exposed.

We publish this amendment before an anticipated revision of the entire document, work on which will begin immediately after publication of this amendment. The committee is aware of a number of other areas in the document which will also require consideration at that time, including updating references of other standards to the latest versions. (Where such documents existed, the versions of standards referenced in the body of this document were the ones available at the time of publication of the Nov 2009 revision.)

Our expectation is that the replacement portions that address with MAP and SPAT will coexist with the rest of the document, and that entire document can therefore be used in early deployment until it is reissued with further changes and additional content. The committee also stresses that the unamended portions and messages defined in the document remain standardized and normative.

FOREWORD

Prepared for use by the DSRC committee of the SAE by SubCarrier Systems Corp (SCSC).

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1. SCOPE

This SAE Standard specifies a message set, and its data frames and data elements specifically for use by applications intended to utilize the 5.9 GHz Dedicated Short Range Communications for Wireless Access in Vehicular Environments (DSRC/WAVE, referenced in this document simply as “DSRC”), communications systems. Although the scope of this Standard is focused on DSRC, this message set, and its data frames and data elements have been designed, to the extent possible, to also be of potential use for applications that may be deployed in conjunction with other wireless communications technologies. This Standard therefore specifies the definitive message structure and provides sufficient background information to allow readers to properly interpret the message definitions from the point of view of an application developer implementing the messages according to the DSRC Standards.

1.1 Purpose

The purpose of this SAE Standard is to support interoperability among DSRC applications through the use of a standardized message set, and its data frames and data elements. This Standard provides information that is useful in understanding how to apply the various DSRC Standards, along with the message set specified herein, to produce interoperable DSRC applications.

This second published version of SAE J2735 is designated a 'Standard' rather than a 'Recommended Practice.' This implies that the data set dictionary in this version is deployable. It also creates a requirement that future revisions of SAE J2735 be backward compatible with this revision. This revision adds content to and corrects errors in the previous published Standard.

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2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J2540 Messages for Handling Strings and Look-Up Tables in ATIS Standards

SAE J2540-2 ITIS Phrase Lists (International Traveler Information Systems)

SAE J2630 Converting ATIS Message Standards From ASN.1 To XML

SAE J670 Vehicle Dynamics Terminology

2.1.2 IEEE Publications

Available from IEEE Operations Center, 445 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

IEEE Std 1609.2™-2006 IEEE Trial-Use Standard for Wireless Access in Vehicular Environments—Security Services for Applications and Management Messages, approved by SASB 8 June 2006, cover date 6 July 2006. And its adopted successors.

IEEE Std 1609.3™-2007 IEEE Trial-Use Standard for Wireless Access in Vehicular Environments (WAVE)—Networking Services, approved by SASB 23 march 2007, cover date 20 April 2007. And its adopted successors.

IEEE Std 1609.4™-2006 IEEE Trial-Use Standard for Wireless Access in Vehicular Environments (WAVE)—Multi-channel Operation, approved 30 October 2006, cover date 29 November 2006. And its adopted successors.

IEEE Std 802.11™-2007 Standard for LAN/MAN - Specific requirements Part 11: Wireless LAN Medium Access Control (MAC)and Physical Layer (PHY) Specifications, Institute of Electrical and Electronics Engineers / 12-Jun-2007 (date on the cover) / 1232 pages ISBN: 9780738156552

2.1.3 ISO Publications

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Available from American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, Tel: 212-642-4900, www.ansi.org.

ISO/IEC 8824-1:1998 Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation.

ISO/IEC 8824-2:1998 Information technology - Abstract Syntax Notation One (ASN.1): Information object specification.

ISO/IEC 8824-3:1998 Information technology - Abstract Syntax Notation One (ASN.1): Constraint specification.

ISO/IEC 8824-4:1998 Information technology - Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications.

2.1.4 RTCM Publications

Available from the Radio Technical Commission For Maritime Services, 1800 N Kent St., Suite 1060, Arlington, VA 22209, www.rtcm.org.

RTCM 10402.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service -Version 2.3 Revision 2.3 adopted on August 20, 2001 and its successors.

RTCM Standard 10410.0 for Networked Transport of RTCM via Internet Protocol (Ntrip) Revision 1.0 adopted on September 30, 2004 and its successors.

RTCM Standard 10403.1 for Differential GNSS (Global Navigation Satellite Systems) Services -Version 3 adopted on October 27, 2006 and its successors, including amendment #2 adopted August 31, 2007.

2.1.5 NMEA Publication

Available from National Marine Electronics Association, 7 Riggs Ave., Severna Park, MD 21146, www.nmea.org.
NMEA 183 Interface Standard V 3.01, published by the National Marine Electronics Association (NMEA) released January 2002.

2.2 Related Publications

It should be noted that this standard is intended to be independent of the underlying protocols used. However, it is also noted that early deployments are expected to use the “DSRC-WAVE” technology hosted at 5.9 GHz. For such applications the following standards are also of value.

2.2.1 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM E2158-01 Standard Specification for Dedicated Short Range Communication (DSRC) Physical Layer Using Microwave in the 902 to 928 MHz Band

ASTM E2213 -03 Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems - 5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications

2.2.2 IEEE Publications

Available from IEEE Operations Center, 445 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

IEEE Std 1609.0™-2013 IEEE Guide for Wireless Access in Vehicular Environments (WAVE) - Architecture

IEEE Std 1609.2™-2013 IEEE Standard for Wireless Access in Vehicular Environments — Security Services for Applications and Management Messages.

IEEE Std 1609.3™-2010 IEEE Standard for Wireless Access in Vehicular Environments (WAVE)—Networking Services,

IEEE Std 1609.4™-2010 IEEE Standard for Wireless Access in Vehicular Environments (WAVE)—Multi-channel Operation.

IEEE Std 1609.12™-2012 Draft Standard for Wireless Access in Vehicular Environments (WAVE) – Identifier Allocations

IEEE Std 802.11™-2012 Standard for LAN/MAN - Specific requirements Part 11: Wireless LAN

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IEEE Standard 802.11p-2010	IEEE Standard for Information Technology - Local and metropolitan area networks - Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 6: Wireless Access in Vehicular Environments.

3. TERMS AND DEFINITIONS

For the purposes of this standard, the following definitions, abbreviations and acronyms apply.

3.1 DEFINITIONS

For the purposes of this standard, the following definitions shall apply.

3.1.1 Actuated Operation

A type of traffic control signal operation in which some or all signal phases are operated on the basis of actuation, e.g. detector inputs. A signal without any actuation runs on either fixed time or time of day operation. A signal may be semi-actuated as well.

3.1.2 Application-Specific Data Dictionary

A data dictionary specific to a particular implementation of an ITS application. Local deployments which use DSRC (or other message sets) may often select a subset of the defined messages meeting their specific needs and create an application-specific data dictionary for that deployment.

3.1.3 Approach

All lanes of traffic moving towards an intersection or a midblock location from one direction, including any adjacent parking lane(s). In the context of this standard an approach is an arbitrary collection of lanes used in the flow of traffic proceeding to an intersection or a midblock location. An approach is typically identified by its general flow, i.e. “the east-bound approach”. In this standard an approach consists of one or more motor vehicle lanes of travel as well as possible pedestrian lanes, parking lanes, barriers, and other types of lane objects some of which cross the path of the motor vehicle travel.

3.1.4 Basic Encoding Rules

Rules laid out by the ASN.1 standard for encoding abstract information into a concrete data stream. The DSRC message set standard uses DER, a variant of BER for its encoding.

3.1.5 BLOB

Binary Large OBject, a term used in software to describe sequences of octets or bytes where any inner encoding or meaning is not visible.

3.1.6 Byte Type Encoding

A type of information encoding where units of information are handled in modular increments of 8 bits.

3.1.7 Computed Lane

A computed lane is a lane drivable by motorized vehicle traffic which shares its path definition with another nearby lane at the same intersection. It is one of several types of basic lanes defined in the message set. The computed lane allows saving of message bytes used to express the geometric path of multiple lanes approaching an intersection from the same direction.

3.1.8 Conflict Monitor

A device used to detect and respond to improper or conflicting signal indications and improper operating voltages in a traffic controller assembly.

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3.1.9 Control Channel (CCH)

The radio channel of those defined in IEEE 802.11 used for exchange of management data and WAVE Short Messages.

3.1.10 Controller Assembly

A complete electrical device mounted in a cabinet for controlling the operation of a highway traffic signal.

3.1.11 Controller Unit

That part of a controller assembly that is devoted to the selection and timing of the display of signal indications.

3.1.12 Cycle

One complete sequence of signal indications.

3.1.13 Cycle Length

The duration of one complete sequence of signal indications. The cycle length is not generally fixed at actuated controllers.

3.1.14 Dark Mode

The lack of all signal indications at a signalized location. (The dark mode is most commonly associated with power failures, ramp meters, beacons, and some movable bridge signals.) Note that when the SPAT message is used to convey the status of a non-signalized 4-way stop type of intersection, if an approach is modeled as being in the dark mode, it would indicate that the signage is missing (normally a flashing red stop would be indicated).

3.1.15 Data

Representations of static or dynamic entities in a formalized manner suitable for communication, interpretation, or processing by humans or by machines.

3.1.16 Data Concept

Any of a group of data dictionary structures defined in this standard (e.g., data element, data element concept, entity type, property, value domain, data frame, or message) referring to abstractions or things in the natural world that can be identified with explicit boundaries and meaning and whose properties and behavior all follow the same rules.

3.1.17 Data Consumer

Any entity in the ITS environment which consumes data from others.

3.1.18 Data Dictionary

An information technology for documenting, storing and retrieving the syntactical form (i.e., representational form) and some usage semantics of data elements and other data concepts. The major message sets of ITS, of which DSRC is but one, are kept and represented in a data dictionary.

3.1.19 Data Element

A syntactically formal representation of some single unit of information of interest (such as a fact, proposition, observation, etc.) with a singular instance value at any point in time, about some entity of interest (e.g., a person, place, process, property, object, concept, association, state, event). A data element is considered indivisible.

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3.1.20 Data Frame

(Formerly: Data Structure, which appears in the early ITS efforts, is now more commonly called a Data Frame. The definition and meaning, which follows, remains the same.)

One of the constructs used to represent the contents of a Data Dictionary. From a computer science perspective, data frames are viewed as logical groupings of other data frames and of data elements to describe "structures" or parts of messages used in this and other standards. A data frame is a collection of two or more other data concepts in a known ordering. These data concepts may be simple (data elements) or complex (data frames). A construct composed entirely of an octet string is considered a data frame if the octet string represents two or more distinct data concepts.

3.1.21 Data Plane

The communication protocols defined to carry application and management data across the communications medium.

3.1.22 Data Structure

Any construct (including data elements, data frames, and other data concepts) used to represent the contents of a data dictionary.

3.1.23 Data Type

A classification of the collection of letters, digits, and/or symbols used to encode values of a data element based upon the operations that can be performed on the data element. For example, real, integer, character string, Boolean, bitstring, etc.

3.1.24 Dialog

A sequence of two or more messages which are exchanged in a known sequence and format (typically of a request followed by one or more replies), which are considered a bound transactional exchange between the parties.

3.1.25 Distinguished Encoding Rules

A variant of ASN BER encoding used by this standard.

3.1.26 Dual-Arrow Signal Section

A type of signal section designed to include both a yellow arrow and a green arrow.

3.1.27 Egress

In the context of this standard an egress is a flow of vehicular or other types of traffic leaving an intersection on one or more of the defined lanes of travel.

3.1.28 Encounter

In the context of this standard an encounter is an exchange of messages between two or more DSRC equipped devices (OBUs or RSUs) lasting for a brief period of time.

3.1.29 Entity

Anything of interest (such as a person, place, process, property, object, concept, association, state, event, etc.) within a given domain of discourse (in this case within the ITS domain of discourse).

3.1.30 Entity Type

An abstract type of structure defined in the ITS data register but no longer used. There are no entity types defined in this standard.

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3.1.31 Flashing Mode

A mode of operation in which at least one traffic signal indication (but more typically all signal indication of the entire signalized intersection) in each vehicular signal face of a highway traffic signal is turned on and off repetitively. Expressed in the terminology of the SPAT message, this is reflected in the descriptions of signal states of the affected lanes (in that movement) being set to red flashing.

3.1.32 Full-Actuated Operation

A type of traffic control signal operation in which all signal phases function on the basis of actuation.

3.1.33 Functional-Area Data Dictionary (FADD)

A data dictionary that is intended to standardize data element syntax, and semantics, within and among application areas within the same functional area. This DSRC standard is a FADD.

3.1.34 Ingress

In the context of this standard an egress is a flow of vehicular or other types of traffic approaching an intersection on one or more of the defined lanes of travel.

3.1.35 Intelligent Transportation Systems (ITS)

Systems that apply modern technology to transportation problems. Another appropriate meaning of the ITS acronym is integrated transportation systems, which stressed that ITS systems will often integrate components and users from many domains, both public and private.

3.1.36 Interoperability

The ability to share information between heterogeneous applications and systems.

3.1.37 Intersection

In the context of this standard an intersection is a nexus where two or more approaches meet and vehicles and other type users may travel between the connecting links. Typically this is a signalized intersection when considered by this standard, and as such the modes of allowed travel are reflected in the signal phases, the geometry of the intersection itself, and the local regulatory environment. The messages of this standard convey some of this information to the traveling public. Specifically, the MAP message conveys the relevant the road geometry, while the SPAT message conveys the current signal indication to allow and control movement in the intersection.

3.1.38 Intersection Control Beacon

A beacon used only at an intersection to control two or more directions of travel.

3.1.39 Interval

The part of a signal cycle during which signal indications are stable and do not change. In the SPAT message the current timing value for the remaining interval time estimate as well as the anticipated interval for yellow change interval is provided for each lane. Because signal interval times commonly change based on triggering events in many types of signaling systems, the value provided in the SPAT message may represent a minimal value that is extended and updated as the message is re-issued each time.

3.1.40 Interval Sequence

The order of appearance of signal indications during successive intervals of a signal cycle.

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3.1.41 IT IS

International Traveler Information Systems, the term commonly associated with the standard for incident phrases developed by the SAE ATIS Committee in conjunction with ITE TMDD and other standards. This work contains a wide variety of standard phrases to describe incidents and is expected to be used throughout the ITS industry. The codes found there can be used for sorting and classifying types of incident events, as well as creating uniform human readable phrases. In the capacity of classifying incident types, ITIS phrases are used in many areas. ITIS phrases can also be freely mixed with text and used to describe many incidents.

3.1.42 Lane

In the context of this standard a lane is a portion of the transportation network (typically a section of roadway geometry) which is being described (its paths and various attributes about it) or referred to. In the DSRC message set, the lane object is widely used. Lanes consist not only of sections of “drivable” roadway traversed by motor vehicles, but other types of lanes including pedestrian and bicycle walkways, trains and transit lanes, and certain types of dividers and barriers. When used in describing an intersection, a lane is defined for each possible path into and out of the intersection (in the MAP message), and the current signal phase (and therefore the allowed movements) then applicable to that lane or its approach is provided in the SPAT message.

3.1.43 Lane-Use Control Signal

A signal face displaying signal indications to permit or prohibit the use of specific lanes of a roadway or to indicate the impending prohibition of such use.

3.1.44 Link (RF)

A communications channel being used in support of application data transfer needs.

3.1.45 Link (Traffic)

A segment of a road network; while highway links are generally separated by one data collection node (such as an RSU or a vehicle detector station), local road links tend to be limited by intersections with cross streets. Other common usages of the word "link," such as those used in telecommunications, may also appear in the document.

3.1.46 Management Plane

The collection of functions performed in support of the communication system operation, but not directly involved in passing application data.

3.1.47 Message

A well structured set of data elements and data frames that can be sent as a unit between devices to convey some semantic meaning in the context of the applications about which this standard deals. Within Section 5 of this standard, each sub-section (e.g., 5.1) defines one message. The term "message type" has the same meaning as "message" in this standard.

3.1.48 Message Set

A collection of messages based on the ITS functional-area they pertain to. The collection of messages defined in Section 5 of this standard is a message set

3.1.49 Networking Services

The collection of management plane and data plane function at the network layer and transport layer, supporting WAVE communications.

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3.1.50 Notification

An indication of an event of interest, sent to an application. Also a term used by lower layers inform upper layers an event of interest in a protocol stack.

3.1.51 Offset (Phase)

Offset is the time lag for the cycle start of a coordinated signal. Quoting from the FHWA Signal Timing Manual, Chapter 6, Section 6.1 Terminology. (Draft 3 version, development still underway): “The time relationship between coordinated phases defined reference point and a defined master reference (master clock or sync pulse)." In other words, a local signal controller setting that references the start of the green to a common clock so the beginning of green can be coordinated along a roadway to speed motorist along at a designed speed.

3.1.52 On-Board Unit

An On-Board Unit (OBU) is a vehicle mounted DSRC device used to transmit and receive a variety of message traffic to and from other DSRC devices (other OBUs and RSUs). Among the message types and applications supported by this process are vehicle safety messages, a primary subject of this standard, used to exchange information on each vehicle's dynamic movements for coordination and safety. An OBU contains a station (STA).

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3.1.53 Pedestrian Change Interval

An interval during which the flashing UPRAISED HAND (symbolizing DONT WALK) signal indication is displayed, often also called the pedestrian clearance time. During this interval the SPAT messages indicates a don’t walk state for that pedestrian lane (along with an optional period of time remaining for this state).

3.1.54 Pedestrian Clearance Time

The minimum time provided for a pedestrian crossing in a crosswalk, after leaving the curb or shoulder, to travel to the far side of the traveled way or to a median. During this interval the SPAT messages indicates a Flashing Don’t Walk indication for that pedestrian lane (along with an optional period of time remaining for this state). The duration for such time intervals comes from MUTCD and is based on a rate of speed of 2 meters per second.

3.1.55 Pedestrian Phase

The time during which a walking figure or word “WALK” is presented and the DON’T WALK is presented. The pedestrian phase is also the time interval of the pedestrian walk interval and the pedestrian change interval combined.

3.1.56 Pedestrian Walk Interval

An interval during which the WALKING PERSON (symbolizing WALK) signal indication is displayed. When a verbal message is provided at an accessible pedestrian signal, the verbal message is “walk sign.” During this interval the SPAT messages indicates a walk state for that pedestrian lane (along with an optional period of time remaining for this state and the subsequent pedestrian clearance state).

3.1.57 Permissive Mode

A mode (left or right) of traffic control signal operation in which, when a CIRCULAR GREEN signal indication is displayed, left and/or right turns are permitted to be made after yielding to pedestrians and/or oncoming traffic.

3.1.58 Preemption Control

The transfer of normal operation of a traffic control signal to a special control mode of operation.

3.1.59 Pretimed Operation

A type of traffic control signal operation in which none of the signal phases function on the basis of actuation. When such a signal operation is reflected in the SPAT message, the time intervals given for various signal phases are fixed and do not vary based on any form of actuation. Pretimed operation may be fixed or based on time of day schedules.

3.1.60 Protected Mode

A mode (left or right) of traffic control signal operation in which left or right turns are permitted to be made when a left or right GREEN ARROW signal indication is displayed.

3.1.61 Provider Service Context (PSC)

A field associated with a PSID containing supplementary information related to the service. The format of the PSC is PSID dependent.

3.1.62 Provider Service Identifier (PSID)

A number that identifies a service provided by an application. PSID is defined in IEEE Std 1609.3.

3.1.63 Red Clearance Interval

An optional interval that follows a yellow change interval and precedes the next conflicting green interval.

3.1.64 Reference Lane

A reference lane is a lane drivable by motorized vehicle traffic which also contains a detailed path definition of the lane's geometry (a center line path and width) as well as basic attributes (such as the allowed maneuvers) about the lane. The provided path data may optionally be shared with another nearby lane (a "computed lane") in the same intersection. It is one of several basic types of lanes defined in the message set.

3.1.65 Reference Point

A reference point is a complete latitude – longitude – and vertical point on the reference surface which is used as an initial starting point for subsequent orthogonal offset X, Y, Z values from that point. All roadway geometry, maps of intersections, lane and curve descriptions, and other geometrical data that is encoded in this standard uses a systems of local reference points to index and offset the data that follows.

3.1.66 Roadside Unit

A RoadSide Unit (RSU) is a DSRC device used to transmit to, and receive from, DSRC equipped moving vehicles (OBUs). The RSU transmits from a fixed position on the roadside (which may in fact be a permanent installation or from "temporary" equipment brought on-site for a period of time associated with an incident, road construction, or other event). Some RSUs have the ability to transmit signals with greater power than OBUs and some may have connectivity to other nodes or the Internet. An RSU contains a station (STA).

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3.1.67 Semi-Actuated Operation

A type of traffic control signal operation in which at least one, but not all, signal phases function on the basis of actuation.

3.1.68 Service Channel

Secondary channels (logical channels) used for application-specific information exchanges.

3.1.69 Signal Head

An assembly of one or more signal lamps. One or more signal heads may be used to provide complementary indications to one of more approaches, which may cover multiple lanes. The definitive mapping to specific lanes can be determined by examining the SPAT and MAP fragment messages.

3.1.70 Signal Phase

The right-of-way, yellow change, and red clearance intervals in a cycle that are assigned to an independent traffic movement, or combination of movements. Each of these cycles are reflected in the SPAT message for the lanes that are part of the movement(s), along with its expected timing interval (which may be updated in signal systems that vary the time interval based on actuation or other methods).

3.1.71 Signal Section

Two or more traffic control signals operating in signal coordination. Also called a signal system.

3.1.72 Signal Timing

The amount of time allocated for the display of a signal indication, slang.

3.1.73 SPAT

In the context of this standard, Signal Phase And Timing (SPAT), is a message type which describes the current state of a signal system and its phases and relates this to the specific lanes (and therefore to movements and approaches) in the intersection. It is used along with the MAP message to allow describing an intersection and its current control state.

3.1.74 Split (Phase)

In split phase operations opposing turn lanes are coordinated at differing times. For example, the east and west left turn movements would get green arrows at different times.

3.1.75 Split (Signal)

Signal split is a term having to do with coordinated signals. Signal split pertains to time allocated to the coordinated road vs. the cross streets.

3.1.76 Stability Control

A system which operates to prevent a car from sliding sideways under dynamic driving conditions.

3.1.77 Station

Any device that contains an IEEE 802.11 conformant medium access control (MAC) and physical layer (PHY) interface to the wireless medium. Both an RSU and an OBU contain stations (STA).

3.1.78 Stop Line

The stop line is a defined location along the path of the lane type where users (vehicles) are presumed to stop and come to rest at the edge of the intersection. The stop line is used as the starting point to define the centerline path of a lane in the messages (with sets of offset points defining the path of the lane proceeding away from the stop line). While stop lines are normally considered for lanes describing motorized vehicle travel, they are also used on other forms of lanes (such as pedestrian walkway lanes) to describe the initial point of the path.

3.1.79 Syntax

The structure of expressions in a language, and the rules governing the structure of a language.

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3.1.80 Transactions

Bi-directional data exchanges between devices (RSUs and OBUs).

3.1.81 Unavailable

In the context of this standard and in the context of a data concept definition, the term unavailable shall mean that the value of this data concept could not be obtained for use in the message.

3.1.82 Value Domain

A well known range of values, or terminology, or enumeration that many be referenced as an abstract type the ITS data register but no longer used. There are very many value domains used in ITS standards.

3.1.83 Vehicle Type

In the context of this standard the vehicle type is a data element used to define overall gross size and mass of a vehicle, Observe that this definition differs from the (multiple other) vehicle types defined elsewhere in other standards used in the ITS.

3.1.84 Walk Interval

An interval during which the WALKING PERSON (symbolizing WALK) signal indication is displayed. When a verbal message is provided at an accessible pedestrian signal, the verbal message is “walk sign.”

3.1.85 Warning Beacon

A beacon used only to supplement an appropriate warning or regulatory sign or marker.

3.1.86 WAVE Device

A device that contains a WAVE-conformant medium access control (MAC) and physical layer (PHY) interface to the wireless medium. (See IEEE 802.11 where it is also referred to as “Outside the Context of a BSS” or OCB, where BSS stands for “Basic Service Set”)

3.1.87 WAVE Management Entity (WME)

The set of management functions, as defined in IEEE Std 1609 documents, required to provide WAVE Networking Services.

3.1.88 XML

A common method of exchanging messages made up of tags and values organized in a data structure and typically transported over common Internet formats such as HTTP. XML has a growing number of supporters due to its ability to be implemented in the types of heterogeneous systems often found in ITS deployments. It is possible to express and exchange the DSRC message set using this method; XML schema definitions are provided in the latter clauses of the standard.

3.1.89 Yellow Change Interval

The first interval following the green interval during which the yellow signal indication is displayed. In the SPAT message the fixed duration of the yellow change interval is (optionally) provided for each active lane being described.

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3.2 ABBREVIATIONS AND ACRONYMS

The terms, abbreviations and acronyms cited below shall be a part of the terms of this standard (and of the other companion volumes and guides) unless specifically cited otherwise.

AAMVA	American Association of Motor Vehicle Administrators
ABS	Anti-lock Braking System
ACM	A La Carte Message
ASC	Advanced Signal Controller
ASN	Abstract Syntax Notation revision One, Also: ASN.1
ASTM	American Society for Testing and Materials
ATIS	Advanced Traveler Information Systems
ATMS	Advanced Transportation Management Systems
BER	Basic Encoding Rules
BLOB	Binary Large OBject
BSM	Basic Safety Message
BSW	Blind Spot Warning
CAN	Controller Area Network
CCC	Cooperative Cruise Control
CCH	Control Channel
CER	Canonical Encoding Rules
CICAS-V	Cooperative Intersection Collision Avoidance System – Violation
CLW	Control Loss Warning
CRC	Cyclic Redundancy Code
CSR	Common Safety Request Message
DE	Data Element
DER	Distinguished Encoding Rules
DF	Data Frame
DNPW	Do Not Pass Warning
DSRC	Dedicated Short Range Communications
DVIN	Driver-Vehicle Interface Notifier
EEBL	Emergency Electronic Brake Lights
EGUI	Engineering Graphical User Interface
ESS	Environmental Sensors Stations
EVA	Emergency Vehicle Alert Message
FCW	Forward Collision Warning
GES	General Estimated System
GID	Geographic Information Description
GMT	Greenwich Mean Time
HMI	Human Machine Interface

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HVPP	Host Vehicle Path Prediction
ICA	Intersection Collision Alert Message
IEEE	Institute of Electrical and Electronics Engineers
IM	Incident Management or inter-modal
IMA	Intersection Movement Assist
IP	Internet Protocol
IPv6	Internet Protocol version 6
ISO	International Standards Organization
ITE	Institute of Transportation Engineers
ITIS	International Traveler Information Systems
LCW	Lane Change Warning
LLC	Logical Link Control
LRMS	Location Referencing Message System
LSB	Least Significant Bit
MAC	Medium Access Control
MAP	Map Data Message
MIB	Management Information Base
MIL	Malfunction Indicator Light (Check Engine Light)
MSB	Most Significant Bit
MSG	Message
NAP	Network Access Point
NEMA	National Electronics Manufacturers Association
NMEA	National Marine Electronics Association
NTCIP	National Transportation Communications for ITS Protocols
NTRIP	Networked Transport of RTCM via Internet Protocol
OBE	On-Board Equipment
OBU	On-Board Unit
OEM	Original Equipment Manufacturer
OTA	Over-The-Air
PDM	Probe Data Management Message
PDU	Protocol Data Unit
PER	Packed Encoding Rules
PH	Path History
PHY	Physical Layer
PP	Path Prediction
PSC	Provider Service Context
PSID	Provider Service Identifier
PSN	Probe Segment Number
PVD	Probe Vehicle Data Message

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RSA	RoadSide Alert Message
RSU	RoadSide Unit
RTCM	Radio Technical Commission for Maritime Services or RTCM Corrections Message
RTK	Real Time Kinematics
SAE	SAE International
SAP	Service Access Point
SC-104	Sub-Committee 104 of the RTCM
SCH	Service Channel
SDH	Sensor Data Handler
SDN	Service Delivery Node
SDO	Standards Developing Organizations or Standards Development Organization
SPAT	Signal Phase and Timing Message
SRM	Signal Request Message
SRS	Safety Restraint System
SSM	Signal Status Message
STA	Station
TA	Threat Arbitration
TC	Traction Control or Target Classification
TCIP	Transit Communications Interface Profiles
TCP	Transmission Control Protocol
TCS	Traction Control System
TIM	Traveler Information Message
TMDD	Traffic Management Data Dictionary
UDP	User Datagram Protocol
USDOT	United States Department of Transportation
UTC	Universal Coordinated Time
VIN	Vehicle Ident Number
VSC	Vehicle Safety Communications
VSC-2	Vehicle Safety Communications 2
V-V	Vehicle-to-Vehicle (also V2V)
WAVE	Wireless Access in Vehicular Environments
WME	WAVE Management Entity
WMH	Wireless Message Handler
WSM	WAVE Short Message
WSMP	WSM Protocol
XML	eXtensible Markup Language

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4. THE USE OF DSRC MESSAGES IN APPLICATIONS

This section contains introductory material about this edition of SAE J2735, background information on the rationale for the Standard, and an introduction to the messages and other data concepts, which follow in Sections 5-8.

4.1 Introduction to DSRC Goals and Objectives (Informative)

Public sector organizations throughout the world have identified the need to reduce fatalities and serious injuries that result from vehicle crashes, as well as the need to reduce traffic congestion. The use of wireless and computer technologies in vehicles, and on the roadway infrastructure, have been identified as promising areas to provide solutions for these needs. Intelligent Transportation System (ITS) planning in many regions of the world has therefore become focused on supporting applications that utilize a common platform to address three priorities:

1. Safety
2. Mobility
3. Commercial (or Private)

Safety applications, in particular, must be interoperable between vehicles from different manufacturers and between vehicles and roadway infrastructure within all the areas where the vehicle is likely to travel. This requirement for interoperability is also relevant to contemplated mobility applications. This SAE Standard specifies messages, data frames and data elements that allow interoperability at the application layer without the need to standardize applications. This approach supports innovation and product differentiation through the use of proprietary applications, while maintaining interoperability by providing a standard message set that can be universally generated and recognized by these proprietary applications.

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The message set specified in this SAE Standard depends upon the lower layers of the DSRC protocol stack (or potentially other wireless communications systems) to deliver the messages from applications at one end of the communication system (for example, in a vehicle) to the other end (for example, in another vehicle). These lower layers of the DSRC protocol stack are defined and specified in standards developed by other Standards Development Organizations (SDOs). In particular, the protocols at the lowest layers are addressed by IEEE Std 802.11, , particularly in the sections referring to “Outside the Context of a BSS” or OCB and the middle layer protocols are covered in the IEEE 1609 Family of Standards for Wireless Access in Vehicular Environments (WAVE). The DSRC family of standards developed by the various SDOs are meant to operate together in a harmonious fashion. This standard defines the content and structure of messages exchanged between applications. A given SAE J2735 message is the payload of the next lower layer protocol, e.g. the "WSM data" field defined in IEEE 1609.3. The aggregate content of an over-the-air packet is determined jointly by all the protocols in the stack.

The following subsection provides an overview of the DSRC architecture and protocol stack. Subsequent annexes describe examples of how the message and data concepts specified in this Standard might be used, which also strongly influenced the philosophy of the message design. These messages are presented in Section 5. The particular message design techniques described in this Standard have allowed for the construction of a dictionary of reusable, relevant data frames and data elements that support interoperability for currently envisioned applications and are also intended to expedite the development of future messages. The standard data frames are presented in Section 6 of this Standard, and the data elements are specified in Section 7. Data concepts reused from other areas of ITS work are presented in Section 8.

4.2 DSRC Overview (Informative)

The Wireless Access for Vehicular Environment (WAVE) communications system is designed to enable vehicle-to-vehicle and vehicle-to/from-infrastructure communications in order to provide a common platform to achieve the safety, mobility and commercial priorities described in 4.1. Interoperability is a fundamental requirement of this common platform, and WAVE is designed to provide the required interoperable wireless networking services for transportation. As well, the WAVE system uniquely supports the high-availability, low-latency communications requirements of vehicle safety applications, such as pre-crash collision mitigation, intersection collision avoidance and cooperative collision avoidance.

The physical layer (PHY) and the medium access control (MAC) layer of the WAVE system are specified in IEEE Standard 802.11™-2007, as amended (hereafter IEEE 802.11). The system generally supports a MAC and PHY for each channel on which it operates, i.e., the control channel (CCH) and/or one or more service channels (SCHs). The range of this system is generally considered to be line-of-sight distances of less than 1000 meters. The MAC and PHY protocols have been modified to support usage by vehicles traveling at highway speeds.

The IEEE Standard 1609™ family of standards (hereafter IEEE 1609) provides enhancements to the IEEE 802.11 medium access control (MAC) that support WAVE safety, mobility and private applications in a multi-channel system by specifying mechanisms for prioritized access, channel routing, channel coordination and data transmission.

The upper layers of the network stack, up to the application layer, are defined in IEEE 1609. There are two pathways through the WAVE upper layers above the LLC layer: the Wave Short Message Protocol (WSMP) stack and the IPv6 stack. IEEE 1609 describes networking services for applications running over either of these stacks, as well as describing the operation of the WSMP stack. Transmissions on the CCH are limited to WAVE Short Messages (WSM) and some management messages. Both the WSMP stack and the IPv6 stack may be used for communications on SCHs. The WSMP stack is generally used for broadcast applications. The IPv6 stack is typically used with UDP for the messages defined in this standard.

IEEE 1609 defines secure message formats, and specifies how these secure messages are processed within the WAVE system. These security services are designed to protect messages from attacks such as eavesdropping, spoofing, alteration and replay, while respecting end users' rights to privacy. The messages covered in IEEE 1609 security procedures include WAVE management messages and application messages, but did not include vehicle-originating safety messages in November 2009. Security services for vehicle-originating safety messages had not been specified in any standard in November 2009, but are required for vehicle safety applications to be widely deployed.

4.3 Philosophy of Message Design (Informative)

The wireless DSRC channels over which SAE J2735 messages are communicated are finite resources, which should be used conservatively in order to achieve good performance in realistic traffic environments. The WAVE Short Message Protocol (WSMP) is designed to operate efficiently over DSRC, using short packets that are frequently broadcast in an un-acknowledged delivery mode. Other protocols can be used over DSRC as well, for example to carry a variety of other ITS related information including such things as ATIS information encoded in XML forms. WSMs also support dialogs and transactions, and these can leave the control channel in order to use a service channel as needed, but the general design goal is to maximize support for short broadcast style messages. To that end, a dense encoding of information is used in defining the messages of this Standard. Several of the design aspects of this encoding are discussed below.

This dense encoding uses a three-way approach:

1. The smallest divisions of information content to be standardized are called Data Elements

2. Data Frames are the next, more complex data structures to be standardized in this dense encoding

3. The top level of complexity in the data structure standardization is called Messages

The above data concepts are all described in both Abstract Syntax Notation revision One (ASN.1, referred to as ASN hereafter) and in an XML schema syntax. This process follows the typical style used for message sets defined in ITS standards by SAE and the other SDOs engaged in ITS development. Complete ASN modules and XSD schema sets of the Standard are available for developers.

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4.4 Message Encoding (Normative)

The ASN specified by this Standard is then encoded for transport by the lower layers (the encoded stream of bytes becomes the payload of that lower layer). The encoding style required to be used to conform with this Standard is the DER variant of BER (the CER variant is not used). The Distinguished Encoding Rules are a specific subset of the Basic Encoding Rules which were developed to allow one (and only one) encoding for any specific message content. The DER style follows the normal byte-aligned Tag-Length-Value format of BER for ASN. Consult any textbook on ASN for further[1] details.

In this standard amendment the above normative use of DER encoding is superseded in selected places where the normative use of unaligned PER encoding (UPER) is now specified rather than DER encoding. In the production of ASN and XML found in this standard there are OCTET STRING segments defined which are made up of inner content constructed as outlined in ASN comments which are part of the definition. In such cases the OTECT STRING shall be encoded to match the described inner content and using the bit and byte numbering and packing order as defined by ASN. When the inner content of an OCTET STRING refers to another data frame or data element found in this standard for its construction, the definition of that element shall be used in the place it is referred to. The resulting content of that portion of the OCTET STRING shall be conformant to the definition of the referenced data frame or data element. As an example, the MsgCount field in DF_ BSM_Blob shall conform to the definition of DE_MsgCount."

5. MESSAGE SETS

This section defines the precise structure of the DSRC messages defined by this standard. The DSRC data concepts in this standard are divided into messages, data frames, and data elements. Messages are made up of content further defined in this document (i.e. made up of entries that are either atomic or complex but which are also defined in this document) and content defined externally to this document. Such external content is reused from other functional areas and standards developed by other groups and SDOs. The contents of this standard (both at the complete message level and its component parts) may be reused by other efforts elsewhere.

All text in this clause is considered normative unless expressly marked otherwise. Definitions for this message set are presented in the following subclauses. The ASN.1 is presented in a section titled ASN.1 Representation. The equivalent XML expression is presented in a section titled XML Representation which follows the translation rule set cited in Clause Two (SAE Standard SAE J2630). Should the two sections conflict in some way, the ASN.1 expression shall take precedence.

The productions of ASN.1 which follow shall be considered normative in nature. While the majority of the normative content is reflected in the actual syntax of the ASN.1, some entries also have additional statements in the ASN.1 comments which shall be considered normative as well. In addition, the textual commentary provided with each entry (in sections marked "use" and "remarks") may also provide additional normative restrictions on the proper use of the entry being described. The XML productions follow directly from the ASN.1 specifications and the same rules shall be applied. Users of this standard seeking to be in conformance with it shall follow the normative text outlined here.

5.1 Message: MSG_BasicSafetyMessage (BSM)

Use: The basic safety message (BSM) is used in a variety of applications to exchange safety data regarding vehicle state. This message is broadcast frequently to surrounding vehicles with a variety of data content as required by safety and other applications. Transmission rates are beyond the scope of this standard, but a rate 10 times per second is typical. Part I data shall be included in every BSM. Part II data are optional for a given BSM and are included as needed according to policies that are beyond the scope of this standard. A BSM without Part II content is also a valid message. Refer to the Annex "Operation with the Basic Safety Message in Vehicles" for examples of how the Basic Safety Message can be used.

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[1] The DSRC committee has developed a (freely available) users guide to illustrate the proper use the messages, and part of that guide provides additional data on the rules of encoding used in the message set.

ASN.1 Representation:

```
BasicSafetyMessage ::= SEQUENCE {
   -- Part I
   msgID       DSRCmsgID,                 -- 1 byte

   -- Sent as a single octet blob
   blob1       BSMblob,

   --
   -- The blob consists of the following 38 packed bytes:
   --
   -- msgCnt      MsgCount,              -x- 1 byte
   -- id          TemporaryID,           -x- 4 bytes
   -- secMark     DSecond,               -x- 2 bytes

   -- pos      PositionLocal3D,
     -- lat       Latitude,              -x- 4 bytes
     -- long      Longitude,             -x- 4 bytes
     -- elev      Elevation,             -x- 2 bytes
     -- accuracy  PositionalAccuracy,    -x- 4 bytes

   -- motion   Motion,
     -- speed     TransmissionAndSpeed,  -x- 2 bytes
     -- heading   Heading,               -x- 2 byte
     -- angle     SteeringWheelAngle     -x- 1 bytes
     -- accelSet  AccelerationSet4Way,   -x- 7 bytes

   -- control  Control,
   -- brakes      BrakeSystemStatus,     -x- 2 bytes

   -- basic    VehicleBasic,
   -- size        VehicleSize,           -x- 3 bytes

   -- Part II, sent as required
   -- Part II,
   safetyExt     VehicleSafetyExtension OPTIONAL,
   status        VehicleStatus          OPTIONAL,

   ... -- # LOCAL_CONTENT
   }
```

XML Representation:

```
<xs:element name="basicSafetyMessage" type="BasicSafetyMessage"/>
<xs:complexType name="BasicSafetyMessage" >
      <xs:sequence>
         <!-- Part I -->
         <xs:element name="msgID" type="DSRCmsgID" />
         <!-- 1 byte
         Sent as a single octet blob -->
         <xs:element name="blob1" type="BSMblob" />
         <!-- The blob consists of the following 38 packed bytes:
          -->
         <!-- msgCnt      MsgCount,              -x- 1 byte
         id          TemporaryID,           -x- 4 bytes
         secMark     DSecond,               -x- 2 bytes
         pos      PositionLocal3D,
         lat       Latitude,              -x- 4 bytes
         long      Longitude,             -x- 4 bytes
         elev      Elevation,             -x- 2 bytes
         accuracy  PositionalAccuracy,    -x- 4 bytes
```

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```
         motion   Motion,
         speed     TransmissionAndSpeed,  -x- 2 bytes
         heading   Heading,               -x- 2 byte
         angle     SteeringWheelAngle    -x- 1 bytes
         accelSet  AccelerationSet4Way,   -x- 7 bytes
         control  Control,
         brakes      BrakeSystemStatus,     -x- 2 bytes
         basic    VehicleBasic,
         size        VehicleSize,           -x- 3 bytes
         Part II,  sent as required
         Part II, -->
         <xs:element name="safetyExt" type="VehicleSafetyExtension"  minOccurs="0"/>
         <xs:element name="status" type="VehicleStatus"  minOccurs="0"/>
         <xs:element name="localBasicSafetyMessage" type="local:BasicSafetyMessage"
minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

Remarks: This message is divided into two parts and uses the same BER-DER encoding system in each. In the Part I area (those data elements which are always sent in each BSM) some data elements have been encoded as a well-defined octet blob to enable concise encoding and conserve channel bandwidth. In the Part II area, BER-DER tags and lengths precede each defined data element in the normal way. Any locally defined content can be added to the part two content in the normal way. Developers of such local content should take steps to avoid creating content with tags which could conflict with future revisions of the standard (such tags should be in the local range of 128~255 to avoid conflict with the national standard).

5.2 Message: MSG_CommonSafetyRequest (CSR)

Use: The Common Safety Request message provides a means by which a vehicle participating in the exchange of the basic safety message can unicast requests to other vehicles for addition information which it requires for the safety applications it is actively running. Responding vehicles will (or may) add this information to the appropriate place in the basic safety message when they broadcast it. Additional operational concepts are explained further in other clauses of this standard.

Addition information (data elements and data frames) can be requested by this message to be placed into the Part II sections of the basic safety message (Part I contains selected information that is always present in every message without exception).

When a device receives a request for a data element it does not understand or support, or from a vehicle with a spatial position or heading that it may choose to ignore, then that request is simply ignored.

ASN.1 Representation:

```
CommonSafetyRequest ::= SEQUENCE {
   msgID        DSRCmsgID,
   msgCnt       MsgCount OPTIONAL,
   id           TemporaryID OPTIONAL,

   -- Note: Uses the same request as probe management
   requests     SEQUENCE (SIZE(1..32)) OF RequestedItem,

   ... -- # LOCAL_CONTENT
   }
```

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XML Representation:
```
<xs:element name="commonSafetyRequest" type="CommonSafetyRequest"/>
<xs:complexType name="CommonSafetyRequest" >
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <xs:element name="msgCnt" type="MsgCount"  minOccurs="0"/>
         <xs:element name="id" type="TemporaryID"  minOccurs="0"/>
         <!-- Note: Uses the same request as probe management -->
         <xs:element name="requests" >
            <xs:complexType>
               <xs:sequence minOccurs="1" maxOccurs="32">
                  <xs:element name="request" type="RequestedItem" />
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <xs:element name="localCommonSafetyRequest" type="local:CommonSafetyRequest"
minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

5.3 Message: MSG_EmergencyVehicleAlert (EVA)

Use: The Emergency Vehicle Alert message is used to broadcast warning messages to surrounding vehicles that an emergency vehicle (typically an incident responder of some type) is operating in the vicinity and that additional caution is required. The message itself is built on the original ATIS roadside alert message which in turn uses the common ITIS phrase list to both describe the event and provide advice and recommendation for travelers. The Emergency Vehicle Alert message appends to the message some additional data elements regarding the overall type of vehicle involved and other useful data. Note that this message can be used by both private and public response vehicles, and that the relative priority of each (as well as security certificates) is determined in the application layer.

ASN.1 Representation:
```
EmergencyVehicleAlert ::= SEQUENCE {
   msgID            DSRCmsgID,
   id               TemporaryID OPTIONAL,
   rsaMsg           RoadSideAlert,
-- the DSRCmsgID inside this
                                 -- data frame is set as per the
                                 -- RoadSideAlert.  The CRC is
                                 -- set to a value of zero.
   responseType     ResponseType                   OPTIONAL,
   details          EmergencyDetails               OPTIONAL,
                    -- Combines these 3 items:
                    -- SirenInUse,
                    -- LightbarInUse,
                    -- MultiVehicleReponse,

   mass             VehicleMass                    OPTIONAL,
   basicType        VehicleType                    OPTIONAL,
                                 -- gross size and axle cnt

   -- type of vehicle and agency when known
   vehicleType      ITIS.VehicleGroupAffected      OPTIONAL,
   responseEquip    ITIS.IncidentResponseEquipment OPTIONAL,
   responderType    ITIS.ResponderGroupAffected    OPTIONAL,
   crc              MsgCRC,
   ... -- # LOCAL_CONTENT
   }
```

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XML Representation:

```
<xs:element name="emergencyVehicleAlert" type="EmergencyVehicleAlert"/>
<xs:complexType name="EmergencyVehicleAlert" >
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <xs:element name="id" type="TemporaryID"  minOccurs="0"/>
         <xs:element name="rsaMsg" type="RoadSideAlert" />
         <!-- the DSRCmsgID inside this
         data frame is set as per the
         RoadSideAlert.  The CRC is
         set to a value of zero. -->
         <xs:element name="responseType" type="ResponseType"  minOccurs="0"/>
         <xs:element name="details" type="EmergencyDetails"  minOccurs="0"/>
         <!-- Combines these 3 items:
         SirenInUse,
         LightbarInUse,
         MultiVehicleReponse, -->
         <xs:element name="mass" type="VehicleMass"  minOccurs="0"/>
         <xs:element name="basicType" type="VehicleType"  minOccurs="0"/>
         <!-- gross size and axle cnt
         type of vehicle and agency when known -->
         <xs:element name="vehicleType" type="itis:VehicleGroupAffected"  minOccurs="0"/>
         <xs:element name="responseEquip" type="itis:IncidentResponseEquipment"
minOccurs="0"/>
         <xs:element name="responderType" type="itis:ResponderGroupAffected"
minOccurs="0"/>
         <xs:element name="crc" type="MsgCRC" />
         <xs:element name="localEmergencyVehicleAlert" type="local:EmergencyVehicleAlert"
minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

Remarks: The TemporaryID data element shall be sent only if the vehicle wishes to identify itself to others. If a data element value is not known or will not be sent (because its presence is marked OPTIONAL in the ASN) then that data item will not be part of the message. The CRC value found as part of the Road Side Alert message shall be properly set for the value for the bytes enclosed in that message, and the CRC value found as part of the Emergency Vehicle message shall be properly set for the value for the bytes enclosed in that message. In other words, the Road Side Alert message shall be a valid message within the Emergency Vehicle message.

5.4 Message: MSG_IntersectionCollisionAvoidance (ICA)

Use: This message deals with providing data from the vehicle to build intersection collision avoidance systems with. It identifies the intersection being reported on and the recent path and accelerations of the vehicle.

ASN.1 Representation:

```
IntersectionCollision ::= SEQUENCE {
   msgID          DSRCmsgID,
   msgCnt         MsgCount,
   id             TemporaryID,
   secMark        DSecond OPTIONAL,
   path           PathHistory,
                  -- a set of recent path histories
   intersetionID  IntersectionID,
                  -- the applicable Intersection, from the MAP-GID
                  -- the best applicable movement, from the MAP-GID
   laneNumber     LaneNumber,
                  -- the best applicable Lane, from the MAP-SPAT-GID
                  -- zero sent if unknown
   eventFlag      EventFlags,
                  -- used to convey vehicle Panic Events,
```

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```
                  -- Set to indicate "Intersection Violation"
   ... -- # LOCAL_CONTENT
   }
```

XML Representation:

```
<xs:element name="intersectionCollision" type="IntersectionCollision"/>
<xs:complexType name="IntersectionCollision" >
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <xs:element name="msgCnt" type="MsgCount" />
         <xs:element name="id" type="TemporaryID" />
         <xs:element name="secMark" type="DSecond"  minOccurs="0"/>
         <xs:element name="path" type="PathHistory" />
         <!-- a set of recent path histories -->
         <xs:element name="intersetionID" type="IntersectionID" />
         <!-- the applicable Intersection,  from the MAP-GID
         the best applicable movement,  from the MAP-GID -->
         <xs:element name="laneNumber" type="LaneNumber" />
         <!-- the best applicable Lane,  from the MAP-SPAT-GID
         zero sent if unknown -->
         <xs:element name="eventFlag" type="EventFlags" />
         <!-- used to convey vehicle Panic Events,
         Set to indicate &quot;Intersection Violation&quot; -->
         <xs:element name="localIntersectionCollision" type="local:IntersectionCollision"
minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

5.5 Message: MSG_MapData (MAP)

Use: The MapData message is used to convey many types of geographic road information. At the current time its primary use is to convey one or more intersection lane geometry maps within a single message. The map message content includes such items as complex intersection descriptions, road segment descriptions, high speed curve outlines (used in curve safety messages), and segments of roadway (used in some safety and for platoon applications). A given single MapData message may convey descriptions of one or more geographic areas or intersections. The contents of this message often involve defining the details of indexing systems that are in turn used by other messages to relate additional information (for example, the signal phase and timing via the SPAT message) to events at specific geographic locations on the roadway.

ASN.1 Representation:

```
MapData ::= SEQUENCE {
   msgID              DSRCmsgID2,
   msgSubID           DSRCmsgSubID OPTIONAL,
   msgIssueRevision   MsgCount,
   layerType          LayerType OPTIONAL,
   layerID            LayerID  OPTIONAL,
   intersections      IntersectionGeometryList OPTIONAL,
                      -- All Intersection definitions

   -- NOTE:
   -- other map data will be added here as it is defined
   -- (curve warnings, construction routes, etc.)
   -- as an example of this:
   roadSegments       RoadSegmentList OPTIONAL,
                      -- All roadway descriptions

   dataParameters     DataParameters OPTIONAL,
                      -- Any meta data regarding the map contents

   restrictionList    RestrictionClassList OPTIONAL,
```

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```
                     -- Any restriction ID tables which have
                     -- established for these map entries
   regional          RegionalMapData OPTIONAL,
                     -- regional extensions
   crc               MsgCRC OPTIONAL,
                     -- The crc may be provided by other layers
                     -- and when encoding in UPER is not to be used
   ... -- # LOCAL_CONTENT
   }
```

5.6 Message: MSG_NMEA_Corrections (NMEA)

Use: The NMEA_Corrections message is used to encapsulate NMEA 183 style differential corrections for GPS radio navigation signals as defined by the NMEA (National Marine Electronics Association) committee in its Protocol 0183 standard. Here, in the work of DSRC, these messages are "wrapped" for transport on the DSRC media, and then can be re-constructed back into the final expected formats defined by the NMEA standard and used directly by GPS positioning systems to increase the absolute and relative accuracy estimates produced.

ASN.1 Representation:

```
NMEA-Corrections ::= SEQUENCE {
   msgID      DSRCmsgID,
   rev        NMEA-Revision,
              -- the specific edition of the standard
              -- that is being sent, normally 2.0
   msg        NMEA-MsgType,
              -- the message and sub-message type, as
              -- defined in the revision being used
   -- NOTE as the message type is also in the payload,
   wdCount    INTEGER (0..1023),
              -- a count of bytes to follow
   payload    NMEA-Payload,
   ...
   }
```

XML Representation:

```
<xs:element name="nMEA-Corrections" type="NMEA-Corrections"/>
<xs:complexType name="NMEA-Corrections" >
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <xs:element name="rev" type="NMEA-Revision" />
         <!-- the specific edition of the standard
         that is being sent,  normally 2.0 -->
         <xs:element name="msg" type="NMEA-MsgType" />
         <!-- the message and sub-message type,  as
         defined in the revision being used
         NOTE as the message type is also in the payload, -->
         <xs:element name="wdCount" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedShort">
                  <xs:maxInclusive value="1023"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- a count of bytes to follow -->
         <xs:element name="payload" type="NMEA-Payload" />
      </xs:sequence>
</xs:complexType>
```

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5.7 Message: MSG_ProbeDataManagement (PDM)

Use: The ProbeDataManagement message is used to control the type of data collected and sent by OBUs to the local RSU (also called a STA in some documents) . Taken at a defined snapshot event to define RSU coverage patterns such as the moment an OBU joins or becomes associated with an RSU and can send probe data.

ASN.1 Representation:

```
ProbeDataManagement ::= SEQUENCE {
   msgID               DSRCmsgID,          -- This is a unique message
                                           -- identifier, NOT related to
                                           -- the PSID\PSC

   sample              Sample,             -- identifies vehicle
                                           -- population affected

   directions          HeadingSlice,
                                           -- Applicable headings/directions
   term CHOICE {
      termtime         TermTime,           -- Terminate management process
                                           -- based on Time-to-Live
      termDistance     TermDistance        -- Terminate management process
                                           -- based on Distance-to-Live
      },
   snapshot CHOICE {
      snapshotTime     SnapshotTime,       -- Collect snapshots based on time
      snapshotDistance SnapshotDistance    -- Collect snapshots based on Distance
      },
   txInterval          TxTime,             -- Time Interval at which to send snapshots
   cntTthreshold       Count,              -- number of thresholds that will be changed
   dataElements SEQUENCE (SIZE(1..32)) OF
                       VehicleStatusRequest,
                                           -- a data frame and its assoc thresholds

   ...
   }
```

XML Representation:

```
<xs:element name="probeDataManagement" type="ProbeDataManagement"/>
<xs:complexType name="ProbeDataManagement" >
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <!-- This is a unique message
         identifier,  NOT related to
         the PSID\PSC -->
         <xs:element name="sample" type="Sample" />
         <!-- identifies vehicle
         population affected -->
         <xs:element name="directions" type="HeadingSlice" />
         <!-- Applicable headings/directions -->
         <xs:element name="term" >
            <xs:complexType>
               <xs:choice>
                  <xs:element name="termtime" type="TermTime" />
                  <!-- Terminate management process
                  based on Time-to-Live -->
                  <xs:element name="termDistance" type="TermDistance" />
                  <!-- Terminate management process
                  based on Distance-to-Live -->
               </xs:choice>
            </xs:complexType>
         </xs:element>
         <xs:element name="snapshot" >
```

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```
            <xs:complexType>
               <xs:choice>
                  <xs:element name="snapshotTime" type="SnapshotTime" />
                  <!-- Collect snapshots based on time -->
                  <xs:element name="snapshotDistance" type="SnapshotDistance" />
                  <!-- Collect snapshots based on Distance -->
               </xs:choice>
            </xs:complexType>
         </xs:element>
         <xs:element name="txInterval" type="TxTime" />
         <!-- Time Interval at which to send snapshots -->
         <xs:element name="cntTthreshold" type="Count" />
         <!-- number of thresholds that will be changed -->
         <xs:element name="dataElements" >
            <xs:complexType>
               <xs:sequence minOccurs="1" maxOccurs="32">
                  <xs:element name="dataElement" type="VehicleStatusRequest" />
                  <!-- a data frame and its assoc thresholds -->
               </xs:sequence>
            </xs:complexType>
         </xs:element>
      </xs:sequence>
</xs:complexType>
```

Remarks: The ProbeDataManagement message originates from the ATMS and its associated infrastructure and is used to control the types of information reported back to meet the needs of the ATMS and private users of the data.

5.8 Message: MSG_ProbeVehicleData (PVD)

Use: The probe vehicle message frame is defined below. The probe vehicle message is used to exchange status about a vehicle with other (typically RSU) DSRC readers to allow the collection of information about typically vehicle traveling behaviors along a segment of road. The exchanges of this message as well as the event which caused the collection of various elements defined in the messages are defined in Annex B of this standard. In typical use the reporting vehicle has collected one or more snapshots which it will send to a receiving RSU along with information (the vector) about the point in time and space when the snapshot event occurred. Because any sequence of snapshots are related within a limit range of time and space, some data compression may be used in the message to reduce redundant information.

ASN.1 Representation:

```
ProbeVehicleData ::= SEQUENCE {
   msgID            DSRCmsgID,              -- App ID value, 1 byte
   segNum           ProbeSegmentNumber OPTIONAL,
                                            -- a short term Ident value
                                            -- not used when ident is used
   probeID          VehicleIdent OPTIONAL,
                                            -- ident data for selected
                                            -- types of vehicles
   startVector      FullPositionVector,     -- the space and time of
                                            -- transmission to the RSU
   vehicleType      VehicleType,            -- type of vehicle, 1 byte
   cntSnapshots     Count OPTIONAL,
                                            -- a count of how many snaphots
                                            -- type entries will follow
   snapshots        SEQUENCE (SIZE(1..32)) OF Snapshot,
                                            -- a seq of name-value pairs
                                            -- along with the space and time
                                            -- of the first measurement set
   ... -- # LOCAL_CONTENT
   } -- Est size about 64 bytes plus snapshot sizes (about 12 per)
```

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XML Representation:

```
<xs:element name="probeVehicleData" type="ProbeVehicleData"/>
<xs:complexType name="ProbeVehicleData" >
      <xs:annotation>
         <xs:documentation>
            Est size about 64 bytes plus snapshot sizes  (about 12 per)
         </xs:documentation>
      </xs:annotation>
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <!-- App ID value,  1 byte -->
         <xs:element name="segNum" type="ProbeSegmentNumber"  minOccurs="0"/>
         <!-- a short term Ident value
         not used when ident is used -->
         <xs:element name="probeID" type="VehicleIdent"  minOccurs="0"/>
         <!-- ident data for selected
         types of vehicles -->
         <xs:element name="startVector" type="FullPositionVector" />
         <!-- the space and time of
         transmission to the RSU -->
         <xs:element name="vehicleType" type="VehicleType" />
         <!-- type of vehicle,  1 byte -->
         <xs:element name="cntSnapshots" type="Count"  minOccurs="0"/>
         <!-- a count of how many snaphots
         type entries will follow -->
         <xs:element name="snapshots" >
            <xs:complexType>
               <xs:sequence minOccurs="1" maxOccurs="32">
                  <xs:element name="snapshot" type="Snapshot" />
                  <!-- a seq of name-value pairs along with the space and time of the
first measurement set -->
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <xs:element name="localProbeVehicleData" type="local:ProbeVehicleData"
minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

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Remarks: At the time of writing additional probe vehicle messages are being developed that will allow control over what information is gathered and reported in a probe vehicle message. Builders are urged to consider these messages in their development of products using this message.

5.9 Message: MSG_RoadSideAlert (RSA)

Use: This message is used to send alerts for nearby hazards to travelers. Unlike many other messages which use the LRMS profiles to describe the areas affected, this message likely applies to the receiver by the very fact that it is received. In other words, it does not use LRMS. Typically transmitted over the Dedicated Short Range Communications (DSRC) media in both WSM and XML forms, this message provides simple alerts to travelers (both in vehicle and with portable devices). Typical example messages would be "bridge icing ahead" or "train coming" or "ambulances operating in the area." The full range of ITIS phrases are supported here, but those dealing with mobile hazards, construction zones, and roadside events are the ones most frequently expected to be found in use.

This message is for the alerting of roadway hazards; not for vehicle cooperative communications, mayday, or other safety applications. It is generally presumed that each receiving device is aware of its own position and heading, but this is not a requirement to receive and understand these messages. Nor is having a local base map.

The position section of the message gives a simple (and optional) vector for where the hazard is located (fixed or moving) and can be used to filter some messages as being not applicable. Consider a "train approaching" message which indicates the train is in fact traveling away from the receiver. The basic messages types themselves are represented in the standard ITIS codes sent only in their integer representation formats. This ITIS list is national in scope, never outdated (items can only be added), and in this use does not allow local additions. Refer to SAE J2540.1 for the complete code list. A priority level for the message is also sent, which may be matched to various other priorities in the cockpit to determine the order and type of message presentation to minimize driver distraction. Message transmission priority is typically handled in the IEEE 1609 standard layer in the application stack and is a function of the application type. A duration field provides a gross level for the range (distance) of applicability for the message over distance. For example, some messages are no longer meaningful to the traveler once the vehicle has moved a distance down the roadway link.

In many cases a complex event will also be explained in the other supporting ATIS messages (available on DSRC service channels), and a linkage value is given in those cases when such data is available.

ASN.1 Representation:

```
RoadSideAlert ::= SEQUENCE {
   msgID          DSRCmsgID,
                  -- the message type.
   msgCnt         MsgCount,
   typeEvent      ITIS.ITIScodes,
                  -- a category and an item from that category
                  -- all ITS stds use the same types here
                  -- to explain the type of  the
                  -- alert / danger / hazard involved
                  -- two bytes in length
   description    SEQUENCE (SIZE(1..8)) OF ITIS.ITIScodes OPTIONAL,
                  -- up to eight ITIS code entries to further
                  -- describe the event, give advice, or any
                  -- other ITIS codes
                  -- up to 16 bytes in length
   priority       Priority OPTIONAL,
                  -- the urgency of this message, a relative
                  -- degree of merit compared with other
                  -- similar messages for this type (not other
                  -- message being sent by the device), nor a
                  -- priority of display urgency
                  -- one byte in length
   heading        HeadingSlice  OPTIONAL,
                  -- Applicable headings/direction
   extent         Extent OPTIONAL,
                  -- the spatial distance over which this
                  -- message applies and should be presented
                  -- to the driver
                  -- one byte in length
   positon        FullPositionVector OPTIONAL,
                  -- a compact summary of the position,
                  -- heading, rate of speed, etc of the
                  -- event in question. Including stationary
                  -- and wide area events.
   furtherInfoID  FurtherInfoID OPTIONAL,
                  -- a link to any other incident
                  -- information data that may be available
                  -- in the normal ATIS incident description
                  -- or other messages
                  -- 1~2 bytes in length
    crc           MsgCRC
    }
```

XML Representation:

```
<xs:element name="roadSideAlert" type="RoadSideAlert"/>
<xs:complexType name="RoadSideAlert" >
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <!-- the message type. -->
         <xs:element name="msgCnt" type="MsgCount" />
         <xs:element name="typeEvent" >
```

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```
            <xs:simpleType>
               <xs:restriction base ="itis:ITIScodes"/>
            </xs:simpleType>
         </xs:element>
         <!-- a category and an item from that category
         all ITS stds use the same types here
         to explain the type of  the
         alert / danger / hazard involved
         two bytes in length -->
         <xs:element name="description"  minOccurs="0">
            <xs:complexType>
               <xs:sequence minOccurs="1" maxOccurs="8">
                  <xs:element name="description-item" >
                     <xs:simpleType>
                        <xs:restriction base ="itis:ITIScodes"/>
                     </xs:simpleType>
                  </xs:element>
                  <!-- up to eight ITIS code entries to further describe the event,  give
advice,  or any other ITIS codes up to 16 bytes in length -->
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <xs:element name="priority" type="Priority"  minOccurs="0"/>
         <!-- the urgency of this message,  a relative
         degree of merit compared with other
         similar messages for this type  (not other
         message being sent by the device) ,  nor a
         priority of display urgency
         one byte in length -->
         <xs:element name="heading" type="HeadingSlice"  minOccurs="0"/>
         <!-- Applicable headings/direction -->
         <xs:element name="extent" type="Extent"  minOccurs="0"/>
         <!-- the spatial distance over which this
         message applies and should be presented
         to the driver
         one byte in length -->
         <xs:element name="positon" type="FullPositionVector"  minOccurs="0"/>
         <!-- a compact summary of the position,
         heading,  rate of speed,  etc of the
         event in question. Including stationary
         and wide area events. -->
         <xs:element name="furtherInfoID" type="FurtherInfoID"  minOccurs="0"/>
         <!-- a link to any other incident
         information data that may be available
         in the normal ATIS incident description
         or other messages
         1~2 bytes in length -->
         <xs:element name="crc" type="MsgCRC" />
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_EmergencyVehicleAlert (EVA) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: This message is also used a building block for other DSRC messages. When used in other public safety messages, additional elements may be appended to form new message types.

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5.10 Message: MSG_RTCM_Corrections (RTCM)

Use: The RTCM_Corrections message is used to encapsulate RTCM differential corrections for GPS and other radio navigation signals as defined by the RTCM (Radio Technical Commission For Maritime Services) special committee number 104 in its various standards. Here, in the work of DSRC, these messages are "wrapped" for transport on the DSRC media, and then can be re-constructed back into the final expected formats defined by the RTCM standard and used directly by various positioning systems to increase the absolute and relative accuracy estimates produced.

ASN.1 Representation:

```
RTCM-Corrections ::= SEQUENCE {
   msgID       DSRCmsgID,
   msgCnt      MsgCount,
   rev         RTCM-Revision,
               -- the specific edition of the standard
               -- that is being sent

   anchorPoint FullPositionVector OPTIONAL,
   -- precise observer position, if needed

   -- precise ant position and noise data
   rtcmHeader  RTCMHeader,
   -- octets of:
   -- status       GPSstatus
   -- antOffsets   AntennaOffsetSet(x,y,z)

   -- one or more RTCM messages
   rtcmSets    SEQUENCE (SIZE(1..5)) OF RTCMmsg,
   ... -- # LOCAL_CONTENT
   }
```

XML Representation:

```
<xs:element name="rTCM-Corrections" type="RTCM-Corrections"/>
<xs:complexType name="RTCM-Corrections" >
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <xs:element name="msgCnt" type="MsgCount" />
         <xs:element name="rev" type="RTCM-Revision" />
         <!-- the specific edition of the standard
         that is being sent -->
         <xs:element name="anchorPoint" type="FullPositionVector"  minOccurs="0"/>
         <!-- precise observer position,  if needed
         precise ant position and noise data -->
         <xs:element name="rtcmHeader" type="RTCMHeader" />
         <!-- octets of:
         status      GPSstatus
         antOffsets  AntennaOffsetSet (x, y, z)
         one or more RTCM messages -->
         <xs:element name="rtcmSets" >
            <xs:complexType>
               <xs:sequence minOccurs="1" maxOccurs="5">
                  <xs:element name="rtcmSet" type="RTCMmsg" />
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <xs:element name="localRTCM-Corrections" type="local:RTCM-Corrections"
minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

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Remarks: Observe that the transport layer details (preamble, CRC, etc.) as outlined in RTCM standard 10403.1 version 3.0 clause four are not sent in this message. In a similar fashion, the same framing information found in clause 4.2 of the RTCM standard 10402.3 (version 2.3) is not sent. These would be reconstituted after reception by a mobile device and before sending the resultant message to any positioning device expecting messages in such a format, as outlined in the RTCM recommendations found in clause four of each document. Also observe that the specific bit ordering of the transport message level used in the final message varies between RTCM version 3.x and that of version 2.3.

5.11 Message: MSG_SignalPhaseAndTiming Message (SPAT)

Use: The Signal Phase and Timing (SPAT) message is used to convey the current status of one or more signalized intersections. Along with the MSG_MapData message (which describes a full geometric layout of an intersection) the receiver of this message can determine the state of the signal phasing and when the next expected phase will occur.

The SPAT message sends the current movement state of each active phase in the system as needed (such as values of what states are active and values at what time a state has begun/does begin earliest, is expected to begin most likely and will end latest). The state of inactive movements is not normally transmitted. Movements are mapped to specific approaches and connections of ingress to egress lanes and by use of the SignalGroupID in the MapData message

The current signal preemption and priority status values (when present or active) are also sent. A more complete summary of any pending priority or preemption events can be found in the Signal Status message.

ASN.1 Representation:
```
SPAT ::= SEQUENCE {
   msgID          DSRCmsgID2,
   msgSubID       DSRCmsgSubID OPTIONAL,
   name           DescriptiveName OPTIONAL,
                  -- human readable name for this collection
                  -- to be used only in debug mode

   intersections IntersectionStateList,
                  -- sets of SPAT data (one per intersection)

   -- If PrioritizationResponse data is required, it is found
   -- in the RegionalSPAT entry below

   regional      RegionalSPAT OPTIONAL, -- regional extensions
   ... -- # LOCAL_CONTENT
   }
```

5.12 Message: MSG_SignalRequestMessage (SRM)

Use: The Signal Request Message is a message sent by a vehicle to the RSU in a signalized intersection. It is used for either a priority signal request or a preemption signal request depending on the way the message flag is set. In either case, the vehicle identifies itself (using its VIN or another method supported by the VehicleIdent data frame), its current speed, heading and location (using the Blob of the BSM), and makes a specific request for service (Vehicle Request) as well as an anticipated time of service (a start time and end time). The specific request for service is typically based on previously decoding and examining the list of supported zones for that intersection (sent in the MAP messages). The outcome of all of the pending requests to a signal can be found in the Signal Status Message (SSM), and may be reflected in the SPAT message contents if successful.

ASN.1 Representation:
```
SignalRequestMsg ::= SEQUENCE {
   msgID           DSRCmsgID,
   msgCnt          MsgCount,

   -- Request Data
   request        SignalRequest,
                  -- the specific request to the intersection
                  -- contains IntersectionID, cancel flags,
                  -- requested action, optional lanes data
```

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```
   timeOfService  DTime  OPTIONAL,
                  -- the time in the near future when service is
                  -- requested to start

   endOfService   DTime  OPTIONAL,
                  -- the time in the near future when service is
                  -- requested to end

   transitStatus  TransitStatus OPTIONAL,
                  -- additional information pertaining
                  -- to transit events

   -- User Data
   vehicleVIN     VehicleIdent  OPTIONAL,
                  -- a set of unique strings to identify the requesting vehicle

   vehicleData    BSMblob,
                  -- current position data about the vehicle

   status         VehicleRequestStatus  OPTIONAL,
                  -- current status data about the vehicle

   ...
   }
```

XML Representation:

```
<xs:complexType name="SignalRequestMsg" >
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <xs:element name="msgCnt" type="MsgCount" />
         <!-- Request Data -->
         <xs:element name="request" type="SignalRequest" />
         <!-- the specific request to the intersection
         contains IntersectionID, cancel flags,
         requested action,    OPTIONAL   lanes data -->
         <xs:element name="timeOfService" type="DTime"  minOccurs="0"/>
         <!-- the time in the near future when service is
         requested to start -->
         <xs:element name="endOfService" type="DTime"  minOccurs="0"/>
         <!-- the time in the near future when service is
         requested to end -->
         <xs:element name="transitStatus" type="TransitStatus"  minOccurs="0"/>
         <!-- additional information pertaining
         to transit events
         User Data -->
         <xs:element name="vehicleVIN" type="VehicleIdent"  minOccurs="0"/>
         <!-- a set of unique strings to identify the requesting vehicle -->
         <xs:element name="vehicleData" type="BSMblob" />
         <!-- current position data about the vehicle -->
         <xs:element name="status" type="VehicleRequestStatus"  minOccurs="0"/>
         <!-- current status data about the vehicle -->
      </xs:sequence>
</xs:complexType>
```

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5.13 Message: MSG_SignalStatusMessage (SSM)

Use: The Signal Status Message is a message sent by an RSU in a signalized intersection. It is used to relate the current status of the signal and any collection of pending or active preemption or priority events acknowledged by the controller. The data contained in this message allow other users to determine their "ranking" for any request they have made as well as see the currently active events. When there have been no recently received requests for service messages, this message may not be sent. The outcome of all pending requests to a signal can be found in the Signal Status Message, and the current event may also be reflected in the SPAT message contents if successful.

ASN.1 Representation:

```
SignalStatusMessage ::= SEQUENCE {
   msgID          DSRCmsgID,
   msgCnt         MsgCount,
   id             IntersectionID,
                  -- this provides a unique mapping to the
                  -- intersection map in question
                  -- which provides complete location
                  -- and approach/move/lane data
                  -- as well as zones for priority/preemption
   status         IntersectionStatusObject,
                  -- general status of the signal controller
   priority       SEQUENCE (SIZE(1..7)) OF SignalState OPTIONAL,
                  -- all active priority state data
                  -- is found here
   priorityCause VehicleIdent  OPTIONAL,
                  -- vehicle that requested
                  -- the current priority
   prempt         SEQUENCE (SIZE(1..7)) OF SignalState OPTIONAL,
                  -- all active preemption state data
                  -- is found here
   preemptCause   VehicleIdent  OPTIONAL,
                  -- vehicle that requested
                  -- the current preempt
   transitStatus TransitStatus OPTIONAL,
                  -- additional information pertaining
                  -- to transit event, if that is the active event
   ...
   }
```

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XML Representation:

```
<xs:complexType name="SignalStatusMessage" >
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <xs:element name="msgCnt" type="MsgCount" />
         <xs:element name="id" type="IntersectionID" />
         <!-- this provides a unique mapping to the
         intersection map in question
         which provides complete location
         and approach/move/lane data
         as well as zones for priority/preemption -->
         <xs:element name="status" type="IntersectionStatusObject" />
         <!-- general status of the signal controller -->
         <xs:element name="priority"  minOccurs="0">
            <xs:complexType>
               <xs:sequence minOccurs="1" maxOccurs="7">
                  <xs:element name="priority-item" type="SignalState" />
                  <!-- all active priority state data is found here -->
               </xs:sequence>
            </xs:complexType>
```

```
        </xs:element>
        <xs:element name="priorityCause" type="VehicleIdent"  minOccurs="0"/>
        <!-- vehicle that requested
        the current priority -->
        <xs:element name="prempt"  minOccurs="0">
           <xs:complexType>
              <xs:sequence minOccurs="1" maxOccurs="7">
                 <xs:element name="prempt-item" type="SignalState" />
                 <!-- all active preemption state data is found here -->
              </xs:sequence>
           </xs:complexType>
        </xs:element>
        <xs:element name="preemptCause" type="VehicleIdent"  minOccurs="0"/>
        <!-- vehicle that requested
        the current preempt -->
        <xs:element name="transitStatus" type="TransitStatus"  minOccurs="0"/>
        <!-- additional information pertaining
        to transit event,  if that is the active event -->
     </xs:sequence>
</xs:complexType>
```

5.14 Message: MSG_TravelerInformation Message (TIM)

Use: The Traveler Information message is used to send various types of messages (advisory and road sign types) over the WSM stack to vehicles. It makes heavy use of the ITIS encoding system to send well known phrases, but allows limited text for local place names. The supported message types specify several sub-dialects of ITIS phrase patterns to further reduce the number of bytes to be sent. The expressed messages are active at a precise start and duration period, which can be specified to a resolution of a minute. The affected local area can be expressed using either a radius system or a system of short defined regions which is similar to the way roadway geometry is defined in the map fragment messages.

ASN.1 Representation:

```
TravelerInformation ::= SEQUENCE {
   msgID            DSRCmsgID,
   packetID         UniqueMSGID     OPTIONAL,
   urlB             URL-Base        OPTIONAL,
   dataFrameCount   Count           OPTIONAL,

   dataFrames SEQUENCE (SIZE(1..8)) OF SEQUENCE {

      -- Part I, Frame header
      frameType    TravelerInfoType,  -- (enum, advisory or road sign)
      msgId        CHOICE  {
                      furtherInfoID   FurtherInfoID,
                                      -- links to ATIS msg
                      roadSignID      RoadSignID
                                      -- an ID to other data
                      },
      startYear    DYear OPTIONAL,
                   -- Current year used if missing
      startTime    MinuteOfTheYear,
      duratonTime  MinutesDuration,
      priority     SignPrority,

      -- Part II, Applicable Regions of Use
     commonAnchor          Position3D     OPTIONAL,
                           -- a shared anchorpoint
     commonLaneWidth       LaneWidth      OPTIONAL,
                           -- a shared lane width
     commonDirectionality DirectionOfUse OPTIONAL,
```

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```
                         -- a shared direction of use
     regions  SEQUENCE (SIZE(1..16)) OF ValidRegion,

      -- Part III, Content
      content  CHOICE  {
                  advisory       ITIS.ITIScodesAndText,
                                 -- typical ITIS warnings
                  workZone       WorkZone,
                                 -- work zone signs and directions
                  genericSign    GenericSignage,
                                 -- MUTCD signs and directions
                  speedLimit     SpeedLimit,
                                 -- speed limits and cautions
                  exitService    ExitService
                                 -- roadside avaiable services
                  -- other types may be added in future revisions
                  },  --# UNTAGGED
      url      URL-Short OPTIONAL  -- May link to image or other content
      },
   crc        MsgCRC,
   ... -- # LOCAL_CONTENT
   }
```

XML Representation:

```
<xs:element name="travelerInformation" type="TravelerInformation"/>
<xs:complexType name="TravelerInformation" >
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <xs:element name="packetID" type="UniqueMSGID"  minOccurs="0"/>
         <xs:element name="urlB" type="URL-Base"  minOccurs="0"/>
         <xs:element name="dataFrameCount" type="Count"  minOccurs="0"/>
         <xs:element name="dataFrames" >
            <xs:complexType>
               <xs:sequence minOccurs="1" maxOccurs="8">
                  <xs:element name="dataFrame" >
                     <xs:complexType>
                        <xs:sequence>
                           <!-- Part I,  Frame header -->
                           <xs:element name="frameType" type="TravelerInfoType" />
                           <!-- (enum,  advisory or road sign) -->
                           <xs:element name="msgId" >
                              <xs:complexType>
                                 <xs:choice>
                                    <xs:element name="furtherInfoID" type="FurtherInfoID"
/>

                                    <!-- links to ATIS msg -->
                                    <xs:element name="roadSignID" type="RoadSignID" />
                                    <!-- an ID to other data -->
                                 </xs:choice>
                              </xs:complexType>
                           </xs:element>
                           <xs:element name="startYear" type="DYear"  minOccurs="0"/>
                           <!-- Current year used if missing -->
                           <xs:element name="startTime" type="MinuteOfTheYear" />
                           <xs:element name="duratonTime" type="MinutesDuration" />
                           <xs:element name="priority" type="SignPrority" />
                           <!-- Part II,  Applicable Regions of Use -->
                           <xs:element name="commonAnchor" type="Position3D"
minOccurs="0"/>

                           <!-- a shared anchorpoint -->
```

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```
                           <xs:element name="commonLaneWidth" type="LaneWidth"
minOccurs="0"/>
                           <!-- a shared lane width -->
                           <xs:element name="commonDirectionality" type="DirectionOfUse"
minOccurs="0"/>
                           <!-- a shared direction of use -->
                           <xs:element name="regions" >
                              <xs:complexType>
                                 <xs:sequence minOccurs="1" maxOccurs="16">
                                    <xs:element name="region" type="ValidRegion" />
                                 </xs:sequence>
                              </xs:complexType>
                           </xs:element>
                           <!-- Part III,  Content -->
                           <xs:choice >
                              <xs:element name="advisory" type="itis:ITIScodesAndText" />
                              <!-- typical ITIS warnings -->
                              <xs:element name="workZone" type="WorkZone" />
                              <!-- work zone signs and directions -->
                              <xs:element name="genericSign" type="GenericSignage" />
                              <!-- MUTCD signs and directions -->
                              <xs:element name="speedLimit" type="SpeedLimit" />
                              <!-- speed limits and cautions -->
                              <xs:element name="exitService" type="ExitService" />
                              <!-- roadside avaiable services
                              other types may be added in future revisions -->
                           </xs:choice>
                           <xs:element name="url" type="URL-Short"  minOccurs="0"/>
                           <!-- May link to image or other content -->
                        </xs:sequence>
                     </xs:complexType>
                  </xs:element>
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <xs:element name="crc" type="MsgCRC" />
         <xs:element name="localTravelerInformation" type="local:TravelerInformation"
minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

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5.15 Message: MSG_BasicSafetyMessage_Verbose (VBSM)

Use: The verbose variant of the basic safety message is defined here. This message is only used in cases when the part I contents of the message is expanded with BER tagging between each data element (no data blobs are used) and is NEVER transmitted over the air in the WSM format in a production environment. It is intended for system testing and development use only. Refer to the *MSG_BasicSafetyMessage* for additional details.

ASN.1 Representation:

```
BasicSafetyMessageVerbose ::= SEQUENCE {
   -- Part I, sent at all times
   msgID         DSRCmsgID,              -- App ID value, 1 byte

   msgCnt        MsgCount,               -- 1 byte
   id            TemporaryID,            -- 4 bytes
   secMark       DSecond,                -- 2 bytes
   -- pos        PositionLocal3D,
   lat           Latitude,               -- 4 bytes
   long          Longitude,              -- 4 bytes
   elev          Elevation,              -- 2 bytes
```

```
accuracy     PositionalAccuracy,    -- 4 bytes

-- motion    Motion,
speed        TransmissionAndSpeed,  -- 2 bytes
heading      Heading,               -- 2 bytes
angle        SteeringWheelAngle,    -- 1 bytes
accelSet     AccelerationSet4Way,   -- 7 bytes

-- control   Control,
brakes       BrakeSystemStatus,     -- 2 bytes

-- basic     VehicleBasic,
size         VehicleSize,           -- 3 bytes

-- Part II, sent as required
-- Part II,
safetyExt    VehicleSafetyExtension OPTIONAL,
status       VehicleStatus          OPTIONAL,
... -- # LOCAL_CONTENT
}
```

XML Representation:

```
<xs:element name="basicSafetyMessageVerbose" type="BasicSafetyMessageVerbose"/>
<xs:complexType name="BasicSafetyMessageVerbose" >
      <xs:sequence>
         <!-- Part I,  sent at all times -->
         <xs:element name="msgID" type="DSRCmsgID" />
         <!-- App ID value,  1 byte -->
         <xs:element name="msgCnt" type="MsgCount" />
         <!-- 1 byte -->
         <xs:element name="id" type="TemporaryID" />
         <!-- 4 bytes -->
         <xs:element name="secMark" type="DSecond" />
         <!-- 2 bytes
         pos      PositionLocal3D, -->
         <xs:element name="lat" type="Latitude" />
         <!-- 4 bytes -->
         <xs:element name="long" type="Longitude" />
         <!-- 4 bytes -->
         <xs:element name="elev" type="Elevation" />
         <!-- 2 bytes -->
         <xs:element name="accuracy" type="PositionalAccuracy" />
         <!-- 4 bytes
         motion   Motion, -->
         <xs:element name="speed" type="TransmissionAndSpeed" />
         <!-- 2 bytes -->
         <xs:element name="heading" type="Heading" />
         <!-- 2 bytes -->
         <xs:element name="angle" type="SteeringWheelAngle" />
         <!-- 1 bytes -->
         <xs:element name="accelSet" type="AccelerationSet4Way" />
         <!-- 7 bytes
         control  Control, -->
         <xs:element name="brakes" type="BrakeSystemStatus" />
         <!-- 2 bytes
         basic    VehicleBasic, -->
         <xs:element name="size" type="VehicleSize" />
         <!-- 3 bytes
         Part II,  sent as required
         Part II, -->
         <xs:element name="safetyExt" type="VehicleSafetyExtension"  minOccurs="0"/>
```

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```
        <xs:element name="status" type="VehicleStatus"  minOccurs="0"/>
        <xs:element name="localBasicSafetyMessageVerbose"
type="local:BasicSafetyMessageVerbose" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

Remarks: This message is intended for testing and development uses only.

5.16 Message: MSG_UPER_Frame_USA (UPER)

Use: The UPER_Frame data frame is used to hold UPER encoded messages in a simple DER framework for use with other DER message content. In this use the inner UPER encoded message is represented as a sequence of bytes (a BLOB) using the normal UPER encoding complete with any trailing filler bits to complete the final byte. The contentID identifies the contents and the encoding of the msgBlob so that a suitable decoder can correctly decoded the contents.

ASN.1 Representation:

```
UPERframe ::= SEQUENCE {
   msgID           DSRCmsgID2,
                   -- id of this message
   msgSubID        DSRCmsgSubID OPTIONAL,
                   -- sub id of this message
   timeStamp       MinuteOfTheYear OPTIONAL,
   contentID       DSRCmsgID2,
                   -- id of message to follow
   msgBlob         UPER-Blob,
                   -- encoded message in UPER form
                   -- rounded the next full DER byte

   ..., -- # LOCAL_CONTENT
   crc             MsgCRC   OPTIONAL
                   -- The crc may be provided by other layers
   }
```

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6. DATA FRAMES

This section defines the precise structure of the data frames defined by this standard. The DSRC message content defined by this standard is further divided into specific messages, data frames, and elements as defined in this clause and in others of the standard. Typically these messages are made up of content further defined in this document (i.e., made up of entries that are either atomic or complex but which are also defined in this document) and message content defined externally to this document. Such external content is reused from other functional areas and standards developed by other groups and SDOs. The contents of this standard (both at the complete message level and its component parts) may be reused by other efforts elsewhere.

All text in this clause is considered normative unless expressly marked otherwise. Definitions for this message set are presented in the following subclauses. The ASN.1 is presented in a section titled ASN.1 Representation. The equivalent XML expression is presented in a section titled XML Representation which follows the translation rule set cited in Clause Two (SAE Standard J2630). Should the two sections conflict in some way, the ASN.1 expression shall take precedence.

The productions of ASN.1 which follow shall be considered normative in nature. While the majority of the normative content is reflected in the actual syntax of the ASN.1, some entries also have additional statements in the ASN.1 comments which shall be considered normative as well. In addition, the textual commentary provided with each entry (in sections marked "use" and "remarks") may also provide additional normative restrictions on the proper use of the entry being described. The XML productions follow directly from the ASN.1 specifications and the same rules shall be applied. Users of this standard seeking to be in conformance with it shall follow the normative text outlined here.

6.1 Data Element: DF_AccelerationSet4Way

Use: This data frame is a set of acceleration values in 3 orthogonal directions of the vehicle and with yaw rotation rates, expressed as an octet set. The positive longitudinal axis is to the front of the vehicle. The positive lateral axis is to the right side of the vehicle (facing forward). Positive yaw is to the right (clockwise). A positive vertical "z" axis is upward with the zero point at the bottom of the vehicle's tires. The frame of references and axis of rotation used shall be accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

ASN.1 Representation:

```
AccelerationSet4Way ::= OCTET STRING (SIZE(7))
   -- composed of the following:
   -- SEQUENCE {
   --    long Acceleration,          -x- Along the Vehicle Longitudinal axis
   --    lat  Acceleration,          -x- Along the Vehicle Lateral axis
   --    vert VerticalAcceleration,  -x- Along the Vehicle Vertical axis
   --    yaw  YawRate
   --    }
```

XML Representation:

```
<xs:complexType name="AccelerationSet4Way" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            composed of the following:
            SEQUENCE  {
            long Acceleration,           -x- Along the Vehicle Longitudinal axis
            lat  Acceleration,           -x- Along the Vehicle Lateral axis
            vert VerticalAcceleration,   -x- Along the Vehicle Vertical axis
            yaw  YawRate
            }
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="AccelerationSet4Way-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="AccelerationSet4Way-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="10"/>
   </xs:restriction>
</xs:simpleType >
```

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Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleStatus	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_Verbose (VBSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

6.2 Data Frame: DF_AccelSteerYawRateConfidence

Use: A single byte long data frame combining multiple related bit fields into one byte.

ASN.1 Representation:
```
AccelSteerYawRateConfidence ::= SEQUENCE {
   yawRate             YawRateConfidence,
                       -- 3 bits
   acceleration        AccelerationConfidence,
                       -- 3 bits
   steeringWheelAngle  SteeringWheelAngleConfidence
                       -- 2 bits
   }
```

XML Representation:
```
<xs:complexType name="AccelSteerYawRateConfidence" >
      <xs:sequence>
         <xs:element name="yawRate" type="YawRateConfidence" />
         <!-- 3 bits -->
         <xs:element name="acceleration" type="AccelerationConfidence" />
         <!-- 3 bits -->
         <xs:element name="steeringWheelAngle" type="SteeringWheelAngleConfidence" />
         <!-- 2 bits -->
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ConfidenceSet <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.3 Data Frame: DF_AdvisorySpeed

Use: The DF_AdvisorySpeed data frame is used to convey a recommended traveling approach speed to an intersection from the message issuer to various travelers and vehicle types. Besides support for various eco-driving applications, this allows transmitting recommended speeds for specialty vehicles such as transit buses.

ASN.1 Representation:
```
AdvisorySpeed ::= SEQUENCE {
   type         AdvisorySpeedType,
                -- the type of advisory which this is.
   speed        SpeedAdvice OPTIONAL,
                -- See Remarks under the SpeedAdvice entry for
                -- converting and transmitting a speed expressed
                -- in MPH to units of 0.1 m/s
                -- This element is optional ONLY when superceded
                -- by the presence of a regional speed element found in
                -- RegionalAdvisorySpeed
   confidence   SpeedConfidence OPTIONAL,
                -- A confidence value for the above speed
   distance     ZoneLength OPTIONAL,
                -- Unit = 1 meter,
                -- The distance indicates the region for which the advised speed
                -- is recommended, it is specified upstream from the stop bar
                -- along the connected egressing lane
   class        RestrictionClassID OPTIONAL,
                -- the vehicle types to which it applies
                -- when absent, the AdvisorySpeed applies to
                -- all motor vehicle types
```

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```
   regional    RegionalAdvisorySpeed OPTIONAL,
               -- regional extensions
   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_AdvisorySpeedList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.4 Data Frame: DF_AdvisorySpeedList

Use: The AdvisorySpeedList data frame consists of a list of AdvisorySpeed entries.

ASN.1 Representation:

```
AdvisorySpeedList ::= SEQUENCE (SIZE(1..16)) OF AdvisorySpeed
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_MovementEvent CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.5 Data Element: DF_AntennaOffsetSet

Use: The DF_AntennaOffset Set data frame is a collection of three orthogonal offset values expressed in 5 bytes which describes how far the electrical center of an antenna is in each axis from a known anchor point in units of 1cm. When the antenna being describes is on a vehicle, the signed offset shall be from the center of the vehicle for X and Y following the SAE coordinate system: X is lengthwise and Y is lateral across the vehicle, forward and to the right being positive, unsigned Z is vertical, taken from the bottom of the tires and the surface on which the vehicle is resting and normal to the Z axis of the vehicle.

ASN.1 Representation:

```
AntennaOffsetSet ::= OCTET STRING (SIZE(4))
   -- defined as:
   -- SEQUENCE {
   -- antOffsetX  INTEGER (-8191..8191),
                  -- 14 bits in length
                  -- units of 1cm from center
                  -- 8191 to be used for unavailable
   -- antOffsetY  INTEGER (-255..255),
                  -- 9 bits in length
                  -- units of 1cm from center
                  -- 255 to be used for unavailable
   -- antOffsetZ  INTEGER (0..511)
                  -- 9 bits in length
                  -- units of 1cm from ground
                  -- 511 to be used for unavailable
   -- }
```

XML Representation:

```
<xs:complexType name="AntennaOffsetSet" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            defined as:
            SEQUENCE  {
            antOffsetX  INTEGER  (-8191..8191) ,
            14 bits in length
            units of 1cm from center
            8191 to be used for unavailable
            antOffsetY  INTEGER  (-255..255) ,
            9 bits in length
            units of 1cm from center
            255 to be used for unavailable
```

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```
            antOffsetZ  INTEGER  (0..511)
            9 bits in length
            units of 1cm from ground
            511 to be used for unavailable
            }
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="AntennaOffsetSet-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="AntennaOffsetSet-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="6"/>
   </xs:restriction>
</xs:simpleType >
```

6.6 Data Element: DF_BrakeSystemStatus

Use: The Brake System Status data frame conveys a variety of information about the current brake and system control activity of the vehicle. Each of the first four bits indicates whether brakes are active for a given wheel on the vehicle. A value of one shall indicate an active brake. A fifth bit is set to one to indicate when this data is unavailable. The next bit is reserved at this time (and set to zero). The next five 2-bit fields indicate the status respectively of the traction control system, the anti-lock brake system, the stability control system, the brake boost system, and the auxiliary brake system.

ASN.1 Representation:

```
BrakeSystemStatus ::= OCTET STRING (SIZE(2))
   -- Encoded with the packed content of:
   -- SEQUENCE {
   --   wheelBrakes           BrakeAppliedStatus,
   --                         -x- 4 bits
   --   wheelBrakesUnavailable  BOOL
   --                         -x- 1 bit (1=true)
   --   spareBit
   --                         -x- 1 bit, set to zero
   --   traction              TractionControlState,
   --                         -x- 2 bits
   --   abs                   AntiLockBrakeStatus,
   --                         -x- 2 bits
   --   scs                   StabilityControlStatus,
   --                         -x- 2 bits
   --   brakeBoost            BrakeBoostApplied,
   --                         -x- 2 bits
   --   auxBrakes             AuxiliaryBrakeStatus,
   --                         -x- 2 bits
   --   }
```

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XML Representation:

```
<xs:complexType name="BrakeSystemStatus" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            Encoded with the packed content of:
            SEQUENCE  {
            wheelBrakes         BrakeAppliedStatus,
            -x- 4 bits
            wheelBrakesUnavailable  BOOL
            -x- 1 bit  (1=true)
            spareBit
            -x- 1 bit,  set to zero
            traction            TractionControlState,
            -x- 2 bits
            abs                 AntiLockBrakeStatus,
            -x- 2 bits
            scs                 StabilityControlStatus,
            -x- 2 bits
            brakeBoost          BrakeBoostApplied,
            -x- 2 bits
            auxBrakes           AuxiliaryBrakeStatus,
            -x- 2 bits
            }
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="BrakeSystemStatus-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="BrakeSystemStatus-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="3"/>
   </xs:restriction>
</xs:simpleType >
```

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Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleStatus	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_Verbose_(VBSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that when the state of a brake or system control changes it will not only be reflected in this data element, but might also be reflected in a flag within the Event Flags data element, for example in Part II of a Basic Safety Message. However, the Event Flags data element is not required, so a safety system should not depend on its appearance in a message.

6.7 Data Element: DF_BSM_Blob

Use: This octet blob data object is used to convey a vehicle's position and motion and other critical data to be sent in the BSM (the vehicles core state information) . This data frame is used in the Basic Safety Message (hence the name BSM blob) as well as in other messages.

ASN.1 Representation:

```
BSMblob ::= OCTET STRING (SIZE(38))
    -- made up of the following 38 packed bytes:
    -- msgCnt      MsgCount,              -x- 1 byte
    -- id          TemporaryID,           -x- 4 bytes
    -- secMark     DSecond,               -x- 2 bytes

    -- lat         Latitude,              -x- 4 bytes
    -- long        Longitude,             -x- 4 bytes
    -- elev        Elevation,             -x- 2 bytes
    -- accuracy    PositionalAccuracy,    -x- 4 bytes

    -- speed       TransmissionAndSpeed,  -x- 2 bytes
    -- heading     Heading,               -x- 2 byte
    -- angle       SteeringWheelAngle     -x- 1 byte
    -- accelSet    AccelerationSet4Way,   -x- accel set (four way) 7 bytes

    -- brakes      BrakeSystemStatus,     -x- 2 bytes
    -- size        VehicleSize,           -x- 3 bytes
```

XML Representation:

```
<xs:complexType name="BSMblob" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            made up of the following 38 packed bytes:
            msgCnt      MsgCount,              -x- 1 byte
            id          TemporaryID,           -x- 4 bytes
            secMark     DSecond,               -x- 2 bytes
            lat         Latitude,              -x- 4 bytes
            long        Longitude,             -x- 4 bytes
            elev        Elevation,             -x- 2 bytes
            accuracy    PositionalAccuracy,    -x- 4 bytes
            speed       TransmissionAndSpeed,  -x- 2 bytes
            heading     Heading,               -x- 2 byte
            angle       SteeringWheelAngle    -x- 1 byte
            accelSet    AccelerationSet4Way,   -x- accel set  (four way)  7 bytes
            brakes      BrakeSystemStatus,     -x- 2 bytes
            size        VehicleSize,           -x- 3 bytes
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="BSMblob-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="BSMblob-string">
   <xs:restriction base="xs:base64Binary">
```

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```
      <xs:length value="51"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

MSG MSG_BasicSafetyMessage (BSM) <ASN> <XML>, and

MSG MSG_SignalRequestMessage (SRM) <ASN> <XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: The byte order for packing shall follow the rules of ASN (MSB first). If a data element is not to be transmitted (for example the Temporary ID value) then all bits of that value shall be set to zero. The resulting data object is always exactly 38 bytes in length.

6.8 Data Frame: DF_BumperHeights

Use: The DF Bumper Heights data frame conveys the height of the front and rear bumper of the vehicle.

ASN.1 Representation:

```
BumperHeights ::= SEQUENCE {
   frnt       BumperHeightFront,
   rear       BumperHeightRear
   }
```

XML Representation:

```
<xs:complexType name="BumperHeights" >
      <xs:sequence>
         <xs:element name="frnt" type="BumperHeightFront" />
         <xs:element name="rear" type="BumperHeightRear" />
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.9 Data Frame: DF_Circle

Use: The Circle data frame used to define a circle centered at a given point and extended to the given radius. It is typically used to describe the location of signs so that the receiving vehicle can determine if the sign applies to them and their current path.

ASN.1 Representation:

```
Circle ::= SEQUENCE {
   center   Position3D,
   radius   CHOICE {
               radiusSteps  INTEGER (0..32767),
                              -- in unsigned values where
                              -- the LSB is in units of 2.5 cm
               miles        INTEGER (1..2000),
               km           INTEGER (1..5000)
            } --# UNTAGGED
   }
```

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XML Representation:

```
<xs:complexType name="Circle" >
      <xs:sequence>
         <xs:element name="center" type="Position3D" />
         <xs:choice >
            <xs:element name="radiusSteps" >
               <xs:simpleType>
                  <xs:restriction base="xs:unsignedShort">
                     <xs:maxInclusive value="32767"/>
                  </xs:restriction>
               </xs:simpleType>
            </xs:element>
            <!-- in unsigned values where
            the LSB is in units of 2.5 cm -->
            <xs:element name="miles" >
               <xs:simpleType>
                  <xs:restriction base="xs:unsignedShort">
                     <xs:minInclusive value="1"/>
                     <xs:maxInclusive value="2000"/>
                  </xs:restriction>
               </xs:simpleType>
            </xs:element>
            <xs:element name="km" >
               <xs:simpleType>
                  <xs:restriction base="xs:unsignedShort">
                     <xs:minInclusive value="1"/>
                     <xs:maxInclusive value="5000"/>
                  </xs:restriction>
               </xs:simpleType>
            </xs:element>
         </xs:choice>
      </xs:sequence>
</xs:complexType>
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ValidRegion <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The values km and miles are typically used for wide area weather alert type uses.

6.10 Data Frame: DF_ComputedLane

Use: The DF_ComputedLane data frame is used to contain information needed to compute one lane from another (hence the name). This concept is used purely as a means of saving size in the message payload. The new lane is expressed as an X,Y offset from the first point of the source lane. It can be optionally rotated and scaled. Any attribute information found within the node of the source lane list cannot be changed and must be reused.

ASN.1 Representation:

```
ComputedLane ::= SEQUENCE {
   -- Data needed to created a computed lane
   referenceLaneId     LaneID,
                          -- the lane ID upon which this
                          -- computed lane will be based
   -- Lane Offset in X and Y direction
   offsetXaxis         CHOICE {
                          small   DrivenLineOffsetSm,
                          large   DrivenLineOffsetLg
                          },
   offsetYaxis         CHOICE {
                          small   DrivenLineOffsetSm,
```

```
                          large   DrivenLineOffsetLg
                          },
                          -- An path X offset value for translations of the
                          -- path's points when created translated lanes.
                          -- The values found in the reference lane are
                          -- all offset based on the X and Y values from
                          -- the coordinates of the reference lane's
                          -- starting initial point.
   -- Lane Rotation
   rotateXY            Angle OPTIONAL,
                          -- A path rotation value for the entire lane
                          -- Observe that this rotates the existing orientation
                          -- of the referenced lane, it does not replace it.
   -- Lane Path Scale (zooming)
   scaleXaxis          Scale-B12 OPTIONAL,
   scaleYaxis          Scale-B12 OPTIONAL,
                          -- value for translations or zooming of the path's
                          -- points. The values found in the reference lane
                          -- are all expanded of contracted based on the X
                          -- and Y and width values from the coordinates of
                          -- the reference lane's starting initial point.
                          -- The Z axis remains untouched.
   regional            RegionalComputedLane OPTIONAL,
                       -- regional extensions
   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeList2 CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The specified transformation shall be applied to the reference lane without any intermediary loss of precision (truncation) and that the order of the transformations be: the East-West and North-South offsets, the scaling factors, and finally the rotation.

6.11 Data Frame: DF_ConfidenceSet

Use: A set of various measurement confidence values about the vehicle.

ASN.1 Representation:

```
ConfidenceSet ::= SEQUENCE {
   accelConfidence      AccelSteerYawRateConfidence OPTIONAL,
   speedConfidence      SpeedandHeadingandThrottleConfidence OPTIONAL,
   timeConfidence       TimeConfidence OPTIONAL,
   posConfidence        PositionConfidenceSet OPTIONAL,
   steerConfidence      SteeringWheelAngleConfidence OPTIONAL,
   throttleConfidence   ThrottleConfidence OPTIONAL,
   ... -- # LOCAL_CONTENT
   }
```

XML Representation:

```
<xs:complexType name="ConfidenceSet" >
      <xs:sequence>
         <xs:element name="accelConfidence" type="AccelSteerYawRateConfidence"
minOccurs="0"/>
         <xs:element name="speedConfidence" type="SpeedandHeadingandThrottleConfidence"
minOccurs="0"/>
         <xs:element name="timeConfidence" type="TimeConfidence"  minOccurs="0"/>
         <xs:element name="posConfidence" type="PositionConfidenceSet"  minOccurs="0"/>
         <xs:element name="steerConfidence" type="SteeringWheelAngleConfidence"
minOccurs="0"/>
```

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```
        <xs:element name="throttleConfidence" type="ThrottleConfidence"  minOccurs="0"/>
        <xs:element name="localConfidenceSet" type="local:ConfidenceSet" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.12 Data Frame: DF_ConnectingLane

Use: The DF_ConnectingLane data concept ties a single lane to a single maneuver needed to reach it from another lane. It is typically used to connect the allowed maneuver from the end of a lane to the outbound lane so that these can be mapped to the SPAT message to which both lanes apply.

ASN.1 Representation:

```
ConnectingLane ::= SEQUENCE {
   lane       LaneID,    -- Index of the connecting lane
   maneuver   AllowedManeuvers OPTIONAL
                         -- The Maneuver between
                         -- the enclosing lane and this lane
                         -- at the stop line to connect them
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Connection <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.13 Data Frame: DF_Connection

Use: The Connection data structure is used in the ConnectsTo data frame to provide data about how the stop line at the end of a single lane connects to another lane beyond its stop point. The ConnectingLane entry ties an outbound (egress) lane by its index to a valid single maneuver required to reach that outbound lane. The SignalGroupID maps this to a single SPAT index. (Note that more than one entry can exist for any given lane to handle admissive and protected conditions). When present, the RestrictionClass can be used to further restrict this information to defined classes of users. The ConnectionID entry is used to provide an index to any dynamic clearance data that may be sent in another message. The entries for ConnectionID, IntersectionID, and RestrictionClassID are not expected to be used in most intersections.

ASN.1 Representation:

```
Connection ::= SEQUENCE {
   -- The subject lane connecting to this lane is:
   connectingLane      ConnectingLane,
                       -- The index of the connecting lane and also
                       -- the maneuver from the current lane to it
   remoteIntersection IntersectionReferenceID OPTIONAL,
                       -- This entry is only used when the
                       -- indicated connecting lane belongs
                       -- to another intersection layout. This
                       -- provides a means to create meshes of lanes

   -- SPAT mapping details at the stop line are:
   signalGroup         SignalGroupID OPTIONAL,
                       -- The matching signal group send by
                       -- the SPAT message for this lane/maneuver
                       -- Shall be present unless the connectingLane
                       -- has not signal group (is un-signalized)
   userClass           RestrictionClassID OPTIONAL,
                       -- The Restriction Class of users this applies to
                       -- The use of some lane/maneuver and SignalGroupID
                       -- pairings are restricted to selected users
                       -- when absent, the SignalGroupID applies to all
```

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```
   -- Movement assist details are given by:
   connectionID        LaneConnectionID OPTIONAL
                       -- An optional connection index used to
                       -- relate this lane connection to any dynamic
                       -- clearance data in the SPAT. Note that
                       -- the index may be shared with other
                       -- connections if the clearance data is common
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ConnectsToList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The assignment of lanes in the *connects To* structure shall start with the leftmost lane from the vehicle perspective (the u-turn lane in some cases) followed by subsequent lanes in a clockwise assignment order. Therefore, the rightmost lane to which this lane connects would always be listed last. Note that this order is observed regardless of which side of the road vehicles use. If this structure is used in the lane description, then all valid lanes to which the subject lane connects shall be listed.

6.14 Data Frame: DF_ConnectionManeuverAssist

Use: The ConnectionManeuverAssist data frame contains information about the the dynamic flow of traffic for the lane(s) and maneuvers in question (as determined by the LaneConnectionID). Note that this information can be sent regarding any *lane-to-lane* movement, it need not be limited to the lanes with active (non-red) phases when sent.

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ASN.1 Representation:

```
ConnectionManeuverAssist ::= SEQUENCE {
   connectionID         LaneConnectionID,
                        -- the common connectionID used by all lanes to which
                        -- this data applies
                        -- (this value traces to ConnectsTo entries in lanes)
   -- Expected Clearance Information
   queueLength          ZoneLength OPTIONAL,
                        -- Unit = 1 meter, 0 = no queue
                        -- The distance from the stop line to the back
                        -- edge of the last vehicle in the queue,
                        -- as measured along the lane center line.
   availableStorageLength ZoneLength OPTIONAL,
                        -- Unit = 1 meter, 0 = no space remains
                        -- Distance (e.g. beginning from the downstream
                        -- stop-line up to a given distance) with a high
                        -- probability for successfully executing the
                        -- connection maneuver between the two lanes
                        -- during the current cycle.
                        -- Used for enhancing the awareness of vehicles
                        -- to anticipate if they can pass the stop line
                        -- of the lane. Used for optimizing the green wave,
                        -- due to knowledge of vehicles waiting in front
                        -- of a red light (downstream).
                        -- The element nextTime in TimeChangeDetails
                        -- in the containing data frame contains the next
                        -- timemark at which an active phase is expected,
                        -- a form of storage flush interval.
   waitOnStop           WaitOnStopline OPTIONAL,
                        -- If "true", the vehicles on this specific connecting
                        -- maneuver have to stop on the stop-line and not
                        -- to enter the collision area
   pedBicycleDetect     PedestrianBicycleDetect OPTIONAL,
                        -- true if ANY ped or bicycles are detected crossing
                        -- the above lanes. Set to false ONLY if there is a
```

```
                         -- high certainty that there are none present,
                         -- otherwise element is not sent.
   regional              RegionalConnectionManeuverAssist OPTIONAL,
                         -- regional extensions
   ... -- # LOCAL_CONTENT
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ManeuverAssistList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.15 Data Frame: DF_ConnectsToList

Use: The ConnectsTo data structure is used in the generic lane descriptions to provide a sequence of other defined lanes to which each lane connects to beyond its stop point. See the Connection data frame entry for details. Note that this data concept is not used in some lane object types.

ASN.1 Representation:

```
ConnectsToList ::= SEQUENCE (SIZE(1..16)) OF Connection
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_GenericLane CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The assignment of lanes in the *Connects To* structure shall start with the leftmost lane from the vehicle perspective (the u-turn lane in some cases) followed by subsequent lanes in a clockwise assignment order. Therefore, the rightmost lane to which this lane connects would always be listed last. Note that this order is observed regardless of which side of the road vehicles use. If this structure is used in the lane description, then all valid lanes to which the subject lane connects shall be listed.

6.16 Data Frame: DF_DataParameters

Use: The DataParameters date frame is used to provide basic (static) information on how a map fragment was processed or determined.

ASN.1 Representation:

```
DataParameters ::= SEQUENCE {
   processMethod      IA5String(SIZE(1..255)) OPTIONAL,
   processAgency      IA5String(SIZE(1..255)) OPTIONAL,
   lastCheckedDate    IA5String(SIZE(1..255)) OPTIONAL,
   geoidUsed          IA5String(SIZE(1..255)) OPTIONAL,
   ... -- # LOCAL_CONTENT
   }
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_MapData (MAP) <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.17 Data Frame: DF_DDate

Use: The DSRC style date is a compound value consisting of finite-length sequences of integers (not characters) of the form: "yyyy, mm, dd" - as defined below.

ASN.1 Representation:

```
DDate ::= SEQUENCE {
   year     DYear,              -- 2 bytes
   month    DMonth,             -- 1 byte
   day      DDay                -- 1 byte
   }
```

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XML Representation:

```
<xs:complexType name="DDate" >
      <xs:sequence>
         <xs:element name="year" type="DYear" />
         <!-- 2 bytes -->
         <xs:element name="month" type="DMonth" />
         <!-- 1 byte -->
         <xs:element name="day" type="DDay" />
         <!-- 1 byte -->
      </xs:sequence>
</xs:complexType>
```

6.18 Data Frame: DF_DDateTime

Use: The DSRC style date is a compound value consisting of finite-length sequences of integers (not characters) of the form: "yyyy, mm, dd, hh, mm, ss (sss+)" - as defined below.

ASN.1 Representation:

```
DDateTime ::= SEQUENCE {
   year     DYear     OPTIONAL,     -- 2 bytes
   month    DMonth    OPTIONAL,     -- 1 byte
   day      DDay      OPTIONAL,     -- 1 byte
   hour     DHour     OPTIONAL,     -- 1 byte
   minute   DMinute   OPTIONAL,     -- 1 byte
   second   DSecond   OPTIONAL      -- 2 bytes
   }
```

XML Representation:

```
<xs:complexType name="DDateTime" >
      <xs:sequence>
         <xs:element name="year" type="DYear"  minOccurs="0"/>
         <!-- 2 bytes -->
         <xs:element name="month" type="DMonth"  minOccurs="0"/>
         <!-- 1 byte -->
         <xs:element name="day" type="DDay"  minOccurs="0"/>
         <!-- 1 byte -->
         <xs:element name="hour" type="DHour"  minOccurs="0"/>
         <!-- 1 byte -->
         <xs:element name="minute" type="DMinute"  minOccurs="0"/>
         <!-- 1 byte -->
         <xs:element name="second" type="DSecond"  minOccurs="0"/>
         <!-- 2 bytes -->
      </xs:sequence>
</xs:complexType>
```

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Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_FullPositionVector	<ASN>	<XML>, and
DF	DF_VehicleStatus	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that some elements of this structure may not be sent when not needed. At least one element shall be present.

6.19 Data Frame: DF_DFullTime

Use: The DSRC style full time is derived from complete entry date-time but with the seconds and fraction of a second removed (these are typically sent in another part of the same message). The full time is defined as a compound value consisting of finite-length sequences of integers (not characters) of the form: "yyyy, mm, dd, hh, mm" - as defined below.

ASN.1 Representation:

```
DFullTime ::= SEQUENCE {
   year    DYear,             -- 2 bytes
   month   DMonth,            -- 1 byte
   day     DDay,              -- 1 byte
   hour    DHour,             -- 1 byte
   minute  DMinute            -- 1 byte
   }
```

XML Representation:

```
<xs:complexType name="DFullTime" >
      <xs:sequence>
         <xs:element name="year" type="DYear" />
         <!-- 2 bytes -->
         <xs:element name="month" type="DMonth" />
         <!-- 1 byte -->
         <xs:element name="day" type="DDay" />
         <!-- 1 byte -->
         <xs:element name="hour" type="DHour" />
         <!-- 1 byte -->
         <xs:element name="minute" type="DMinute" />
         <!-- 1 byte -->
      </xs:sequence>
</xs:complexType>
```

6.20 Data Frame: DF_DMonthDay

Use: The DSRC style month-day is a compound value consisting of finite-length sequences of integers (not characters) of the form: "mm, dd" - as defined below.

ASN.1 Representation:

```
DMonthDay ::= SEQUENCE {
   month   DMonth,            -- 1 byte
   day     DDay               -- 1 byte
   }
```

XML Representation:

```
<xs:complexType name="DMonthDay" >
      <xs:sequence>
         <xs:element name="month" type="DMonth" />
         <!-- 1 byte -->
         <xs:element name="day" type="DDay" />
         <!-- 1 byte -->
      </xs:sequence>
</xs:complexType>
```

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6.21 Data Frame: DF_DTime

Use: The DSRC style time is a compound value consisting of finite-length sequences of integers (not characters) of the form: "hh, mm, ss (sss+) (offset)" - as defined below. Because the length of each element is known, no inner element tagging is used in some forms of transmission. Tagging is used in this instance. In DSRC applications there is no need to send the offset representing the local time zone, so the most common representation for the data frame occupies 4 payload bytes (12 bytes with all tagging) and provides a resolution of one millisecond over a range of one day.

ASN.1 Representation:
```
DTime ::= SEQUENCE {
   hour    DHour,              -- 1 byte
   minute  DMinute,            -- 1 byte
   second  DSecond             -- 2 bytes
   }
```

XML Representation:
```
<xs:complexType name="DTime" >
      <xs:sequence>
         <xs:element name="hour" type="DHour" />
         <!-- 1 byte -->
         <xs:element name="minute" type="DMinute" />
         <!-- 1 byte -->
         <xs:element name="second" type="DSecond" />
         <!-- 2 bytes -->
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_SignalRequestMessage (SRM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.22 Data Frame: DF_DYearMonth

Use: The DSRC style year-month is a compound value consisting of finite-length sequences of integers (not characters) of the form: "yyyy, mm" - as defined below.

ASN.1 Representation:
```
DYearMonth ::= SEQUENCE {
   year    DYear,              -- 2 bytes
   month   DMonth              -- 1 byte
   }
```

XML Representation:
```
<xs:complexType name="DYearMonth" >
      <xs:sequence>
         <xs:element name="year" type="DYear" />
         <!-- 2 bytes -->
         <xs:element name="month" type="DMonth" />
         <!-- 1 byte -->
      </xs:sequence>
</xs:complexType>
```

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6.23 Data Frame: DF_EnabledLaneList

Use: The Enabled Lane List data frame is a sequence of lane IDs for lane objects that are *activated* in the current map configuration. These lanes, unlike most lanes, have their *RevocableLane* bit set to one (asserted). Such lanes are not considered to be part of the current map unless they are in the Enabled Lane List. This concept is used to describe all the possible regulatory states for a given physical lane. For example, it is not uncommon to enable or disable the ability to make a right hand turn on red during different periods of a day. Another similar example would be a lane which is used for driving during one period and where parking is allowed at another. Traditionally, this information is conveyed to the vehicle driver by local signage. By using the Enabled Lane List data frame in conjunction with the *RevocableLane* bit and constructing a separate lane object in the intersection map for each different configuration, a single unified map can be developed and used. This overcomes the need to manage the process of sending different maps reflecting the then current configuration which was necessary in the 2009 edition of the standard, reducing the process to simply listing which lanes are then active in the current configuration.

ASN.1 Representation:
```
EnabledLaneList ::= SEQUENCE (SIZE(1..16)) OF LaneID
   -- The unique ID numbers for each
   -- lane object which is 'active'
   -- as part of the dynamic map contents.
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_IntersectionState CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.24 Data Frame: DF_FullPositionVector

Use: A complete report of the vehicle's position, speed, and heading and an instant in time. Used in the probe vehicle message (and elsewhere) as the initial position information. Often followed by other data frames that may provide offset path data.

ASN.1 Representation:
```
FullPositionVector ::= SEQUENCE {
   utcTime             DDateTime OPTIONAL,    -- time with mSec precision
   long                Longitude,             -- 1/10th microdegree
   lat                 Latitude,              -- 1/10th microdegree
   elevation           Elevation OPTIONAL,    -- 3 bytes, 0.1 m
   heading             Heading OPTIONAL,
   speed               TransmissionAndSpeed OPTIONAL,
   posAccuracy         PositionalAccuracy OPTIONAL,
   timeConfidence      TimeConfidence OPTIONAL,
   posConfidence       PositionConfidenceSet OPTIONAL,
   speedConfidence     SpeedandHeadingandThrottleConfidence OPTIONAL,
   ... -- # LOCAL_CONTENT
   }
```

XML Representation:
```
<xs:complexType name="FullPositionVector" >
      <xs:sequence>
         <xs:element name="utcTime" type="DDateTime"  minOccurs="0"/>
         <!-- time with mSec precision -->
         <xs:element name="long" type="Longitude" />
         <!-- 1/10th microdegree -->
         <xs:element name="lat" type="Latitude" />
         <!-- 1/10th microdegree -->
         <xs:element name="elevation" type="Elevation"  minOccurs="0"/>
         <!-- 3 bytes,  0.1 m -->
         <xs:element name="heading" type="Heading"  minOccurs="0"/>
         <xs:element name="speed" type="TransmissionAndSpeed"  minOccurs="0"/>
         <xs:element name="posAccuracy" type="PositionalAccuracy"  minOccurs="0"/>
         <xs:element name="timeConfidence" type="TimeConfidence"  minOccurs="0"/>
```

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```
         <xs:element name="posConfidence" type="PositionConfidenceSet"  minOccurs="0"/>
         <xs:element name="speedConfidence" type="SpeedandHeadingandThrottleConfidence"
minOccurs="0"/>
         <xs:element name="localFullPositionVector" type="local:FullPositionVector"
minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is directly used by the following 7 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_PathHistory	<ASN>	<XML>, and
DF	DF_RTCMPackage	<ASN>	<XML>, and
DF	DF_Snapshot	<ASN>	<XML>, and
DF	DF_VehicleStatus	<ASN>	<XML>, and
MSG	MSG_ProbeVehicleData (PVD)	<ASN>	<XML>, and
MSG	MSG_RoadSideAlert (RSA)	<ASN>	<XML>, and
MSG	MSG_RTCM_Corrections (RTCM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: In edition one of the standard the first 2 bytes were a *DSecond* followed by *DFullTime* in 6 bytes. This produced a complete time value in 8 bytes. In this edition, these have been re-ordered into a single value, that of *DDateTime*. This changes the ordering encoded over the air, and the ordering and the tags when expressed in ASN and XML.

6.25 Data Frame: DF_GenericLane

Use: The GenericLane data frame is used for all types of lanes, e.g. motorized vehicle lanes, crosswalks, medians. Note: In the 2009 version of this standard each lane type was specified in a distinct data frame, and there was no GenericLane data frame.

The GenericLane describes the basic attribute information of the lane. The LaneID value for each lane is unique within an intersection. One use for the LaneID is in the SPAT message, where a given signal or movement phase is mapped to a set of applicable lanes using their respective LaneIDs. The NodeList2 data frame includes a sequence of offset points (or node points) representing the center line path of the lane. As described in this standard, node points are sets of variable sized delta orthogonal offsets from the prior point in the node path (the initial point is offset from the LLH anchor point used in the intersection). Each node point may convey optional attribute data as well. The use of attributes is described further in the Node definition, and in a later clause, but an example use would be to indicate a node point where the lane width changes.

It should be noted that a "lane" is an abstract concept that can describe objects other than motorized vehicle lanes, and that the generic lane structure (using features drawn from Japanese usage) also allows combining multiple physical lanes into a single lane object. In addition, such lanes can describe connectivity points with other lanes beyond a single intersection, extending such a lane description over multiple nearby physical intersections and side streets which themselves may not be equipped or assigned an index number in the regional intersection numbering system. (See the ConnectsTo entry for details) This has value when describing a broader service area in terms of the roadway network, probably with less precision and detail.

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ASN.1 Representation:

```
GenericLane ::= SEQUENCE {
   laneID            LaneID,
                     -- The unique ID number assigned
                     -- to this lane object
   name              DescriptiveName OPTIONAL,
                     -- often for debug use only
                     -- but at times used to name ped crossings
   ingressApproach   ApproachID OPTIONAL, -- inbound
   egressApproach    ApproachID OPTIONAL, -- outbound
                     -- Approach IDs to which this lane belongs
   laneAttributes    LaneAttributes,
                     -- All Attribute information about
                     -- the basic selected lane type
                     -- Directions of use, Geometric co-sharing
                     -- and Type Specific Attributes
                     -- These Attributes are 'lane - global' that is,
                     -- they are true for the entire length of the lane
   maneuvers         AllowedManeuvers OPTIONAL,
                     -- the permitted maneuvers for this lane
   nodeList          NodeList2,
                     -- Lane spatial path information as well as
                     -- various Attribute information along the node path
                     -- Attributes found here are more general and may
                     -- come and go over the length of the lane.
   connectsTo        ConnectsToList OPTIONAL,
                     -- a list of other lanes and their signal group IDs
                     -- each connecting lane and its signal group ID
                     -- is given, therefore this element provides the
                     -- information formally in "signalGroups" in prior
                     -- editions.
   overlays          OverlayLaneList OPTIONAL,
                     -- A list of any lanes which have spatial paths that
                     -- overlay (run on top of, and not simply cross)
                     -- the path of this lane when used
   regional          RegionalGenericLane OPTIONAL,
                     -- regional extensions
   ...
   }
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_LaneList	<ASN>	<>, and
DF	DF_RoadLaneSetList	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

6.26 Data Frame: DF_IntersectionGeometry

Use: A complete description of an intersection's roadway geometry and its allowed navigational paths (independent of any additional regulatory restrictions that may apply over time or from user classification).

ASN.1 Representation:

```
IntersectionGeometry ::= SEQUENCE {
   name        DescriptiveName OPTIONAL,
                            -- For debug use only
   id          IntersectionReferenceID,
```

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```
                                -- A globally unique value set,
                                -- consisting of a regionID and
                                -- intersection ID assignment
   revision    MsgCount,

   -- Required default values about lane descriptions follow
   refPoint    Position3D-2, -- The reference from which subsequent
                                -- data points are offset until a new
                                -- point is used.
   laneWidth   LaneWidth OPTIONAL,
                                -- Reference width used by all subsequent
                                -- lanes unless a new width is given
   speedLimits SpeedLimitList OPTIONAL,
                                -- Reference regulatory speed limits
                                -- used by all subsequent
                                -- lanes unless a new speed is given
                                -- See Remarks under the SpeedAdvice entry
                                -- for converting and transmitting a speed
                                -- expressed in MPH to units of 0.1 m/s

   -- Complete details regarding each lane type in this intersection
   laneSet     LaneList,        -- Data about one or more lanes
                                -- (all lane data is found here)

   -- Data describing how to use and request preemption and
   -- priority services from this intersection (if supported)
   -- NOTE Additonal data may be added in the next release of the
   -- standard at this point to handle this concept
   preemptPriorityData PreemptPriorityList OPTIONAL,
                               -- data about one or more regional
                               -- preempt or priority zones

   regional    RegionalIntersection  OPTIONAL,
               -- regional message content to be placed here
   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_IntersectionGeometryList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The PreemptZones and PriorityZones are used to relate each signal preempt and priority zone to a specific request values that a vehicle would use when making a request.

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6.27 Data Frame: DF_IntersectionGeometryList

Use: The IntersectionGeometryList data frame consists of a list of IntersectionGeometry entries.

ASN.1 Representation:

```
IntersectionGeometryList ::= SEQUENCE (SIZE(1..32)) OF IntersectionGeometry
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_MapData (MAP) <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.28 Data Frame: DF_IntersectionReferenceID

Use: The IntersectionReferenceID data frame conveys the combination of an optional RegionalID and of an IntersectionID that is unique within that region. When the RegionalID is present the IntersectionReferenceID is guaranteed to be globally unique.

ASN.1 Representation:

```
IntersectionReferenceID ::= SEQUENCE {
   region   RoadRegulatorID OPTIONAL,
            -- a globally unique regional assignment value
            -- typical assigned to a regional DOT authority
            -- the value zero shall be used for testing needs
   id       IntersectionID
            -- a unique mapping to the intersection
            -- in question within the above region of use
   }
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_Connection	<ASN>	<>, and
DF	DF_IntersectionGeometry CHANGED	<ASN>	<>, and
DF	DF_IntersectionState CHANGED	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: A *fully qualified* intersection consists of its regionally unique ID (the IntersectionID) and its region ID (the RegionalID). Taken together these form a unique value which is never repeated.

6.29 Data Frame: DF_IntersectionState

Use: The IntersectionState data frame is used to convey all the SPAT information for a single intersection. Both current and future data can be sent.

ASN.1 Representation:

```
IntersectionState ::= SEQUENCE {
   name         DescriptiveName OPTIONAL,
                -- human readable name for intersection
                -- to be used only in debug mode
   id           IntersectionReferenceID,
                -- A globally unique value set, consisting of a
                -- regionID and intersection ID assignment
                -- provides a unique mapping to the
                -- intersection MAP in question
                -- which provides complete location
                -- and approach/move/lane data
   revision     MsgCount,
   status       IntersectionStatusObject,
                -- general status of the controller(s)
   moy          MinuteOfTheYear OPTIONAL,
                -- Minute of current UTC year
                -- used only with messages to be archived
   timeStamp    DSecond2 OPTIONAL,
                -- the mSec point in the current UTC minute that
                -- this message was constructed
   enabledLanes EnabledLaneList OPTIONAL,
                -- a list of lanes where the RevocableLane bit
                -- has been set which are now active and
                -- therefore part of the current intersection
   states       MovementList,
                -- Each Movement is given in turn
                -- and contains its signal phase state,
                -- mapping to the lanes it applies to, and
                -- point in time it will end, and it
```

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```
                  -- may contain both active and future states
   maneuverAssistList  ManeuverAssistList OPTIONAL,
                  -- Assist data
   priority       SignalControlState OPTIONAL,
                  -- the active priority state data, if present
   preempt        SignalControlState OPTIONAL,
                  -- the active preemption state data, if present

   regional       RegionalIntersectionState OPTIONAL,
                  -- regional extensions
   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_IntersectionStateList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.30 Data Frame: DF_IntersectionStateList

Use: The IntersectionStateList data frame consists of a list of IntersectionState entries.

ASN.1 Representation:

```
IntersectionStateList ::= SEQUENCE (SIZE(1..32)) OF  IntersectionState
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_SignalPhaseAndTiming Message (SPAT) <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.31 Data Frame: DF_ITIS_Phrase_ExitService

Use: A data frame to allow sequences of ITIS codes, short text strings, and numerical values to be expressed in the normal ITIS vocabulary method and pattern. Note that the allowed text strings are more limited then the normal ITIS format in order to converse bandwidth. All ITIS phrase data, when encoded in a DER form, shall always be expressed as integer values rather then their full text equivalents.

ASN.1 Representation:

```
ExitService ::= SEQUENCE (SIZE(1..10)) OF SEQUENCE {
  item CHOICE     {
       itis   ITIS.ITIScodes,
       text   IA5String  (SIZE(1..16))
       } -- # UNTAGGED
  }
```

XML Representation:

```
<xs:complexType name="ExitService" >
      <xs:sequence minOccurs="1" maxOccurs="10">
         <xs:element name="exitService-item" >
            <xs:complexType>
               <xs:sequence>
                  <xs:choice >
                     <xs:element name="itis" type="itis:ITIScodes" />
                     <xs:element name="text" >
                        <xs:simpleType>
                           <xs:restriction base="xs:string">
                              <xs:minLength value="1"/>
                              <xs:maxLength value="16"/>
                           </xs:restriction>
                        </xs:simpleType>
                     </xs:element>
                  </xs:choice>
               </xs:sequence>
```

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```
            </xs:complexType>
         </xs:element>
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_TravelerInformation Message (TIM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.32 Data Frame: DF_ITIS_Phrase_GenericSignage

Use: A data frame to allow sequences of ITIS codes, short text strings, and numerical values to be expressed in the normal ITIS vocabulary method and pattern. Note that the allowed text strings are more limited then the normal ITIS format in order to converse bandwidth. All ITIS phrase data, when encoded in a DER form, shall always be expressed as integer values rather then their full text equivalents.

ASN.1 Representation:

```
GenericSignage ::= SEQUENCE (SIZE(1..10)) OF SEQUENCE {
  item CHOICE    {
       itis   ITIS.ITIScodes,
       text   IA5String  (SIZE(1..16))
       } -- # UNTAGGED
  }
```

XML Representation:

```
<xs:complexType name="GenericSignage" >
      <xs:sequence minOccurs="1" maxOccurs="10">
         <xs:element name="genericSignage-item" >
            <xs:complexType>
               <xs:sequence>
                  <xs:choice >
                     <xs:element name="itis" type="itis:ITIScodes" />
                     <xs:element name="text" >
                        <xs:simpleType>
                           <xs:restriction base="xs:string">
                              <xs:minLength value="1"/>
                              <xs:maxLength value="16"/>
                           </xs:restriction>
                        </xs:simpleType>
                     </xs:element>
                  </xs:choice>
               </xs:sequence>
            </xs:complexType>
         </xs:element>
      </xs:sequence>
</xs:complexType>
```

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Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_TravelerInformation Message (TIM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.33 Data Frame: DF_ITIS_Phrase_SpeedLimit

Use: A data frame to allow sequences of ITIS codes, short text strings, and numerical values to be expressed in the normal ITIS vocabulary method and pattern. Note that the allowed text strings are more limited then the normal ITIS format in order to converse bandwidth. All ITIS phrase data, when encoded in a DER form, shall always be expressed as integer values rather then their full text equivalents.

ASN.1 Representation:
```
SpeedLimit ::= SEQUENCE (SIZE(1..10)) OF SEQUENCE {
  item CHOICE    {
       itis   ITIS.ITIScodes,
       text   IA5String  (SIZE(1..16))
       } -- # UNTAGGED
  }
```

XML Representation:
```
<xs:complexType name="SpeedLimit" >
      <xs:sequence minOccurs="1" maxOccurs="10">
         <xs:element name="speedLimit-item" >
            <xs:complexType>
               <xs:sequence>
                  <xs:choice >
                     <xs:element name="itis" type="itis:ITIScodes" />
                     <xs:element name="text" >
                        <xs:simpleType>
                           <xs:restriction base="xs:string">
                              <xs:minLength value="1"/>
                              <xs:maxLength value="16"/>
                           </xs:restriction>
                        </xs:simpleType>
                     </xs:element>
                  </xs:choice>
               </xs:sequence>
            </xs:complexType>
         </xs:element>
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_TravelerInformation Message (TIM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.34 Data Frame: DF_ITIS_Phrase_WorkZone

Use: A data frame to allow sequences of ITIS codes, short text strings, and numerical values to be expressed in the normal ITIS vocabulary method and pattern. Note that the allowed text strings are more limited then the normal ITIS format in order to converse bandwidth. All ITIS phrase data, when encoded in a DER form, shall always be expressed as integer values rather then their full text equivalents.

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ASN.1 Representation:
```
WorkZone ::= SEQUENCE (SIZE(1..10)) OF SEQUENCE {
  item CHOICE    {
       itis   ITIS.ITIScodes,
       text   IA5String  (SIZE(1..16))
       } -- # UNTAGGED
  }
```

XML Representation:
```
<xs:complexType name="WorkZone" >
      <xs:sequence minOccurs="1" maxOccurs="10">
         <xs:element name="workZone-item" >
            <xs:complexType>
               <xs:sequence>
                  <xs:choice >
                     <xs:element name="itis" type="itis:ITIScodes" />
                     <xs:element name="text" >
                        <xs:simpleType>
```

```
                        <xs:restriction base="xs:string">
                           <xs:minLength value="1"/>
                           <xs:maxLength value="16"/>
                        </xs:restriction>
                     </xs:simpleType>
                  </xs:element>
               </xs:choice>
            </xs:sequence>
         </xs:complexType>
      </xs:element>
   </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_TravelerInformation Message (TIM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.35 Data Frame: DF_J1939-Data Items

Use: This a data frame used to sent various J1939 defined data elements from the vehicle.

ASN.1 Representation:

```
J1939data ::= SEQUENCE {
   -- Tire conditions
   tires SEQUENCE (SIZE(0..16)) OF SEQUENCE {
      location             TireLocation            OPTIONAL,
      pressure             TirePressure            OPTIONAL,
      temp                 TireTemp                OPTIONAL,
      wheelSensorStatus    WheelSensorStatus       OPTIONAL,
      wheelEndElectFault   WheelEndElectFault      OPTIONAL,
      leakageRate          TireLeakageRate         OPTIONAL,
      detection            TirePressureThresholdDetection OPTIONAL,
      ...
      } OPTIONAL,
   -- Vehicle Weight by axle
   axle SEQUENCE (SIZE(0..16)) OF SEQUENCE {
      location             AxleLocation            OPTIONAL,
      weight               AxleWeight              OPTIONAL,
      ...
      } OPTIONAL,
   trailerWeight           TrailerWeight           OPTIONAL,
   cargoWeight             CargoWeight             OPTIONAL,
   steeringAxleTemperature SteeringAxleTemperature OPTIONAL,
   driveAxleLocation       DriveAxleLocation       OPTIONAL,
   driveAxleLiftAirPressure DriveAxleLiftAirPressure OPTIONAL,
   driveAxleTemperature    DriveAxleTemperature    OPTIONAL,
   driveAxleLubePressure   DriveAxleLubePressure   OPTIONAL,
   steeringAxleLubePressure SteeringAxleLubePressure OPTIONAL,
   ...
   }
```

XML Representation:

```
<xs:complexType name="J1939data" >
      <xs:sequence>
         <!-- Tire conditions -->
         <xs:element name="tires"  minOccurs="0">
            <xs:complexType>
               <xs:sequence minOccurs="0" maxOccurs="16">
                  <xs:element name="tire" >
                     <xs:complexType>
                        <xs:sequence>
```

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```
                           <xs:element name="location" type="TireLocation"
minOccurs="0"/>
                           <xs:element name="pressure" type="TirePressure"
minOccurs="0"/>
                           <xs:element name="temp" type="TireTemp"  minOccurs="0"/>
                           <xs:element name="wheelSensorStatus" type="WheelSensorStatus"
minOccurs="0"/>
                           <xs:element name="wheelEndElectFault"
type="WheelEndElectFault"  minOccurs="0"/>
                           <xs:element name="leakageRate" type="TireLeakageRate"
minOccurs="0"/>
                           <xs:element name="detection"
type="TirePressureThresholdDetection"  minOccurs="0"/>
                        </xs:sequence>
                     </xs:complexType>
                  </xs:element>
                  <!-- Vehicle Weight by axle -->
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <xs:element name="axle"  minOccurs="0">
            <xs:complexType>
               <xs:sequence minOccurs="0" maxOccurs="16">
                  <xs:element name="axle-item" >
                     <xs:complexType>
                        <xs:sequence>
                           <xs:element name="location" type="AxleLocation"
minOccurs="0"/>
                           <xs:element name="weight" type="AxleWeight"  minOccurs="0"/>
                        </xs:sequence>
                     </xs:complexType>
                  </xs:element>
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <xs:element name="trailerWeight" type="TrailerWeight"  minOccurs="0"/>
         <xs:element name="cargoWeight" type="CargoWeight"  minOccurs="0"/>
         <xs:element name="steeringAxleTemperature" type="SteeringAxleTemperature"
minOccurs="0"/>
         <xs:element name="driveAxleLocation" type="DriveAxleLocation"  minOccurs="0"/>
         <xs:element name="driveAxleLiftAirPressure" type="DriveAxleLiftAirPressure"
minOccurs="0"/>
         <xs:element name="driveAxleTemperature" type="DriveAxleTemperature"
minOccurs="0"/>
         <xs:element name="driveAxleLubePressure" type="DriveAxleLubePressure"
minOccurs="0"/>
         <xs:element name="steeringAxleLubePressure" type="SteeringAxleLubePressure"
minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.36 Data Frame: DF_LaneAttributes

Use: The Lane Attributes data frame holds all the constant attribute information of any lane object (as well as denoting the basic lane type itself) within a single structure. Constant attribute information are those values which do not change over the path of the lane, such as the direction of allowed travel. Other lane attribute information can change *at* or *between* each node.

The structure consists of three element parts is as follows. LaneDirection specifies the allowed directions of travel, if any. LaneSharing indicates whether this lane type is shared with other types of travel modes or users. The lane type is defined in LaneTypeAttributes, along with additional attributes specific to that type.

The fundamental type of lane object is described by the element selected in the LaneTypeAttributes data concept. Additional information specific or unique to a given lane type can be found there as well. A regional extension is provided as well.

Note that combinations of regulatory maneuver information such as "both a left turn and straight ahead movement are allowed, but never a u-turn," are expressed by the AllowedManeuvers data concept which typically follows after this element and in the same structure. Note that not all lane objects require this information (for example a median). The various values are set via bit flags to indicate the assertion of a value. Each defined lane type contains the bit flags suitable for its application area.

Note that the concept of LaneSharing is used to indicate that there are other users of this lane with equal regulatory rights to occupy the lane (which is a term this standard does not formally define since it varies by world region). A typical case is a light rail vehicle running along the same lane path as motorized traffic. In such a case. motor traffic may be allowed equal access to the lane when a train is not present. Another case would be those intersection lanes (at the time of writing rather unusual) where bicycle traffic is given full and equal right of way to an entire width of motorized vehicle lane. This example would not be a bike lane or bike box in the traditional sense.

ASN.1 Representation:

```
LaneAttributes ::= SEQUENCE {
   directionalUse  LaneDirection,        -- directions of lane use
   sharedWith      LaneSharing,          -- co-users of the lane path
   laneType        LaneTypeAttributes,   -- specific lane type data
   regional        RegionalLaneAttributes OPTIONAL
                                         -- regional extensions
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_GenericLane CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.37 Data Frame: DF_LaneDataAttribute

Use: The data frame *DF_LaneDataAttribute* is used to relate an attribute and a control value at a node point or along a lane segment from an enumerated list of defined choices. It is then followed by a defined data value associated with it and which is defined elsewhere in this standard.

ASN.1 Representation:

```
LaneDataAttribute ::= CHOICE {
    -- Segment attribute types and the data needed for each
    pathEndPointAngle         DeltaAngle,
                              -- adjusts final point/width slant
                              -- of the lane to align with the stop line
    laneCrownPointCenter      RoadwayCrownAngle,
                              -- sets the canter of the road bed
                              -- from centerline point
    laneCrownPointLeft        RoadwayCrownAngle,
                              -- sets the canter of the road bed
                              -- from left edge
    laneCrownPointRight       RoadwayCrownAngle,
                              -- sets the canter of the road bed
                              -- from right edge
    laneAngle                 MergeDivergeNodeAngle,
                              -- the angle or direction of another lane
                              -- this is required to support Japan style
                              -- when a merge point angle is required
    speedLimits               SpeedLimitList,
                              -- Reference regulatory speed limits
                              -- used by all segments
```

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```
    -- Add others as needed, here or in regional space
    regional                RegionalLaneDataAttribute,
                            -- regional extensions
    ...
    }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneDataAttributeList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: This data concept handles a variety of use case needs with a common and consistent message pattern. The typical use of this data concept (and several similar others) is to inject the selected Attribute into the spatial description of a lane's center line path (the segment list). In this way, attribute information which is true for a portion of the overall lane can be described when needed. This attribute information applies from the node point in the stream of segment data until changed again. Denoting the porous aspects of a lane along its path as it merges with another lane would be an example of this use case. In this case the start and end node points would be followed by suitable segment attributes. Reusing a lane path (previously called a computed lane) is another example. In this case the reference lane to be reused appears as a segment attribute followed by the lane value. It is then followed by one or more segment attributes which relate the positional translation factors to be used (offset, rotate, scale) and any further segment attribute changes.

6.38 Data Frame: DF_LaneDataAttributeList

Use: The LaneDataAttributeList data frame consists of a list of LaneDataAttribute entries.

ASN.1 Representation:
```
LaneDataAttributeList ::= SEQUENCE (SIZE(1..8)) OF LaneDataAttribute
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeAttributeSet <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.39 Data Frame: DF_LaneList

Use: The LaneList data frame consists of a list of GenericLane entries.

ASN.1 Representation:
```
LaneList ::= SEQUENCE (SIZE(1..255)) OF GenericLane
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_IntersectionGeometry CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.40 Data Frame: DF_LaneTypeAttributes

Use: The Lane Type Attributes data frame is used to hold attribute information specific to a given lane type. It is typically used in the DE_LaneAttributes data frame as part of an overall description of a lane object. Information unique to this the specific type of lane is found here. Information common to lanes is expressed in other entries. The various values are set by bit flags to indicate the assertion of a value. Each defined lane type contains bit flags suitable for its application area.

ASN.1 Representation:
```
LaneTypeAttributes ::= CHOICE {
   vehicle        LaneAttributes-Vehicle,        -- motor vehicle lanes
   crosswalk      LaneAttributes-Crosswalk,      -- pedestrian crosswalks
   bikeLane       LaneAttributes-Bike,           -- bike lanes
   sidewalk       LaneAttributes-Sidewalk,       -- pedestrian sidewalk paths
   median         LaneAttributes-Barrier,        -- medians & channelization
   striping       LaneAttributes-Striping,       -- roadway markings
   trackedVehicle LaneAttributes-TrackedVehicle, -- trains and trolleys
   parking        LaneAttributes-Parking,        -- parking and stopping lanes
   ...
   }
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneAttributes <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.41 Data Frame: DF_ManeuverAssistList

Use: The ManeuverAssistList data frame consists of a list of ConnectionManeuverAssist entries.

ASN.1 Representation:

```
ManeuverAssistList ::= SEQUENCE (SIZE(1..16)) OF ConnectionManeuverAssist
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_IntersectionState CHANGED	<ASN>	<>, and
DF	DF_MovementState	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

6.42 Data Frame: DF_MovementEvent

Use: The MovementEvent data frame contains details about a single movement. It is used by the movement state to convey one of number of movements (typically occurring over a sequence of times) for a single GroupId.

ASN.1 Representation:

```
MovementEvent ::= SEQUENCE {
   eventState   MovementPhaseState,
                -- Consisting of:
                -- Phase state (the basic 11 states)
                -- Directional, protected, or permissive state

   timing       TimeChangeDetails OPTIONAL,
                -- Timing Data in UTC time stamps for event
                -- includes start and min/max end times of phase
                -- confidence and estimated next occurrence

   speeds       AdvisorySpeedList OPTIONAL,
                -- various speed advisories for use by
                -- general and specific types of vehicles
                -- supporting green-wave and other flow needs
                -- See Remarks under the SpeedAdvice entry for
                -- converting and transmitting a speed expressed
                -- in MPH to units of 0.1 m/s

   regional     RegionalMovementEvent OPTIONAL,
                -- regional extensions
   ... -- # LOCAL_CONTENT
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_MovementEventList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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6.43 Data Frame: DF_MovementEventList

Use: The MovementEventList data frame consists of a list of MovementEvent entries.

ASN.1 Representation:
```
MovementEventList ::= SEQUENCE (SIZE(1..16)) OF MovementEvent
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_MovementState <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.44 Data Frame: DF_MovementList

Use: The MovementList data frame consists of a list of MovementState entries.

ASN.1 Representation:
```
MovementList ::= SEQUENCE (SIZE(1..255)) OF MovementState
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_IntersectionState CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.45 Data Frame: DF_MovementState

Use: The MovementState data frame is used to convey various information about the current or future movement state of a designated collection of one or more lanes of a common type. This is referred to as the GroupID. Note that lane object types supported include both motorized vehicle lanes as well as pedestrian lanes and dedicated rail and transit lanes. Of the reported data elements, the time to change (the time remaining in the current state) is often of the most value. Lanes with a common state (typically adjacent sets of lanes in an approach) in a signalized intersection will have individual lane values such as total vehicle counts, summed. It is used in the SPAT message to convey every active movement in a given intersection so that vehicles, when combined with certain map information, can determine the state of the signal phases.

ASN.1 Representation:
```
MovementState ::= SEQUENCE {
   movementName       DescriptiveName OPTIONAL,
                      -- uniquely defines movement by name
                      -- human readable name for intersection
                      -- to be used only in debug mode
   signalGroup        SignalGroupID,
                      -- the group id is used to map to lists
                      -- of lanes (and their descriptions)
                      -- which this MovementState data applies to
                      -- see comments in the Remarks for usage details
   state-time-speed   MovementEventList,
                      -- Consisting of sets of movement data with:
                      -- a)  SignalPhaseState
                      -- b)  TimeChangeDetails,  and
                      -- c)  AdvisorySpeeds      (optional )
                      -- Note one or more of the movement events may be for
                      -- a future time and that this allows conveying multiple
                      -- predictive phase and movement timing for various uses
                      -- for the current signal group
   maneuverAssistList ManeuverAssistList OPTIONAL,
                      -- This information may also be placed in the
                      -- IntersectionState when common information applies to
                      -- different lanes in the same way
   regional           RegionalMovementState OPTIONAL,
                      -- regional extensions
   ... -- # LOCAL_CONTENT
   }
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_MovementList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that the value given for the *time to change* will vary in many actuated signalized intersections based on the sensor data received during the phase. The data transmitted always reflects the then most current timemark value (which is the point in UTC time when the change will occur). As an example, in a phase which may vary from 15 to 25 seconds of duration based on observed traffic flows, a time to change value of 15 seconds in the future might be transmitted for many consecutive seconds (and the time mark value extended for as much as 10 seconds depending on the extension time logic used by the controller before it either times out or gaps out), followed by a final time mark value reflecting the decreasing values as the time runs out, presuming the value was not again extended to a new time mark due to other detection events. The time to change element can therefore generally be regarded as a guaranteed minimum value of the time that will elapse unless a preemption event occurs.

In use the GroupID element is matched to lanes that are members of that ID. The type of lane (vehicle, crosswalk, etc.) is known by the lane description as well as its allowed maneuvers and any vehicle class restrictions. Every lane type is treated the same way (cross walks map to suitable meanings etc.). Lane objects which are not part of the sequence of signalized lanes do not appear in any GroupID. The visual details of how a given signal phase is presented to a mobile user will vary based on lane type and with regional conventions. Not all signal states will be used in all regional deployments. For example a pre-green visual indication is not generally found in US deployments. Under such operating conditions, the unused phase states are simply skipped.

6.46 Data Frame: DF_Node_LLmD_64b

Use: A 64-bit node type with lat-long values expressed in standard SAE one tenth of a micro degree.

ASN.1 Representation:
```
Node-LLmD-64b ::= SEQUENCE {
   lon  Longitude,
   lat  Latitude
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeOffsetPoint <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.47 Data Frame: DF_Node_XY_20b

Use: A 20-bit node type with offset values from the last point in X and Y.

ASN.1 Representation:
```
Node-XY-20b ::= SEQUENCE {
   x  Offset-B10,
   y  Offset-B10
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeOffsetPoint <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.48 Data Frame: DF_Node_XY_22b

Use: A 22-bit node type with offset values from the last point in X and Y.

ASN.1 Representation:
```
Node-XY-22b ::= SEQUENCE {
   x  Offset-B11,
   y  Offset-B11
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeOffsetPoint <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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6.49 Data Frame: DF_Node_XY_24b

Use: A 24-bit node type with offset values from the last point in X and Y.

ASN.1 Representation:
```
Node-XY-24b ::= SEQUENCE {
   x  Offset-B12,
   y  Offset-B12
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeOffsetPoint <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.50 Data Frame: DF_Node_XY_26b

Use: A 26-bit node type with offset values from the last point in X and Y.

ASN.1 Representation:
```
Node-XY-26b ::= SEQUENCE {
   x  Offset-B13,
   y  Offset-B13
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeOffsetPoint <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.51 Data Frame: DF_Node_XY_28b

Use: A 28-bit node type with offset values from the last point in X and Y.

ASN.1 Representation:
```
Node-XY-28b ::= SEQUENCE {
   x  Offset-B14,
   y  Offset-B14
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeOffsetPoint <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.52 Data Frame: DF_Node_XY_32b

Use: A 32-bit node type with offset values from the last point in X and Y.

ASN.1 Representation:
```
Node-XY-32b ::= SEQUENCE {
   x  Offset-B16,
   y  Offset-B16
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeOffsetPoint <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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6.53 Data Frame: DF_NodeAttributeList

Use: The NodeAttributeList data frame consists of a list of NodeAttribute entries.

ASN.1 Representation:

```
NodeAttributeList ::= SEQUENCE (SIZE(1..8)) OF NodeAttribute
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeAttributeSet <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.54 Data Frame: DF_NodeAttributeSet

Use: The DF_NodeAttributeSet is a data frame used to convey one to more changes in the attribute set which occurs at the node point at which it is used. Some of these attributes persist until the end of the lane or until changed again or turned off. Other attributes have a *scope of use* which is limited to the node in which they are found. Besides the basic attributes, optional data elements for increasing or decreasing the width and elevation values from the prior values are also provided.

ASN.1 Representation:

```
NodeAttributeSet ::= SEQUENCE {
   localNode     NodeAttributeList OPTIONAL,
                 -- Attribute states which pertain to this node point
   disabled      SegmentAttributeList OPTIONAL,
                 -- Attribute states which are disabled at this node point
   enabled       SegmentAttributeList OPTIONAL,
                 -- Attribute states which are enabled at this node point
                 -- and which remain enabled until disabled or the lane ends
   data          LaneDataAttributeList OPTIONAL,
                 -- Attributes which require an additional data values
                 -- some of these are local to the node point, while others
                 -- persist with the provided values until changed
                 -- and this is indicated in each entry
   regional      RegionalNodeAttributeList OPTIONAL,
                 -- Regional extensions
   dWidth        Offset-B10 OPTIONAL,
                 -- A value added to the current lane width
                 -- at this node and from this node onwards, in 1cm steps
                 -- lane width between nodes are a linear taper between pts
                 -- the value of zero shall not be sent here
   dElevation    Offset-B10 OPTIONAL,
                 -- A value added to the current Elevation
                 -- at this node from this node onwards, in 10cm steps
                 -- elevations between nodes are a linear taper between pts
                 -- the value of zero shall not be sent here
   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Node <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.55 Data Frame: DF_NodeList2

Use: The NodeList2 data structure provides the sequence of signed offset node point values for determining the Xs and Ys (and, possibly Width or Zs when present) using the then current Position3D object to build a path for the centerline of the subject lane type. Each X,Y point is referred to as a Node Point. The straight line paths between these points are referred to as Segments.

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All nodes may have various optional attributes the state of which can vary along the path and are enabled and disabled by the sequence of objects found in the list of node structures. Refer to the supporting users guide for a description of how to correctly encode and decode the types of the data element as well as examples of use. As a simple example, a motor vehicle lane may have a section of the overall lane path marked "do not block" indicating that vehicles should not come to a stop and remain in that region. This is encoded in the Node data structures by an element in once node to indicate the start of the do not block lane attributes at a given offset, and then by a termination element when this attribute is set false. Other types of elements in the segment choice allow inserting attributes containing data values affecting the segment or the node.

ASN.1 Representation:
```
NodeList2 ::= CHOICE {
   nodes     NodeSet,
             -- a lane made up of two or more
             -- node points and any attributes
             -- defined in those nodes
   computed  ComputedLane,
             -- a lane path computed by translating
             -- the data defined by another lane
   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_GenericLane CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: When describing a path, the first node is the one closest to the intersection for the lane or the beginning point in a roadway segment. Typically, this is located on the stop line for approaches. Safety applications can use this to identify their stop line without having to consult the Intersection Message. For egresses, the first node indicates where the outbound lane begins.

6.56 Data Frame: DF_NodeList

Use: The NodeList data structure provides the sequence of signed offset values for determining the Xs and Ys (and, possibly Width or Zs when present) using the then current Position3D object to build a path for the enclosing ReferenceLane relating to a lane in the current intersection.

ASN.1 Representation:
```
NodeList ::= SEQUENCE (SIZE(1..64)) OF Offsets
   -- the Position3D ref point (starting point or anchor)
   -- is found in the outer object.
   -- Offsets are additive from the last point.
```

XML Representation:
```
<xs:complexType name="NodeList" >
      <xs:sequence minOccurs="1" maxOccurs="64">
         <xs:element name="node" type="Offsets" />
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_ShapePointSet	<ASN>	<XML>, and
DF	DF_SignalControlZone	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

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Remarks: When describing a path, the first node is the one closest to the intersection for the lane or the beginning point in a roadway segment. Typically, this is located on the stop line for approaches. Safety applications can use this to identify their stop line without having to consult the Intersection Message. For egresses, the first node indicates where the outbound lane begins.

When the node list is used to describe "non stopping areas" in a path (such as a stripped do not block area or a railroad crossing) then the offsets are taken in paired sets. The first offset provides the start of the area to be avoided, while the 2nd offset provides the end of that area. The path is presumed to follow the same linear path described by the node list for the lane.

Subsequent nodes provide points further and further away along the lane's driven line. Include as many as necessary to characterize lane curvature "within tolerance."

6.57 Data Frame: DF_Node

Use: The DF_Node data frame presents a structure to hold data for a signal node point in a lane. Each selected node has an X and Y offset from the prior node point (or a complete lat-long representation in some cases) as well as optional attribute information. A lanes node list is made up of a sequence of these to describe the lane path. The X,Y points are selected to reflect the centerline of the lane with sufficient accuracy for the intended applications. Simple lanes can be adequately described with only two node points, while lanes with curvature may require more points. Changes to the lane width and elevation can be expressed in the NodeAttributes entry, as well as various attributes that pertain to either the current node point or to one of more subsequent segments along the list of lane node points. As a broad concept, NodeAttributes are used to describe aspects of the lane that persist for only portion of the overall lane path (either at a node or over a set of segments).

A further description of the use of the *NodeOffsetPoint* and the *Attributes* data concepts can be found in the data dictionary entries for each one. Note that each allows regional variants to be supported as well.

ASN.1 Representation:
```
Node ::= SEQUENCE {
   delta       NodeOffsetPoint,
               -- A choice of which X,Y offset value to use
               -- this includes various delta values as well a regional choices
   attributes  NodeAttributeSet OPTIONAL,
               -- Any optional Attributes which are needed
               -- This includes changes to the current lane width and elevation
   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeSet <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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6.58 Data Frame: DF_NodeOffsetPoint

Use: The DF_NodeOffsetPoint data frame presents a structure to hold different sized data frames for a single node point in a lane. Nodes are described in terms and X and Y offsets in units of 1 centimeter. Changes in elevation and in the lane width can be expressed in a similar way with the optional *Attributes* data entry which appears alongside the *NodeOffsetPoint* in use.

The choice of which node type is driven by the magnitude (size) of the offset data to be encoded. When the distance from the last node point is smaller, the smaller entries can (and should) be chosen

Each single selected node is computed as an X and Y offset from the prior node point unless one of the entries reflecting a complete lat-long representation is selected. In this case, subsequent entries become offsets from that point. This ability was added for assistance with the development, storage, and back office exchange of messages where message size is not a concern and it should not be sent over the air due to its additional message payload size.

The general usage guidance is to construct the lanes node point content with the smallest possible sized element to conserve message size. However, using an element which is larger than needed is not a violation of the ASN.1 rules.

ASN.1 Representation:
```
NodeOffsetPoint ::= CHOICE {
   -- Nodes with X,Y content
   node-XY1         Node-XY-20b,    -- node is within   5.11m of last node
   node-XY2         Node-XY-22b,    -- node is within  10.23m of last node
   node-XY3         Node-XY-24b,    -- node is within  20.47m of last node
   node-XY4         Node-XY-26b,    -- node is within  40.96m of last node
   node-XY5         Node-XY-28b,    -- node is within  81.91m of last node
   node-XY6         Node-XY-32b,    -- node is within 327.67m of last node
   node-LatLon      Node-LLmD-64b,  -- node is a full 32b Lat/Lon range
   node-Regional    RegionalNodeOffsetPoint
                                    -- node which follows is of a
                                    -- regional definition type
   }
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_Node	<ASN>	<>, and
DF	DF_Reg-ConnectionManeuverAssist_EU	<ASN>	<>, and
DF	DF_SignalHeadLocation_EU NEW	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

6.59 Data Frame: DF_NodeSet

Use: The NodeSet data frame consists of a list of Node entries.

ASN.1 Representation:
```
NodeSet ::= SEQUENCE (SIZE(2..63)) OF Node
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeList2 CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.60 Data Element: DF_Offsets

Use: The Offsets data structure provides one set of signed offset values for determining the Xs and Ys (and, possibly Zs when present) using the then current ReferencePoint object to build a single point in a path for the enclosing ReferenceLane relating to a lane in the current intersection.

ASN.1 Representation:
```
Offsets ::= OCTET STRING (SIZE(4..8))
   -- Made up of
   -- SEQUENCE {
   -- xOffset  INTEGER (-32767..32767),
   -- yOffset  INTEGER (-32767..32767),
   -- if 6 or 8 bytes in length:
   -- zOffset  INTEGER (-32767..32767) OPTIONAL,
            -- all above in signed values where
            -- the LSB is in units of 1.0 cm

   -- if 8 bytes in length:
   -- width    LaneWidth              OPTIONAL
   -- a length of 7 bytes is never used
   -- }
```

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XML Representation:
```
<xs:complexType name="Offsets" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            Made up of
            SEQUENCE  {
            xOffset  INTEGER  (-32767..32767) ,
            yOffset  INTEGER  (-32767..32767) ,
            if 6 or 8 bytes in length:
            zOffset  INTEGER  (-32767..32767)   OPTIONAL ,
            all above in signed values where
            the LSB is in units of 1.0 cm
            if 8 bytes in length:
            width    LaneWidth                 OPTIONAL
            a length of 7 bytes is never used
            }
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="Offsets-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="Offsets-string">
   <xs:restriction base="xs:base64Binary">
      <xs:minLength value="6"/>
      <xs:maxLength value="11"/>
   </xs:restriction>
</xs:simpleType >
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeList <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that while latitude and longitude and elevation values are provided in the reference point with respect to the common geoid, these offsets are given in absolute distance (units of 1.0 cm) of offset. When a value for zOffset or for LaneWidth is given, that value persists until changed again for additional nodes in the list.

6.61 Data Frame: DF_OverlayLaneList

Use: The Overlay Lane List data frame is a sequence of lane IDs which refers to lane objects that overlap or overlay the current lane's spatial path.

ASN.1 Representation:
```
OverlayLaneList ::= SEQUENCE (SIZE(1..5)) OF LaneID
   -- The unique ID numbers for any lane object which have
   -- spatial paths that overlay (run on top of, and not
   -- simply cross with) the current lane.
   -- Such as a train path that overlays a motor vehicle
   -- lane object for a roadway segment.
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_GenericLane CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.62 Data Frame: DF_PathHistory

Use: The PathHistory data frame defines an adaptable set of PathHistoryPointSets reflecting recent vehicle movement over some period of time and/or distance. The points present in the history represent a concise representation(s) of the actual path history of the vehicle based on allowable position error tolerance between the actual vehicle path and its concise representation. This data frame allows creating a sequence of positions (typically a vehicle motion track) over a limited period of time or distance (each called PathHistoryPointType).

The initial anchor point shall be the initialPostion data frame or be provided in the message in which the PathHistory is sent (such as the BSM Part I). If the Path History is sent in a message which provides the Full Position vector or similar initial position data then the optional initialPosition element shall not be sent.

The initial anchor point is used to create the offset values of the set. All path history points are older in time than the anchor point used. Each path history point is subtracted from the initial anchor point to create the offset values. The first point set in the message is the closest in time to the anchor point, older points follow in the order in which they were determined.

The PathHistory data itself allows many optional variants of data to be encoded. Each possible set of PathHistoryPointSets data elements is supported in an octet blob style, and the sets of data in that type (a PathHistoryPointType) are sent in a single final octet blob (in other words each octet is made up of one or more sets of inner data, using the same encoding). The number of points sent in the PathHistoryPointSets can be determined by inspecting the length of the T-L-V of the ASN when sent.

The lat-long offset units used in the PathHistoryPointType octet stream support units of 1/10th micro degrees of lat and long. The elevation offset units are in 10cm units. The time is expressed in units of 10 milliseconds. The GPSstatus uses 4 bytes the relate the pseudorange noise measured in the system. The heading and speed are not offset values, and follow the units defined in the ASN comments. All of these items are defined further in the relevant data entry.

ASN.1 Representation:

```
PathHistory ::= SEQUENCE {
   initialPosition  FullPositionVector   OPTIONAL,
   currGPSstatus    GPSstatus            OPTIONAL,
   itemCnt          Count                OPTIONAL,
                    -- Limited to range 1 to 23
                    -- number of points in set to follow
   crumbData    CHOICE {
                -- select one of the possible data sets to be used

                pathHistoryPointSets-01 SEQUENCE (SIZE(1..23)) OF
                      PathHistoryPointType-01,
                      -- made up of sets of the: PathHistoryPointType-1
                      -- a set of all data elements, it is
                      -- non-uniform in size, each item tagged in BER

                pathHistoryPointSets-02 OCTET STRING (SIZE(15..345)),
                      -- made up of sets of the: PathHistoryPointType-02
                      -- sets of all data elements including:
                      -- lat, long, elev, time, accuracy, heading, and speed
                      -- offsets sent as a packed blob of 15 bytes per point

                pathHistoryPointSets-03 OCTET STRING (SIZE(12..276)),
                      -- made up of sets of the: PathHistoryPointType-03
                      -- sets of the following data elements:
                      -- lat, long, elev, time, and accuracy
                      -- offsets sent as a packed blob of 12 bytes per point

                pathHistoryPointSets-04 OCTET STRING (SIZE(8..184)),
                      -- made up of sets of the: PathHistoryPointType-04
                      -- sets of the following data elements:
                      -- lat, long, elev, and time
```

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```
                -- offsets sent as a packed blob of 8 bytes per point

          pathHistoryPointSets-05 OCTET STRING (SIZE(10..230)),
                -- made up of sets of the: PathHistoryPointType-05
                -- sets of the following data elements:
                -- lat, long, elev, and accuracy
                -- offsets sent as a packed blob of 10 bytes per point

          pathHistoryPointSets-06 OCTET STRING (SIZE(6..138)),
                -- made up of sets of the: PathHistoryPointType-06
                -- sets of the following data elements:
                -- lat, long, and elev
                -- offsets sent as a packed blob of 6 bytes per point

          pathHistoryPointSets-07 OCTET STRING (SIZE(11..242)),
                -- made up of sets of the: PathHistoryPointType-07
                -- sets of the following data elements:
                -- lat, long, time, and accuracy
                -- offsets sent as a packed blob of 10.5 bytes per point

          pathHistoryPointSets-08 OCTET STRING (SIZE(7..161)),
                -- made up of sets of the: PathHistoryPointType-08
                -- sets of the following data elements:
                -- lat, long, and time
                -- offsets sent as a packed blob of 7 bytes per point

          pathHistoryPointSets-09 OCTET STRING (SIZE(9..196)),
                -- made up of sets of the: PathHistoryPointType-09
                -- sets of the following data elements:
                -- lat, long, and accuracy
                -- offsets sent as a packed blob of 8.5 bytes per point

          pathHistoryPointSets-10 OCTET STRING (SIZE(5..104))
                -- made up of sets of the: PathHistoryPointType-10
                -- sets of the following data elements:
                -- lat and long
                -- offsets sent as a packed blob of 4.5 bytes per point

          },
   ... -- # LOCAL_CONTENT
   }
```

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XML Representation:

```
<xs:complexType name="PathHistory" >
      <xs:sequence>
         <xs:element name="initialPosition" type="FullPositionVector"  minOccurs="0"/>
         <xs:element name="currGPSstatus" type="GPSstatus"  minOccurs="0"/>
         <xs:element name="itemCnt" type="Count"  minOccurs="0"/>
         <!-- Limited to range 1 to 23
         number of points in set to follow -->
         <xs:element name="crumbData" >
            <xs:complexType>
               <xs:choice>
                  <!-- select one of the possible data sets to be used -->
                  <xs:element name="pathHistoryPointSets-01" >
                     <xs:complexType>
                        <xs:sequence minOccurs="1" maxOccurs="23">
                           <xs:element name="pathHistoryPointSets-01-item"
type="PathHistoryPointType-01" />
                           <!-- made up of sets of the: PathHistoryPointType-1 a set of
all data elements,  it is non-uniform in size,  each item tagged in BER -->
```

```
      </xs:sequence>
   </xs:complexType>
</xs:element>
<xs:element name="pathHistoryPointSets-02" >
   <xs:complexType><xs:simpleContent>
      <xs:extension base="pathHistoryPointSets-02-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent> </xs:complexType>
</xs:element>
<!-- made up of sets of the: PathHistoryPointType-02
sets of all data elements including:
lat,  long,  elev,  time,  accuracy,  heading,  and speed
offsets sent as a packed blob of 15 bytes per point -->
<xs:element name="pathHistoryPointSets-03" >
  <xs:complexType> <xs:simpleContent>
      <xs:extension base="pathHistoryPointSets-03-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
  </xs:simpleContent> </xs:complexType>
</xs:element>
<!-- made up of sets of the: PathHistoryPointType-03
sets of the following data elements:
lat,  long,  elev,  time,  and accuracy
offsets sent as a packed blob of 12 bytes per point -->
<xs:element name="pathHistoryPointSets-04" >
  <xs:complexType> <xs:simpleContent>
      <xs:extension base="pathHistoryPointSets-04-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
  </xs:simpleContent> </xs:complexType>
</xs:element>
<!-- made up of sets of the: PathHistoryPointType-04
sets of the following data elements:
lat,  long,  elev,  and time
offsets sent as a packed blob of 8 bytes per point -->
<xs:element name="pathHistoryPointSets-05" >
   <xs:complexType><xs:simpleContent>
      <xs:extension base="pathHistoryPointSets-05-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
```

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```
            </xs:restriction>
         </xs:simpleType>
       </xs:attribute>
    </xs:extension>
 </xs:simpleContent></xs:complexType>
</xs:element>
<!-- made up of sets of the: PathHistoryPointType-05
sets of the following data elements:
lat,  long,  elev,  and accuracy
offsets sent as a packed blob of 10 bytes per point -->
<xs:element name="pathHistoryPointSets-06" >
   <xs:complexType><xs:simpleContent>
      <xs:extension base="pathHistoryPointSets-06-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent></xs:complexType>
</xs:element>
<!-- made up of sets of the: PathHistoryPointType-06
sets of the following data elements:
lat,  long,  and elev
offsets sent as a packed blob of 6 bytes per point -->
<xs:element name="pathHistoryPointSets-07" >
  <xs:complexType> <xs:simpleContent>
      <xs:extension base="pathHistoryPointSets-07-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
  </xs:simpleContent> </xs:complexType>
</xs:element>
<!-- made up of sets of the: PathHistoryPointType-07
sets of the following data elements:
lat,  long,  time,  and accuracy
offsets sent as a packed blob of 10.5 bytes per point -->
<xs:element name="pathHistoryPointSets-08" >
   <xs:complexType><xs:simpleContent>
      <xs:extension base="pathHistoryPointSets-08-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
  </xs:simpleContent></xs:complexType>
</xs:element>
<!-- made up of sets of the: PathHistoryPointType-08
sets of the following data elements:
lat,  long,  and time
offsets sent as a packed blob of 7 bytes per point -->
```

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```
                  <xs:element name="pathHistoryPointSets-09" >
                     <xs:complexType><xs:simpleContent>
                        <xs:extension base="pathHistoryPointSets-09-string" >
                           <xs:attribute name="EncodingType" use="required">
                             <xs:simpleType>
                                <xs:restriction base="xs:NMTOKEN">
                                   <xs:enumeration value="base64Binary"/>
                                </xs:restriction>
                             </xs:simpleType>
                           </xs:attribute>
                        </xs:extension>
                    </xs:simpleContent> </xs:complexType>
                  </xs:element>
                  <!-- made up of sets of the: PathHistoryPointType-09
                  sets of the following data elements:
                  lat,  long,  and accuracy
                  offsets sent as a packed blob of 8.5 bytes per point -->
                  <xs:element name="pathHistoryPointSets-10" >
                     <xs:complexType><xs:simpleContent>
                        <xs:extension base="pathHistoryPointSets-10-string" >
                           <xs:attribute name="EncodingType" use="required">
                             <xs:simpleType>
                                <xs:restriction base="xs:NMTOKEN">
                                   <xs:enumeration value="base64Binary"/>
                                </xs:restriction>
                             </xs:simpleType>
                           </xs:attribute>
                        </xs:extension>
                     </xs:simpleContent></xs:complexType>
                  </xs:element>
                  <!-- made up of sets of the: PathHistoryPointType-10
                  sets of the following data elements:
                  lat and long
                  offsets sent as a packed blob of 4.5 bytes per point -->
               </xs:choice>
            </xs:complexType>
         </xs:element>
         <xs:element name="localPathHistory" type="local:PathHistory" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>

                  <xs:simpleType name="pathHistoryPointSets-02-string">
                     <xs:restriction base="xs:base64Binary">
                        <xs:minLength value="20"/>
                        <xs:maxLength value="460"/>
                     </xs:restriction>
                  </xs:simpleType >
                  <xs:simpleType name="pathHistoryPointSets-03-string">
                     <xs:restriction base="xs:base64Binary">
                        <xs:minLength value="16"/>
                        <xs:maxLength value="368"/>
                     </xs:restriction>
                  </xs:simpleType >
                  <xs:simpleType name="pathHistoryPointSets-04-string">
                     <xs:restriction base="xs:base64Binary">
                        <xs:minLength value="11"/>
                        <xs:maxLength value="246"/>
                     </xs:restriction>
                  </xs:simpleType >
                  <xs:simpleType name="pathHistoryPointSets-05-string">
                     <xs:restriction base="xs:base64Binary">
```

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```
            <xs:minLength value="14"/>
            <xs:maxLength value="307"/>
         </xs:restriction>
      </xs:simpleType >
      <xs:simpleType name="pathHistoryPointSets-06-string">
         <xs:restriction base="xs:base64Binary">
            <xs:minLength value="8"/>
            <xs:maxLength value="184"/>
         </xs:restriction>
      </xs:simpleType >
      <xs:simpleType name="pathHistoryPointSets-07-string">
         <xs:restriction base="xs:base64Binary">
            <xs:minLength value="15"/>
            <xs:maxLength value="323"/>
         </xs:restriction>
      </xs:simpleType >
      <xs:simpleType name="pathHistoryPointSets-08-string">
         <xs:restriction base="xs:base64Binary">
            <xs:minLength value="10"/>
            <xs:maxLength value="215"/>
         </xs:restriction>
      </xs:simpleType >
      <xs:simpleType name="pathHistoryPointSets-09-string">
         <xs:restriction base="xs:base64Binary">
            <xs:minLength value="12"/>
            <xs:maxLength value="266"/>
         </xs:restriction>
      </xs:simpleType >
      <xs:simpleType name="pathHistoryPointSets-10-string">
         <xs:restriction base="xs:base64Binary">
            <xs:minLength value="7"/>
            <xs:maxLength value="139"/>
         </xs:restriction>
      </xs:simpleType >
```

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Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleSafetyExtension	<ASN>	<XML>, and
MSG	MSG_IntersectionCollisionAvoidance (ICA)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: Sets of octets in paths will be packed bit shifted and aligned such that no unused bits are created. This will require shifting every odd history point by 4 bits for those data sets that do not end on an even byte boundary (those with no elevation entry). The very last four bits of the very last byte of the last point shall be filled with zeros if it does not end on a byte boundary.

6.63 Data Frame: DF_PathHistoryPointType-01

Use: The PathHistoryPointType-1 data frame one of a set of related items to carry prior position data (typically vehicle trials). In use, sequences of this data set are sent (one per point). In this data frame each element is delimited by tags, in other variants the data is expressed in a single octet blob.

ASN.1 Representation:

```
PathHistoryPointType-01 ::= SEQUENCE {
   latOffset  INTEGER (-131072..131071),
              -- in 1/10th micro degrees
              -- value  131071 to be used for  131071 or greater
```

```
            -- value -131071 to be used for -131071 or less
            -- value -131072 to be used for unavailable lat or long

   longOffset INTEGER (-131072..131071),
            -- in 1/10th micro degrees
            -- value  131071 to be used for  131071 or greater
            -- value -131071 to be used for -131071 or less
            -- value -131072 to be used for unavailable lat or long

    elevationOffset INTEGER (-2048..2047) OPTIONAL,
            -- LSB units of of 10 cm
            -- value  2047 to be used for  2047 or greater
            -- value -2047 to be used for -2047 or greater
            -- value -2048 to be unavailable

    timeOffset INTEGER (1..65535) OPTIONAL,
            -- LSB units of of 10 mSec
            -- value  65534 to be used for 65534 or greater
            -- value  65535 to be unavailable

    posAccuracy PositionalAccuracy OPTIONAL,
            -- four packed bytes

    heading    INTEGER (-128..127) OPTIONAL,
            -- where the LSB is in
            -- units of 1.5 degrees
            -- value -128 for unavailable
            -- not an offset value

    speed      TransmissionAndSpeed  OPTIONAL
            -- upper bits encode transmission
            -- where the LSB is in
            -- units of 0.02 m/s
            -- not an offset value
   }
```

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XML Representation:

```
<xs:complexType name="PathHistoryPointType-01" >
      <xs:sequence>
         <xs:element name="latOffset" >
            <xs:simpleType>
               <xs:restriction base="xs:int">
                  <xs:minInclusive value="-131072"/>
                  <xs:maxInclusive value="131071"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- in 1/10th micro degrees
         value  131071 to be used for  131071 or greater
         value -131071 to be used for -131071 or less
         value -131072 to be used for unavailable lat or long -->
         <xs:element name="longOffset" >
            <xs:simpleType>
               <xs:restriction base="xs:int">
                  <xs:minInclusive value="-131072"/>
                  <xs:maxInclusive value="131071"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- in 1/10th micro degrees
         value  131071 to be used for  131071 or greater
```

```
        value -131071 to be used for -131071 or less
        value -131072 to be used for unavailable lat or long -->
        <xs:element name="elevationOffset"  minOccurs="0">
           <xs:simpleType>
              <xs:restriction base="xs:short">
                 <xs:minInclusive value="-2048"/>
                 <xs:maxInclusive value="2047"/>
              </xs:restriction>
           </xs:simpleType>
        </xs:element>
        <!-- LSB units of of 10 cm
        value  2047 to be used for  2047 or greater
        value -2047 to be used for -2047 or greater
        value -2048 to be unavailable -->
        <xs:element name="timeOffset"  minOccurs="0">
           <xs:simpleType>
              <xs:restriction base="xs:unsignedShort">
                 <xs:minInclusive value="1"/>
              </xs:restriction>
           </xs:simpleType>
        </xs:element>
        <!-- LSB units of of 10 mSec
        value  65534 to be used for 65534 or greater
        value  65535 to be unavailable -->
        <xs:element name="posAccuracy" type="PositionalAccuracy"  minOccurs="0"/>
        <!-- four packed bytes -->
        <xs:element name="heading"  minOccurs="0">
           <xs:simpleType>
              <xs:restriction base="xs:byte">
                 <xs:minInclusive value="-128"/>
              </xs:restriction>
           </xs:simpleType>
        </xs:element>
        <!-- where the LSB is in
        units of 1.5 degrees
        value -128 for unavailable
        not an offset value -->
        <xs:element name="speed" type="TransmissionAndSpeed"  minOccurs="0"/>
        <!-- upper bits encode transmission
        where the LSB is in
        units of 0.02 m/s
        not an offset value -->
     </xs:sequence>
</xs:complexType>
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_PathHistory <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.64 Data Element: DF_PathHistoryPointType-02

Use: The PathHistoryPointType-2 data element is one of a set of related items to carry past position data (typically vehicle trails). In use, sequences of this data set are sent (one per data point), typically combined into a single final octet string.

ASN.1 Representation:

```
PathHistoryPointType-02 ::= OCTET STRING (SIZE(15))
   -- To be made up of packed bytes as follows:
   -- latOffset  INTEGER (-131072..131071) (18 signed bits)
   -- longOffset INTEGER (-131072..131071) (18 signed bits)
    -- in 1/10th micro degrees
```

```
-- value  131071 to be used for  131071 or greater
-- value -131071 to be used for -131071 or less
-- value -131072 to be used for unavailable lat or long

-- elevationOffset    INTEGER (-2048..2047), (12 signed bits)
-- LSB units of 10 cm
-- value  2047 to be used for  2047 or greater
-- value -2047 to be used for -2047 or greater
-- value -2048 to be unavailable

-- timeOffset INTEGER (0..65535), (16 unsigned bits)
-- LSB units of of 10 mSec
-- value  65534 to be used for 65534 or greater
-- value  65535 to be unavailable

-- accuracy   PositionalAccuracy
-- four packed bytes

-- heading    INTEGER (-128..127), (8 signed bits)
-- where the LSB is in
-- units of 1.5 degrees
-- value -128 for unavailable
-- not an offset value

-- speed      TransmissionAndSpeed (16 encoded bits)
-- upper bits encode transmission
-- where the LSB is in
-- units of 0.02 m/s
-- not an offset value
```

XML Representation:

```
<xs:complexType name="PathHistoryPointType-02" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            To be made up of packed bytes as follows:
            latOffset  INTEGER  (-131072..131071)   (18 signed bits)
            longOffset INTEGER  (-131072..131071)   (18 signed bits)
            in 1/10th micro degrees
            value  131071 to be used for  131071 or greater
            value -131071 to be used for -131071 or less
            value -131072 to be used for unavailable lat or long
            elevationOffset    INTEGER  (-2048..2047) ,   (12 signed bits)
            LSB units of 10 cm
            value  2047 to be used for  2047 or greater
            value -2047 to be used for -2047 or greater
            value -2048 to be unavailable
            timeOffset INTEGER  (0..65535) ,   (16 unsigned bits)
            LSB units of of 10 mSec
            value  65534 to be used for 65534 or greater
            value  65535 to be unavailable
            accuracy   PositionalAccuracy
            four packed bytes
            heading    INTEGER  (-128..127) ,   (8 signed bits)
            where the LSB is in
            units of 1.5 degrees
            value -128 for unavailable
            not an offset value
            speed      TransmissionAndSpeed  (16 encoded bits)
            upper bits encode transmission
            where the LSB is in
```

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```
            units of 0.02 m/s
            not an offset value
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="PathHistoryPointType-02-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="PathHistoryPointType-02-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="20"/>
   </xs:restriction>
</xs:simpleType >
```

Remarks: The delta units used in the latOffset and Long offset are 1/10th micro degrees from the anchor point given by the full position vector. The delta units used in the elevationOffset are 10 cm from the elevation of the full position vector. The delta units of time used in the time offset are unsigned 10 mSec. The delta units used in the heading are units of 1.2 deg. The delta units used in the speed are unsigned units of 0.02 m/Sec.

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6.65 Data Element: DF_PathHistoryPointType-03

Use: The PathHistoryPointType-3 data element is one of a set of related items to carry past position data (typically vehicle trails). In use, sequences of this data set are sent (one per data point), typically combined into a single final octet string.

ASN.1 Representation:

```
PathHistoryPointType-03 ::= OCTET STRING (SIZE(12))
   -- To be made up of packed bytes as follows:
   -- latOffset  INTEGER (-131072..131071) (18 signed bits)
   -- longOffset INTEGER (-131072..131071) (18 signed bits)
    -- in 1/10th micro degrees
    -- value  131071 to be used for  131071 or greater
    -- value -131071 to be used for -131071 or less
    -- value -131072 to be used for unavailable lat or long

   -- elevationOffset    INTEGER (-2048..2047), (12 signed bits)
    -- LSB units of 10 cm
    -- value  2047 to be used for  2047 or greater
    -- value -2047 to be used for -2047 or greater
    -- value -2048 to be unavailable

   -- timeOffset INTEGER (0..65535), (16 unsigned bits)
    -- LSB units of of 10 mSec
    -- value  65534 to be used for 65534 or greater
    -- value  65535 to be unavailable

   -- accuracy   PositionalAccuracy
    -- four packed bytes
```

XML Representation:

```
<xs:complexType name="PathHistoryPointType-03" >
   <xs:simpleContent>
      <xs:annotation>
```

```
         <xs:documentation>
            To be made up of packed bytes as follows:
            latOffset  INTEGER  (-131072..131071)   (18 signed bits)
            longOffset INTEGER  (-131072..131071)   (18 signed bits)
            in 1/10th micro degrees
            value  131071 to be used for  131071 or greater
            value -131071 to be used for -131071 or less
            value -131072 to be used for unavailable lat or long
            elevationOffset    INTEGER  (-2048..2047) ,   (12 signed bits)
            LSB units of 10 cm
            value  2047 to be used for  2047 or greater
            value -2047 to be used for -2047 or greater
            value -2048 to be unavailable
            timeOffset INTEGER  (0..65535) ,   (16 unsigned bits)
            LSB units of of 10 mSec
            value  65534 to be used for 65534 or greater
            value  65535 to be unavailable
            accuracy   PositionalAccuracy
            four packed bytes
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="PathHistoryPointType-03-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="PathHistoryPointType-03-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="16"/>
   </xs:restriction>
</xs:simpleType >
```

Remarks: The delta units used in the latOffset and Long offset are 1/10th micro degrees from the anchor point given by the full position vector. The delta units used in the elevationOffset are 10 cm from the elevation of the full position vector. The delta units of time used in the time offset are unsigned 10 mSec.

6.66 Data Element: DF_PathHistoryPointType-04

Use: The PathHistoryPointType-4 data element is one of a set of related items to carry past position data (typically vehicle trails). In use, sequences of this data set are sent (one per data point), typically combined into a single final octet string.

ASN.1 Representation:

```
PathHistoryPointType-04 ::= OCTET STRING (SIZE(8))
   -- To be made up of packed bytes as follows:
   -- latOffset  INTEGER (-131072..131071) (18 signed bits)
   -- longOffset INTEGER (-131072..131071) (18 signed bits)
    -- in 1/10th micro degrees
    -- value  131071 to be used for  131071 or greater
    -- value -131071 to be used for -131071 or less
    -- value -131072 to be used for unavailable lat or long

   -- elevationOffset    INTEGER (-2048..2047), (12 signed bits)
    -- LSB units of 10 cm
```

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```
    -- value  2047 to be used for  2047 or greater
    -- value -2047 to be used for -2047 or greater
    -- value -2048 to be unavailable

   -- timeOffset INTEGER (0..65535), (16 unsigned bits)
    -- LSB units of of 10 mSec
    -- value  65534 to be used for 65534 or greater
    -- value  65535 to be unavailable
```

XML Representation:

```
<xs:complexType name="PathHistoryPointType-04" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            To be made up of packed bytes as follows:
            latOffset  INTEGER  (-131072..131071)   (18 signed bits)
            longOffset INTEGER  (-131072..131071)   (18 signed bits)
            in 1/10th micro degrees
            value  131071 to be used for  131071 or greater
            value -131071 to be used for -131071 or less
            value -131072 to be used for unavailable lat or long
            elevationOffset    INTEGER  (-2048..2047) ,   (12 signed bits)
            LSB units of 10 cm
            value  2047 to be used for  2047 or greater
            value -2047 to be used for -2047 or greater
            value -2048 to be unavailable
            timeOffset INTEGER  (0..65535) ,   (16 unsigned bits)
            LSB units of of 10 mSec
            value  65534 to be used for 65534 or greater
            value  65535 to be unavailable
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="PathHistoryPointType-04-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="PathHistoryPointType-04-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="11"/>
   </xs:restriction>
</xs:simpleType >
```

Remarks: The delta units used in the latOffset and Long offset are 1/10th micro degrees from the anchor point given by the full position vector. The delta units used in the elevationOffset are 10 cm from the elevation of the full position vector. The delta units of time used in the time offset are unsigned 10 mSec.

6.67 Data Element: DF_PathHistoryPointType-05

Use: The PathHistoryPointType-5 data element is one of a set of related items to carry past position data (typically vehicle trails). In use, sequences of this data set are sent (one per data point), typically combined into a single final octet string.

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ASN.1 Representation:

```
PathHistoryPointType-05 ::= OCTET STRING (SIZE(10))
   -- To be made up of packed bytes as follows:
   -- latOffset  INTEGER (-131072..131071) (18 signed bits)
   -- longOffset INTEGER (-131072..131071) (18 signed bits)
    -- in 1/10th micro degrees
    -- value  131071 to be used for  131071 or greater
    -- value -131071 to be used for -131071 or less
    -- value -131072 to be used for unavailable lat or long

   -- elevationOffset    INTEGER (-2048..2047), (12 signed bits)
    -- LSB units of 10 cm
    -- value  2047 to be used for  2047 or greater
    -- value -2047 to be used for -2047 or greater
    -- value -2048 to be unavailable

   -- accuracy   PositionalAccuracy
    -- four packed bytes
```

XML Representation:

```
<xs:complexType name="PathHistoryPointType-05" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            To be made up of packed bytes as follows:
            latOffset  INTEGER  (-131072..131071)   (18 signed bits)
            longOffset INTEGER  (-131072..131071)   (18 signed bits)
            in 1/10th micro degrees
            value  131071 to be used for  131071 or greater
            value -131071 to be used for -131071 or less
            value -131072 to be used for unavailable lat or long
            elevationOffset    INTEGER  (-2048..2047) ,   (12 signed bits)
            LSB units of 10 cm
            value  2047 to be used for  2047 or greater
            value -2047 to be used for -2047 or greater
            value -2048 to be unavailable
            accuracy   PositionalAccuracy
            four packed bytes
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="PathHistoryPointType-05-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="PathHistoryPointType-05-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="14"/>
   </xs:restriction>
</xs:simpleType >
```

Remarks: The delta units used in the latOffset and Long offset are 1/10th micro degrees from the anchor point given by the full position vector. The delta units used in the elevationOffset are 10 cm from the elevation of the full position vector.

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6.68 Data Element: DF_PathHistoryPointType-06

Use: The PathHistoryPointType-6 data element is one of a set of related items to carry past position data (typically vehicle trails). In use, sequences of this data set are sent (one per data point), typically combined into a single final octet string.

ASN.1 Representation:

```
PathHistoryPointType-06 ::= OCTET STRING (SIZE(6))
   -- To be made up of packed bytes as follows:
   -- latOffset  INTEGER (-131072..131071) (18 signed bits)
   -- longOffset INTEGER (-131072..131071) (18 signed bits)
    -- in 1/10th micro degrees
    -- value  131071 to be used for  131071 or greater
    -- value -131071 to be used for -131071 or less
    -- value -131072 to be used for unavailable lat or long

   -- elevationOffset    INTEGER (-2048..2047), (12 signed bits)
    -- LSB units of 10 cm
    -- value  2047 to be used for  2047 or greater
    -- value -2047 to be used for -2047 or greater
    -- value -2048 to be unavailable
```

XML Representation:

```
<xs:complexType name="PathHistoryPointType-06" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            To be made up of packed bytes as follows:
            latOffset  INTEGER  (-131072..131071)   (18 signed bits)
            longOffset INTEGER  (-131072..131071)   (18 signed bits)
            in 1/10th micro degrees
            value  131071 to be used for  131071 or greater
            value -131071 to be used for -131071 or less
            value -131072 to be used for unavailable lat or long
            elevationOffset    INTEGER  (-2048..2047) ,   (12 signed bits)
            LSB units of 10 cm
            value  2047 to be used for  2047 or greater
            value -2047 to be used for -2047 or greater
            value -2048 to be unavailable
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="PathHistoryPointType-06-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="PathHistoryPointType-06-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="8"/>
   </xs:restriction>
</xs:simpleType >
```

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Remarks: The delta units used in the latOffset and Long offset are 1/10th micro degrees from the anchor point given by the full position vector. The delta units used in the elevationOffset are 10 cm from the elevation of the full position vector.

6.69 Data Element: DF_PathHistoryPointType-07

Use: The PathHistoryPointType-7 data element is one of a set of related items to carry past position data (typically vehicle trails). In use, sequences of this data set are sent (one per data point), typically combined into a single final octet string.

ASN.1 Representation:
```
PathHistoryPointType-07 ::= OCTET STRING (SIZE(11)) -- in fact 10.5
   -- To be made up of packed bytes as follows:
   -- latOffset  INTEGER (-131072..131071) (18 signed bits)
   -- longOffset INTEGER (-131072..131071) (18 signed bits)
    -- in 1/10th micro degrees
    -- value  131071 to be used for  131071 or greater
    -- value -131071 to be used for -131071 or less
    -- value -131072 to be used for unavailable lat or long

   -- timeOffset INTEGER (0..65535), (16 unsigned bits)
    -- LSB units of of 10 mSec
    -- value  65534 to be used for 65534 or greater
    -- value  65535 to be unavailable

   -- accuracy   PositionalAccuracy
    -- four packed bytes
```

XML Representation:
```
<xs:complexType name="PathHistoryPointType-07" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            in fact 10.5
            To be made up of packed bytes as follows:
            latOffset  INTEGER  (-131072..131071)   (18 signed bits)
            longOffset INTEGER  (-131072..131071)   (18 signed bits)
            in 1/10th micro degrees
            value  131071 to be used for  131071 or greater
            value -131071 to be used for -131071 or less
            value -131072 to be used for unavailable lat or long
            timeOffset INTEGER  (0..65535) ,   (16 unsigned bits)
            LSB units of of 10 mSec
            value  65534 to be used for 65534 or greater
            value  65535 to be unavailable
            accuracy   PositionalAccuracy
            four packed bytes
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="PathHistoryPointType-07-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
```

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```
<xs:simpleType name="PathHistoryPointType-07-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="15"/>
   </xs:restriction>
</xs:simpleType >
```

Remarks: The delta units used in the latOffset and Long offset are 1/10th micro degrees from the anchor point given by the full position vector. The delta units of time used in the time offset are unsigned 10 mSec.

6.70 Data Element: DF_PathHistoryPointType-08

Use: The PathHistoryPointType-8 data element is one of a set of related items to carry past position data (typically vehicle trails). In use, sequences of this data set are sent (one per data point), typically combined into a single final octet string.

ASN.1 Representation:
```
PathHistoryPointType-08 ::= OCTET STRING (SIZE(7)) -- in fact 6.5
   -- To be made up of packed bytes as follows:
   -- latOffset  INTEGER (-131072..131071) (18 signed bits)
   -- longOffset INTEGER (-131072..131071) (18 signed bits)
    -- in 1/10th micro degrees
    -- value  131071 to be used for  131071 or greater
    -- value -131071 to be used for -131071 or less
    -- value -131072 to be used for unavailable lat or long

   -- timeOffset INTEGER (0..65535), (16 unsigned bits)
    -- LSB units of of 10 mSec
    -- value  65534 to be used for 65534 or greater
    -- value  65535 to be unavailable
```

XML Representation:
```
<xs:complexType name="PathHistoryPointType-08" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            in fact 6.5
            To be made up of packed bytes as follows:
            latOffset  INTEGER  (-131072..131071)   (18 signed bits)
            longOffset INTEGER  (-131072..131071)   (18 signed bits)
            in 1/10th micro degrees
            value  131071 to be used for  131071 or greater
            value -131071 to be used for -131071 or less
            value -131072 to be used for unavailable lat or long
            timeOffset INTEGER  (0..65535) ,   (16 unsigned bits)
            LSB units of of 10 mSec
            value  65534 to be used for 65534 or greater
            value  65535 to be unavailable
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="PathHistoryPointType-08-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
```

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```
            <xs:enumeration value="base64Binary"/>
         </xs:restriction>
      </xs:simpleType>
    </xs:attribute>
  </xs:extension>
</xs:simpleContent>
</xs:complexType>
<xs:simpleType name="PathHistoryPointType-08-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="10"/>
   </xs:restriction>
</xs:simpleType >
```

Remarks: The delta units used in the latOffset and Long offset are 1/10th micro degrees from the anchor point given by the full position vector. The delta units of time used in the time offset are unsigned 10 mSec.

6.71 Data Element: DF_PathHistoryPointType-09

Use: The PathHistoryPointType-9 data element is one of a set of related items to carry past position data (typically vehicle trails). In use, sequences of this data set are sent (one per data point), typically combined into a single final octet string.

ASN.1 Representation:

```
PathHistoryPointType-09 ::= OCTET STRING (SIZE(9)) -- in fact 8.5
   -- To be made up of packed bytes as follows:
   -- latOffset  INTEGER (-131072..131071) (18 signed bits)
   -- longOffset INTEGER (-131072..131071) (18 signed bits)
    -- in 1/10th micro degrees
    -- value  131071 to be used for  131071 or greater
    -- value -131071 to be used for -131071 or less
    -- value -131072 to be used for unavailable lat or long

   -- accuracy   PositionalAccuracy
    -- four packed bytes
```

XML Representation:

```
<xs:complexType name="PathHistoryPointType-09" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            in fact 8.5
            To be made up of packed bytes as follows:
            latOffset   INTEGER  (-131072..131071)   (18 signed bits)
            longOffset INTEGER  (-131072..131071)   (18 signed bits)
            in 1/10th micro degrees
            value  131071 to be used for  131071 or greater
            value -131071 to be used for -131071 or less
            value -131072 to be used for unavailable lat or long
            accuracy   PositionalAccuracy
            four packed bytes
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="PathHistoryPointType-09-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
```

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```
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="PathHistoryPointType-09-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="12"/>
   </xs:restriction>
</xs:simpleType >
```

Remarks: The delta units used in the latOffset and Long offset are 1/10th micro degrees from the anchor point given by the full position vector.

6.72 Data Element: DF_PathHistoryPointType-10

Use: The PathHistoryPointType-10 data element is one of a set of related items to carry past position data (typically vehicle trails). In use, sequences of this data set are sent (one per data point), typically combined into a single final octet string.

ASN.1 Representation:

```
PathHistoryPointType-10 ::= OCTET STRING (SIZE(5))   -- in fact 4.5
   -- To be made up of packed bytes as follows:
   -- latOffset  INTEGER (-131072..131071) (18 signed bits)
   -- longOffset INTEGER (-131072..131071) (18 signed bits)
    -- in 1/10th micro degrees
    -- value  131071 to be used for  131071 or greater
    -- value -131071 to be used for -131071 or less
    -- value -131072 to be used for unavailable lat or long
```

XML Representation:

```
<xs:complexType name="PathHistoryPointType-10" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            in fact 4.5
            To be made up of packed bytes as follows:
            latOffset  INTEGER (-131072..131071)   (18 signed bits)
            longOffset INTEGER (-131072..131071)   (18 signed bits)
            in 1/10th micro degrees
            value  131071 to be used for  131071 or greater
            value -131071 to be used for -131071 or less
            value -131072 to be used for unavailable lat or long
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="PathHistoryPointType-10-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="PathHistoryPointType-10-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="7"/>
   </xs:restriction>
</xs:simpleType >
```

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Remarks: The delta units used in the latOffset and Long offset are 1/10th micro degrees from the anchor point given by the full position vector.

6.73 Data Frame: DF_PathPrediction

Use: The DF_PathPrediction data frame allows vehicles to share their predicted path trajectory by estimating future vehicle path of travel. This future trajectory estimation provides an indication of future positions of the transmitting vehicle and can significantly enhance in-lane and out-of-lane threat classification. Trajectories in the Path Prediction data element are represented, at a first order of curvature approximation, as a circle with a radius R and an origin located at (0,R), where the x-axis is bore sight from the transmitting vehicle's perspective and normal to the vehicle's vertical axis. The vehicle's (x,y,z) coordinate frame follows the SAE convention. Radius R will be positive for curvatures to the right when observed from the transmitting vehicle's perspective. Radii shall be capped at a maximum value supported by the Path Prediction radius data type. Overflow of this data type shall be interpreted by the receiving vehicle as "a straight path" prediction. The radius can be derived from a number of sources including, but not limited to, map databases, rate sensors, vision systems, and global positioning, the precise algorithm to be used is outside the scope of this document. In the case where the radius is derived from instantaneous vehicle information, such as rate sensors and velocity, and to minimize the effect sensor noise and "in-lane driver wandering", the resulting roadway radius estimation will have to be achieved by using low-pass filtering techniques (time constant typically >2s). To help distinguish between steady state and non-steady state conditions, a confidence factor is included in the data element to provide an indication of signal accuracy due to rapid change in driver input. When driver input is in steady state (straight roadways or curves with a constant radius of curvature), a high confidence value is reported. During non-steady state conditions (curve transitions, lane changes, etc.), signal confidence is reduced.

ASN.1 Representation:
```
PathPrediction ::= SEQUENCE {
   radiusOfCurve INTEGER (-32767..32767),
                 -- LSB units of 10cm
                 -- straight path to use value of 32767
   confidence    INTEGER (0..200),
                 -- LSB units of 0.5 percent

   ... -- # LOCAL_CONTENT
   }
```

XML Representation:
```
<xs:complexType name="PathPrediction" >
      <xs:sequence>
         <xs:element name="radiusOfCurve" >
            <xs:simpleType>
               <xs:restriction base="xs:short">
                  <xs:minInclusive value="-32767"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- LSB units of 10cm
         straight path to use value of 32767 -->
         <xs:element name="confidence" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte">
                  <xs:maxInclusive value="200"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- LSB units of 0.5 percent -->
         <xs:element name="localPathPrediction" type="local:PathPrediction"
minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleSafetyExtension <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.74 Data Frame: DF_Position3D_2

Use: A data concept which provides a precise location in the WGS-84 coordinate system from which short offsets may then be used to create additional data using a flat earth projection centered from this point. It is typically used in the description of maps and intersections as well as signs and traveler data. A collection of the two 4-byte lat-long information elements and the one 2 byte elevation used to build a complete 3D position set in 10 bytes.

ASN.1 Representation:
```
Position3D-2 ::= SEQUENCE {
   lat         Latitude,                -- in 1/10th micro degrees
   long        Longitude,               -- in 1/10th micro degrees
   elevation   Elevation2 OPTIONAL,     -- in 10 cm units
   regional    RegionalPosition3D OPTIONAL,
                                   -- regional extensions
   ...
   }
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_IntersectionGeometry CHANGED <ASN> <>, and

DF DF_RoadSegment CHANGED <ASN> <>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: When used to describe paths, all subsequent offset values are added ~~to~~ from this point (and thereafter from the prior point) or in order to determine the absolute position to be described. In some data structures more than one Position3D may be present. Data values are interpreted in a stream fashion. That is, until a new Position3D is read, the value for the last one is used as the basis for all offset values found in the same structure.

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6.75 Data Frame: DF_Position3D

Use: A data concept which provides a definitive and precise location in the WSG-84 coordinate system from which short offsets may then used to create additional data using a flat earth projection centered from this point.. Typically used in the description of maps and intersections as well as signs and traveler data. A collection of the two 4 byte lat-long information elements and the one 2 byte elevation used to build a complete 3D position set in 10 bytes.

ASN.1 Representation:
```
Position3D ::= SEQUENCE {
   lat          Latitude,    -- in 1/10th micro degrees
   long         Longitude,   -- in 1/10th micro degrees
   elevation    Elevation    OPTIONAL
   }
```

XML Representation:
```
<xs:complexType name="Position3D" >
      <xs:sequence>
         <xs:element name="lat" type="Latitude" />
         <!-- in 1/10th micro degrees -->
         <xs:element name="long" type="Longitude" />
         <!-- in 1/10th micro degrees -->
         <xs:element name="elevation" type="Elevation"  minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is directly used by the following 5 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_Circle	<ASN>	<XML>, and
DF	DF_RegionPointSet	<ASN>	<XML>, and
DF	DF_RoadSignID	<ASN>	<XML>, and
DF	DF_ShapePointSet	<ASN>	<XML>, and
MSG	MSG_TravelerInformation Message (TIM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: In use to describe paths, all subsequent offset values are added to this point in order to determine the absolute position to be described. In some data structures more than one Position3D may be present. Data values are interpreted in a stream fashion. That is, until a new Position3D is read, the value for the last one is used as the basis for all offset values found in the same structure.

6.76 Data Element: DF_PositionalAccuracy

Use: The DE_ Positional Accuracy element is a 4 octet field of packed data consisting of various parameters of quality used to model the accuracy of the positional determination with respect to each given axis. Note that because the 3 data elements are packed as one single data object, this is treated as a data frame.

ASN.1 Representation:
```
PositionalAccuracy ::= OCTET STRING (SIZE(4))
  -- And the bytes defined as folllows

  -- Byte 1: semi-major accuracy at one standard dev
  -- range 0-12.7 meter, LSB = .05m
  -- 0xFE=254=any value equal or greater than 12.70 meter
  -- 0xFF=255=unavailable semi-major value

  -- Byte 2: semi-minor accuracy at one standard dev
  -- range 0-12.7 meter, LSB = .05m
  -- 0xFE=254=any value equal or greater than 12.70 meter
  -- 0xFF=255=unavailable semi-minor value

  -- Bytes 3-4: orientation of semi-major axis
  -- relative to true north (0~359.9945078786 degrees)
  -- LSB units of 360/65535 deg  = 0.0054932479
  -- a value of 0x0000 =0 shall be 0 degrees
  -- a value of 0x0001 =1 shall be 0.0054932479degrees
  -- a value of 0xFFFE =65534 shall be 359.9945078786 deg
  -- a value of 0xFFFF =65535 shall be used for orientation unavailable
  -- (In NMEA GPGST)
```

XML Representation:
```
<xs:complexType name="PositionalAccuracy" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            And the bytes defined as folllows
            Byte 1: semi-major accuracy at one standard dev
            range 0-12.7 meter,  LSB = .05m
            0xFE=254=any value equal or greater than 12.70 meter
            0xFF=255=unavailable semi-major value
```

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```
            Byte 2: semi-minor accuracy at one standard dev
            range 0-12.7 meter,  LSB = .05m
            0xFE=254=any value equal or greater than 12.70 meter
            0xFF=255=unavailable semi-minor value
            Bytes 3-4: orientation of semi-major axis
            relative to true north  (0~359.9945078786 degrees)
            LSB units of 360/65535 deg  = 0.0054932479
            a value of 0x0000 =0 shall be 0 degrees
            a value of 0x0001 =1 shall be 0.0054932479degrees
            a value of 0xFFFE =65534 shall be 359.9945078786 deg
            a value of 0xFFFF =65535 shall be used for orientation unavailable
            (In NMEA GPGST)
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="PositionalAccuracy-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="PositionalAccuracy-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="6"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_FullPositionVector	<ASN>	<XML>, and
DF	DF_PathHistoryPointType-01	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_Verbose (VBSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

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6.77 Data Element: DF_PositionConfidenceSet

Use: A single byte long data frame combining multiple related bit fields into one byte.

ASN.1 Representation:

```
PositionConfidenceSet ::= OCTET STRING (SIZE(1))
-- To be encoded as:
-- SEQUENCE {
--    pos         PositionConfidence,
--                -x- 4 bits, for both horizontal directions
--    elevation   ElevationConfidence
--                -x- 4 bits
--    }
```

XML Representation:

```
<xs:complexType name="PositionConfidenceSet" >
   <xs:simpleContent>
      <xs:annotation>
```

```
         <xs:documentation>
            To be encoded as:
            SEQUENCE  {
            pos          PositionConfidence,
            -x- 4 bits,  for both horizontal directions
            elevation   ElevationConfidence
            -x- 4 bits
            }
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="PositionConfidenceSet-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="PositionConfidenceSet-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="2"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_ConfidenceSet	<ASN>	<XML>, and
DF	DF_FullPositionVector	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

6.78 Data Frame: DF_PreemptPriorityList

Use: The PreemptPriorityList data frame consists of a list of RegionalSignalControlZone entries.

ASN.1 Representation:

```
PreemptPriorityList ::= SEQUENCE (SIZE(1..32)) OF RegionalSignalControlZone
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_IntersectionGeometry CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.79 Data Frame: DF_Regional_AdvisorySpeed

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:

```
RegionalAdvisorySpeed ::= REGION.Reg-AdvisorySpeed
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_AdvisorySpeed <ASN> <>.

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6.80 Data Frame: DF_Regional_ComputedLane

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalComputedLane ::= REGION.Reg-ComputedLane
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ComputedLane CHANGED <ASN> <>.

6.81 Data Frame: DF_Regional_ConnectionManeuverAssist

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalConnectionManeuverAssist ::= REGION.Reg-ConnectionManeuverAssist
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ConnectionManeuverAssist <ASN> <>.

6.82 Data Frame: DF_Regional_GenericLane

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalGenericLane ::= REGION.Reg-GenericLane
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_GenericLane CHANGED <ASN> <>.

6.83 Data Frame: DF_Regional_Intersection

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalIntersection ::= REGION.Reg-Intersection
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_IntersectionGeometry CHANGED <ASN> <>.

6.84 Data Frame: DF_Regional_IntersectionState

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalIntersectionState ::= REGION.Reg-IntersectionState
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_IntersectionState CHANGED <ASN> <>.

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6.85 Data Frame: DF_Regional_LaneDataAttribute

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalLaneDataAttribute ::= REGION.Reg-LaneDataAttribute
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneDataAttribute <ASN> <>.

6.86 Data Frame: DF_Regional_MapData

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalMapData ::= REGION.Reg-MapData
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_MapData (MAP) <ASN> <>.

6.87 Data Frame: DF_Regional_MovementEvent

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalMovementEvent ::= REGION.Reg-MovementEvent
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_MovementEvent CHANGED <ASN> <>.

6.88 Data Frame: DF_Regional_MovementState

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalMovementState ::= REGION.Reg-MovementState
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_MovementState <ASN> <>.

6.89 Data Frame: DF_Regional_NodeOffsetPoint

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalNodeOffsetPoint ::= REGION.Reg-NodeOffsetPoint
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeOffsetPoint <ASN> <>.

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6.90 Data Frame: DF_Regional_Position3D

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalPosition3D ::= REGION.Reg-Position3D
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Position3D_2 CHANGED <ASN> <>.

6.91 Data Frame: DF_Regional_RegionalLaneAttributes

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalLaneAttributes ::= REGION.Reg-LaneAttributes
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneAttributes <ASN> <>.

6.92 Data Frame: DF_Regional_RegionalNodeAttribute

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalNodeAttribute ::= REGION.Reg-NodeAttribute
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RegionalNodeAttributeList <ASN> <>.

6.93 Data Frame: DF_Regional_RestrictionUserType

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalRestrictionUserType ::= REGION.Reg-RestrictionUserType
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RestrictionUserType <ASN> <>.

6.94 Data Frame: DF_Regional_RoadSegment

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalRoadSegment ::= REGION.Reg-RoadSegment
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RoadSegment CHANGED <ASN> <>.

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6.95 Data Frame: DF_Regional_SignalControlZone

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalSignalControlZone ::= REGION.Reg-SignalControlZone
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_PreemptPriorityList <ASN> <>.

6.96 Data Frame: DF_Regional_SPAT

Use: The regional extension of this data frame. Used to allow each region to define additional content for a given data frame to suit regional needs, if required.

ASN.1 Representation:
```
RegionalSPAT ::= REGION.Reg-SPAT
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_SignalPhaseAndTiming Message (SPAT) <ASN> <>.

6.97 Data Frame: DF_RegionalNodeAttributeList

Use: The RegionalNodeAttributeList data frame consists of a list of RegionalNodeAttribute entries.

ASN.1 Representation:
```
RegionalNodeAttributeList ::= SEQUENCE (SIZE(1..8)) OF RegionalNodeAttribute
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeAttributeSet <ASN> <>.

6.98 Data Frame: DF_RegionList

Use: The DF_RegionList data structure provides the sequence of signed offset values for determining the Xs and Ys (and, possibly Zs when present) using the then current Position3D object to build a path to enclose a region.

ASN.1 Representation:
```
RegionList ::= SEQUENCE (SIZE(1..64)) OF RegionOffsets
   -- the Position3D ref point (starting point or anchor)
   -- is found in the outer object.
```

XML Representation:
```
<xs:complexType name="RegionList" >
      <xs:sequence minOccurs="1" maxOccurs="64">
         <xs:element name="region" type="RegionOffsets" />
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RegionPointSet <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: When describing a path, subsequent nodes provide points further and further away along the developed line. Include as many point as necessary to characterize curvature "within tolerance."

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6.99 Data Frame: DF_RegionOffsets

Use: The RegionOffsetsdata structure provides one set of signed offset values for determining the Xs and Ys (and, possibly Zs when present) using the then current ReferencePoint object to build a single point in a path. Typically is it used to describe large enclosed regions.

ASN.1 Representation:
```
RegionOffsets ::= SEQUENCE {
   xOffset  INTEGER (-32767..32767),
   yOffset  INTEGER (-32767..32767),
   zOffset  INTEGER (-32767..32767) OPTIONAL
            -- all in signed values where
            -- the LSB is in units of 1 meter
   }
```

XML Representation:
```
<xs:complexType name="RegionOffsets" >
      <xs:sequence>
         <xs:element name="xOffset" >
            <xs:simpleType>
               <xs:restriction base="xs:short">
                  <xs:minInclusive value="-32767"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="yOffset" >
            <xs:simpleType>
               <xs:restriction base="xs:short">
                  <xs:minInclusive value="-32767"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="zOffset"  minOccurs="0">
            <xs:simpleType>
               <xs:restriction base="xs:short">
                  <xs:minInclusive value="-32767"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- all in signed values where
         the LSB is in units of 1 meter -->
      </xs:sequence>
</xs:complexType>
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RegionList <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that while latitude and longitude and elevation values are provided in the reference point with respect to the common geoid, these offsets are given in absolute distance (units of 1 meter) of offset. When a value for zOffset is given, that value persists until changed again for additional nodes in the list.

6.100 Data Frame: DF_RegionPointSet

Use: The DF_RegionPointSet DF is used to represent or describe an enclosed region. It is typically employed to define a region where signs or advisories would be valid.

ASN.1 Representation:
```
RegionPointSet ::= SEQUENCE {
   anchor             Position3D  OPTIONAL,
   nodeList           RegionList,
                      -- path details of the regions outline
   ...
   }
```

XML Representation:
```
<xs:complexType name="RegionPointSet" >
      <xs:sequence>
         <xs:element name="anchor" type="Position3D"  minOccurs="0"/>
         <xs:element name="nodeList" type="RegionList" />
         <!-- path details of the regions outline -->
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ValidRegion <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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6.101 Data Frame: DF_RegulatorySpeedLimit

Use: The DF_RegulatorySpeedLimit data frame is used to convey a regulatory speed about a lane, lanes, or roadway segment.

ASN.1 Representation:
```
RegulatorySpeedLimit ::= SEQUENCE {
   type         SpeedLimitType,
                -- The type of regulatory speed which follows
   speed        Velocity
                -- The speed in units of 0.02 m/s
                -- when expressed in MPH this shall be rounded
                -- to the closest integer value
                -- See Remarks under the SpeedAdvice entry for
                -- converting and transmitting a speed expressed
                -- in MPH to units of 0.1 m/s
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_SpeedLimitList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.102 Data Frame: DF_RestrictionClassAssignment

Use: The RestrictionClassAssignment data frame is used to assign (or bind) a single *RestrictionClassID* data element to a list of all user classes to which it applies. A collection of these bindings is conveyed in the *RestrictionClassList* data frame in the MAP message to travelers. The established index is then used in the lane object of the MAP messages, in the *ConnectTo* data frame, to qualify to whom a signal group ID applies when it is sent by the SPAT message about a movement.

ASN.1 Representation:
```
RestrictionClassAssignment ::= SEQUENCE {
   id       RestrictionClassID,
            -- the unique value (within an intersection or local region)
```

```
            -- that is assigned to this group of users
   users    RestrictionUserTypeList
            -- The list of user types/classes
            -- to which this restriction ID applies
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RestrictionClassList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The overall RestrictionClass assignment process allows dynamic support within the framework of the common message set for the various special cases that some signalized intersections must support. While the assigned value needs to be unique only within the scope of the intersection that uses it, the resulting assignment lists will tend to be static and stable for regional deployment areas such as a metropolitan area based on their operational practices and needs.

6.103 Data Frame: DF_RestrictionClassList

Use: The RestrictionClassList data frame is used to enumerate a list of user classes which belong to a given assigned index. The resulting collection is treated as a group by the signal controller when it issues movement data (signal phase information) with the *GroupID* for this group. This data frame is typically static for long periods of time (months) and conveyed to the user by means of the MAP message.

ASN.1 Representation:

```
RestrictionClassList ::= SEQUENCE (SIZE(1..254)) OF
   RestrictionClassAssignment
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_MapData (MAP) <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The overall restriction class assignment process allows dynamic support within the framework of the common message set for the various special cases that some signalized intersections must support. While the assigned value needs to be unique only within the scope of the intersection that uses it, the resulting assignment lists will tend to be static and stable for regional deployment areas such as a metropolitan area based on their operational practices and needs.

6.104 Data Frame: DF_RestrictionUserTypeList

Use: The RestrictionUserTypeList data frame consists of a list of RestrictionUserType entries.

ASN.1 Representation:

```
RestrictionUserTypeList ::= SEQUENCE (SIZE(1..16)) OF  RestrictionUserType
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RestrictionClassAssignment <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.105 Data Frame: DF_RestrictionUserType

Use: The RestrictionUserType data frame is used to provide a means to select one, and only one, user type or class from a number of well-known lists. The selected entry is then used in the overall Restriction Class assignment process to indicate that a given GroupID (a way of expressing a movement in the SPAT/MAP system) applies to (is restricted to) this class of user.

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ASN.1 Representation:
```
RestrictionUserType ::= CHOICE {
   basicType    RestrictionAppliesTo,
                -- a set of the most commonly used types
   regional     RegionalRestrictionUserType
                -- regional extensions
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RestrictionUserTypeList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.106 Data Frame: DF_RoadLaneSetList

Use: The RoadLaneSetList data frame consists of a list of GenericLane entries used to describe a segment of roadway.

ASN.1 Representation:
```
RoadLaneSetList ::= SEQUENCE (SIZE(1..255)) OF GenericLane
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RoadSegment CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.107 Data Frame: DF_RoadSegment

Use: A complete description of a RoadSegment including its geometry and its allowed navigational paths (independent of any additional regulatory restrictions that may apply over time or from user classification) and any current disruptions such as a work zone or incident event.

ASN.1 Representation:
```
RoadSegment ::= SEQUENCE {
   name         DescriptiveName OPTIONAL,
   id           RoadSegmentReferenceID,
                            -- a globally unique value for the segment
   revision     MsgCount,
   -- Required default values about the descriptions to follow
   refPoint     Position3D-2, -- the reference from which subsequent
                            -- data points are offset until a new
                            -- point is used.
   laneWidth    LaneWidth OPTIONAL,
                             -- Reference width used by all subsequent
                             -- lanes unless a new width is given
   speedLimits SpeedLimitList OPTIONAL,
                             -- Reference regulatory speed limits
                             -- used by all subsequent
                             -- lanes unless a new speed is given
                             -- See Remarks under the SpeedAdvice entry
                             -- for converting and transmitting a speed
                             -- expressed in MPH to units of 0.1 m/s
   -- Data describing disruptions in the RoadSegment
   -- such as work zones etc will be added here;
   -- in the US the SAE ITIS codes would be used here
   -- The details regarding each lane type in the RoadSegment
   roadLaneSet RoadLaneSetList,
```

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```
--   roadLaneSet SEQUENCE (SIZE(1..255)) OF
--                  GenericLane,
                           -- data about one or more lanes
                           -- (all lane geometry is here)

   regional     RegionalRoadSegment OPTIONAL,
                           -- regional extensions
   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RoadSegmentList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Very preliminary at this time.

6.108 Data Frame: DF_RoadSegmentList

Use: The RoadSegmentList data frame consists of a list of RoadSegment entries.

ASN.1 Representation:
```
RoadSegmentList ::= SEQUENCE (SIZE(1..32)) OF RoadSegment
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_MapData (MAP) <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.109 Data Frame: DF_RoadSegmentReferenceID

Use: The RoadSegmentReferenceID data frame is used to convey theRoadSegmentID which unique to a given road segment of interest, and also the RegionalID assigned to the region in which is is operating (when required).

ASN.1 Representation:
```
RoadSegmentReferenceID ::= SEQUENCE {
   region   RoadRegulatorID OPTIONAL,
            -- a globally unique regional assignment value
            -- typical assigned to a regional DOT authority
            -- the value zero shall be used for testing needs
   id       RoadSegmentID
            -- a unique mapping to the road segment
            -- in question within the above region of use
            -- during its period of aggiment and use
            -- note that unlike intserectionID values,
            -- this value can be reused by the region
   }
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RoadSegment CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: A *fully qualified* road segment consists of its regionally unique ID (the RoadSegmentID) and it region ID (the RegionalID). Taken together these form a unique value which is never repeated during the same period of time.

6.110 Data Frame: DF_RoadSignID

Use: The RoadSignID data frame is used to provide a precise location of one or more roadside signs.

ASN.1 Representation:
```
RoadSignID ::= SEQUENCE {
   position         Position3D,
                    -- Location of sign
   viewAngle        HeadingSlice,
                    -- Vehicle direction of travel while
                    -- facing active side of sign
   mutcdCode        MUTCDCode OPTIONAL,
                    -- Tag for MUTCD code or "generic sign"
   crc              MsgCRC OPTIONAL
                    -- Used to provide a check sum
   }
```

XML Representation:
```
<xs:complexType name="RoadSignID" >
      <xs:sequence>
         <xs:element name="position" type="Position3D" />
         <!-- Location of sign -->
         <xs:element name="viewAngle" type="HeadingSlice" />
         <!-- Vehicle direction of travel while
         facing active side of sign -->
         <xs:element name="mutcdCode" type="MUTCDCode"  minOccurs="0"/>
         <!-- Tag for MUTCD code or &quot;generic sign&quot; -->
         <xs:element name="crc" type="MsgCRC"  minOccurs="0"/>
         <!-- Used to provide a check sum -->
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_TravelerInformation Message (TIM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.111 Data Frame: DF_RTCMHeader

Use: The DF_RTCMHeader data frame is a collection of data values used to convey RTCM information between users. It is encoded as an octet blob string.

ASN.1 Representation:
```
RTCMHeader ::= OCTET STRING  (SIZE(5))
   -- defined as:
   -- SEQUENCE {
   -- status     GPSstatus,
                 -- to occupy 1 byte
   -- offsetSet  AntennaOffsetSet
                 -- to occupy 4 bytes
   -- }
```

XML Representation:
```
<xs:complexType name="RTCMHeader" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            defined as:
            SEQUENCE  {
            status     GPSstatus,
            to occupy 1 byte
            offsetSet  AntennaOffsetSet
            to occupy 4 bytes
            }
         </xs:documentation>
```

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```
        </xs:annotation>
        <xs:extension base="RTCMHeader-string" >
           <xs:attribute name="EncodingType" use="required">
             <xs:simpleType>
                <xs:restriction base="xs:NMTOKEN">
                   <xs:enumeration value="base64Binary"/>
                </xs:restriction>
             </xs:simpleType>
           </xs:attribute>
        </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="RTCMHeader-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="7"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_RTCMPackage	<ASN>	<XML>, and
MSG	MSG_RTCM_Corrections_(RTCM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

6.112 Data Frame: DF_RTCMmsg

Use: The DF_RTCMmsg holds a single complete RTCM message. The specific type and structure is provided by the RTCM Revision and RTCM ID data elements, which are followed by the actual message payload. This data frame is typically used (in a sequence-of) in the RTCM-Corrections message.

ASN.1 Representation:

```
RTCMmsg ::= SEQUENCE {
   rev        RTCM-Revision OPTIONAL,
   rtcmID     RTCM-ID       OPTIONAL,
              -- the message and sub-message type, as
              -- defined in the RTCM revision being used
   payload    RTCM-Payload,
              -- the payload bytes
   ... -- # LOCAL_CONTENT
   }
```

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XML Representation:

```
<xs:complexType name="RTCMmsg" >
      <xs:sequence>
         <xs:element name="rev" type="RTCM-Revision"  minOccurs="0"/>
         <xs:element name="rtcmID" type="RTCM-ID"  minOccurs="0"/>
         <!-- the message and sub-message type,  as
         defined in the RTCM revision being used -->
         <xs:element name="payload" type="RTCM-Payload" />
         <!-- the payload bytes -->
         <xs:element name="localRTCMmsg" type="local:RTCMmsg" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_RTCM_Corrections (RTCM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.113 Data Frame: DF_RTCMPackage

Use: The RTCMPackage data frame is used to convey a select sub-set of the RTCM messages (message types 1001 TO 1032) which deal with differential corrections between users. Encapsulates messages are those defined in RTCM Standard 10403.1 for Differential GNSS (Global Navigation Satellite Systems) Services -Version 3 adopted on October 27, 2006 and its successors. At the date this standard was published this included Amendment #2 published August 31, 2007.

ASN.1 Representation:
```
RTCMPackage ::= SEQUENCE {
   anchorPoint FullPositionVector OPTIONAL,
   -- precise observer position, if needed

   rtcmHeader  RTCMHeader,
   -- an octet blob consisting of:
   -- one byte with:
   -- GPSstatus
   -- 4 bytes with:
   -- AntennaOffsetSet  containing x,y,z data

   -- note that a max of 16 satellites are allowed
   msg1001    OCTET STRING (SIZE(16..124))  OPTIONAL,
              -- pRange data GPS L1
   msg1002    OCTET STRING (SIZE(18..156))  OPTIONAL,
              -- pRange data GPS L1

   msg1003    OCTET STRING (SIZE(21..210))  OPTIONAL,
               -- pRange data GPS L1, L2
   msg1004    OCTET STRING (SIZE(24..258))  OPTIONAL,
               -- pRange data GPS L1, L2

   msg1005    OCTET STRING (SIZE(19))  OPTIONAL,
              -- observer station data
   msg1006    OCTET STRING (SIZE(21))  OPTIONAL,
              -- observer station data

   msg1007    OCTET STRING (SIZE(5..36))  OPTIONAL,
              -- antenna of observer station data
   msg1008    OCTET STRING (SIZE(6..68))  OPTIONAL,
              -- antenna of observer station data

   msg1009    OCTET STRING (SIZE(16..136))  OPTIONAL,
               -- pRange data GLONASS L1
   msg1010    OCTET STRING (SIZE(18..166))  OPTIONAL,
               -- pRange data GLONASS L1

   msg1011    OCTET STRING (SIZE(21..222))  OPTIONAL,
               -- pRange data GLONASS L1, L2
   msg1012    OCTET STRING (SIZE(24..268))  OPTIONAL,
               -- pRange data GLONASS L1, L2

   msg1013    OCTET STRING (SIZE(13..27))  OPTIONAL,
               -- system parameters data

   ..., -- # LOCAL_CONTENT
```

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```
-- The below items shall never be sent
-- over WSM stack encoding (other encodings may be used)
-- and may be removed from the ASN

msg1014     OCTET STRING (SIZE(15))  OPTIONAL,
            -- Network Aux Station (NAS) data
msg1015     OCTET STRING (SIZE(13..69))  OPTIONAL,
            -- Ionospheric Correction data
msg1016     OCTET STRING (SIZE(14..81))  OPTIONAL,
            -- Geometry Correction data
msg1017     OCTET STRING (SIZE(16..115))  OPTIONAL,
            -- Combined Ionospheric and Geometry data

-- msg1018 is reserved at this time

msg1019     OCTET STRING (SIZE(62))  OPTIONAL,
            -- Satellite Ephermeris data
msg1020     OCTET STRING (SIZE(45))  OPTIONAL,
            -- Satellite Ephermeris data
msg1021     OCTET STRING (SIZE(62))  OPTIONAL,
            -- Helmert-Abridged Molodenski Transform data
msg1022     OCTET STRING (SIZE(75))  OPTIONAL,
            -- Molodenski-Badekas Transform data
msg1023     OCTET STRING (SIZE(73))  OPTIONAL,
            -- Ellipse Residuals data
msg1024     OCTET STRING (SIZE(74))  OPTIONAL,
            -- Plane-Grid Residuals data
msg1025     OCTET STRING (SIZE(25))  OPTIONAL,
            -- Non-Lab Conic Project data
msg1026     OCTET STRING (SIZE(30))  OPTIONAL,
            -- Lab Conic Conform Project data
msg1027     OCTET STRING (SIZE(33))  OPTIONAL,
            -- Ob Mercator Project data

-- msg1028 is reserved at this time

msg1029     OCTET STRING (SIZE(10..69))  OPTIONAL,
            -- Unicode test type data
msg1030     OCTET STRING (SIZE(14..105))  OPTIONAL,
            -- GPS Residuals data
msg1031     OCTET STRING (SIZE(15..107))  OPTIONAL,
            -- GLONASS Residuals data
msg1032     OCTET STRING (SIZE(20))  OPTIONAL,
            -- Ref Station Position data

-- Proprietary Data content (msg40xx to msg4095)
-- may be added as needed

... -- # LOCAL_CONTENT
}
```

XML Representation:

```
<xs:complexType name="RTCMPackage" >
      <xs:sequence>
         <xs:element name="anchorPoint" type="FullPositionVector"  minOccurs="0"/>
         <!-- precise observer position,  if needed -->
         <xs:element name="rtcmHeader" type="RTCMHeader" />
         <!-- an octet blob consisting of:
         one byte with:
         GPSstatus
         4 bytes with:
```

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```
AntennaOffsetSet  containing x, y, z data
note that a max of 16 satellites are allowed -->
<xs:element name="msg1001"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1001-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent></xs:complexType>
</xs:element>
<!-- pRange data GPS L1 -->
<xs:element name="msg1002"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1002-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent></xs:complexType>
</xs:element>
<!-- pRange data GPS L1 -->
<xs:element name="msg1003"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1003-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent></xs:complexType>
</xs:element>
<!-- pRange data GPS L1,  L2 -->
<xs:element name="msg1004"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1004-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent></xs:complexType>
</xs:element>
<!-- pRange data GPS L1,  L2 -->
<xs:element name="msg1005"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1005-string" >
```

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```
            <xs:attribute name="EncodingType" use="required">
              <xs:simpleType>
                 <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="base64Binary"/>
                 </xs:restriction>
              </xs:simpleType>
            </xs:attribute>
         </xs:extension>
      </xs:simpleContent></xs:complexType>
   </xs:element>
   <!-- observer station data -->
   <xs:element name="msg1006"  minOccurs="0">
      <xs:complexType><xs:simpleContent>
         <xs:extension base="msg1006-string" >
            <xs:attribute name="EncodingType" use="required">
              <xs:simpleType>
                 <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="base64Binary"/>
                 </xs:restriction>
              </xs:simpleType>
            </xs:attribute>
         </xs:extension>
      </xs:simpleContent></xs:complexType>
   </xs:element>
   <!-- observer station data -->
   <xs:element name="msg1007"  minOccurs="0">
      <xs:complexType><xs:simpleContent>
         <xs:extension base="msg1007-string" >
            <xs:attribute name="EncodingType" use="required">
              <xs:simpleType>
                 <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="base64Binary"/>
                 </xs:restriction>
              </xs:simpleType>
            </xs:attribute>
         </xs:extension>
      </xs:simpleContent></xs:complexType>
   </xs:element>
   <!-- antenna of observer station data -->
   <xs:element name="msg1008"  minOccurs="0">
      <xs:complexType><xs:simpleContent>
         <xs:extension base="msg1008-string" >
            <xs:attribute name="EncodingType" use="required">
              <xs:simpleType>
                 <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="base64Binary"/>
                 </xs:restriction>
              </xs:simpleType>
            </xs:attribute>
         </xs:extension>
      </xs:simpleContent></xs:complexType>
   </xs:element>
   <!-- antenna of observer station data -->
   <xs:element name="msg1009"  minOccurs="0">
      <xs:complexType><xs:simpleContent>
         <xs:extension base="msg1009-string" >
            <xs:attribute name="EncodingType" use="required">
              <xs:simpleType>
                 <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="base64Binary"/>
                 </xs:restriction>
```

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```
            </xs:simpleType>
          </xs:attribute>
       </xs:extension>
    </xs:simpleContent></xs:complexType>
</xs:element>
<!-- pRange data GLONASS L1 -->
<xs:element name="msg1010"  minOccurs="0">
    <xs:complexType><xs:simpleContent>
       <xs:extension base="msg1010-string" >
          <xs:attribute name="EncodingType" use="required">
            <xs:simpleType>
               <xs:restriction base="xs:NMTOKEN">
                  <xs:enumeration value="base64Binary"/>
               </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
       </xs:extension>
    </xs:simpleContent></xs:complexType>
</xs:element>
<!-- pRange data GLONASS L1 -->
<xs:element name="msg1011"  minOccurs="0">
    <xs:complexType><xs:simpleContent>
       <xs:extension base="msg1011-string" >
          <xs:attribute name="EncodingType" use="required">
            <xs:simpleType>
               <xs:restriction base="xs:NMTOKEN">
                  <xs:enumeration value="base64Binary"/>
               </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
       </xs:extension>
    </xs:simpleContent></xs:complexType>
</xs:element>
<!-- pRange data GLONASS L1,  L2 -->
<xs:element name="msg1012"  minOccurs="0">
    <xs:complexType><xs:simpleContent>
       <xs:extension base="msg1012-string" >
          <xs:attribute name="EncodingType" use="required">
            <xs:simpleType>
               <xs:restriction base="xs:NMTOKEN">
                  <xs:enumeration value="base64Binary"/>
               </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
       </xs:extension>
    </xs:simpleContent></xs:complexType>
</xs:element>
<!-- pRange data GLONASS L1,  L2 -->
<xs:element name="msg1013"  minOccurs="0">
    <xs:complexType><xs:simpleContent>
       <xs:extension base="msg1013-string" >
          <xs:attribute name="EncodingType" use="required">
            <xs:simpleType>
               <xs:restriction base="xs:NMTOKEN">
                  <xs:enumeration value="base64Binary"/>
               </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
       </xs:extension>
    </xs:simpleContent></xs:complexType>
</xs:element>
```

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```
<!-- system parameters data -->
<!-- The below items shall never be sent
over WSM stack encoding  (other encodings may be used)
and may be removed from the ASN -->
<xs:element name="localRTCMPackage" type="local:RTCMPackage" minOccurs="0"/>
<xs:element name="msg1014"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1014-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent></xs:complexType>
</xs:element>
<!-- Network Aux Station  (NAS)  data -->
<xs:element name="msg1015"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1015-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent></xs:complexType>
</xs:element>
<!-- Ionospheric Correction data -->
<xs:element name="msg1016"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1016-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent></xs:complexType>
</xs:element>
<!-- Geometry Correction data -->
<xs:element name="msg1017"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1017-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent></xs:complexType>
</xs:element>
<!-- Combined Ionospheric and Geometry data
```

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```
msg1018 is reserved at this time -->
<xs:element name="msg1019"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1019-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent></xs:complexType>
</xs:element>
<!-- Satellite Ephermeris data -->
<xs:element name="msg1020"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1020-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent></xs:complexType>
</xs:element>
<!-- Satellite Ephermeris data -->
<xs:element name="msg1021"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1021-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent></xs:complexType>
</xs:element>
<!-- Helmert-Abridged Molodenski Transform data -->
<xs:element name="msg1022"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1022-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent></xs:complexType>
</xs:element>
<!-- Molodenski-Badekas Transform data -->
<xs:element name="msg1023"  minOccurs="0">
   <xs:complexType><xs:simpleContent>
      <xs:extension base="msg1023-string" >
         <xs:attribute name="EncodingType" use="required">
```

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```
            <xs:simpleType>
               <xs:restriction base="xs:NMTOKEN">
                  <xs:enumeration value="base64Binary"/>
               </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
       </xs:extension>
    </xs:simpleContent></xs:complexType>
 </xs:element>
 <!-- Ellipse Residuals data -->
 <xs:element name="msg1024"  minOccurs="0">
    <xs:complexType><xs:simpleContent>
       <xs:extension base="msg1024-string" >
          <xs:attribute name="EncodingType" use="required">
            <xs:simpleType>
               <xs:restriction base="xs:NMTOKEN">
                  <xs:enumeration value="base64Binary"/>
               </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
       </xs:extension>
    </xs:simpleContent></xs:complexType>
 </xs:element>
 <!-- Plane-Grid Residuals data -->
 <xs:element name="msg1025"  minOccurs="0">
    <xs:complexType><xs:simpleContent>
       <xs:extension base="msg1025-string" >
          <xs:attribute name="EncodingType" use="required">
            <xs:simpleType>
               <xs:restriction base="xs:NMTOKEN">
                  <xs:enumeration value="base64Binary"/>
               </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
       </xs:extension>
    </xs:simpleContent></xs:complexType>
 </xs:element>
 <!-- Non-Lab Conic Project data -->
 <xs:element name="msg1026"  minOccurs="0">
    <xs:complexType><xs:simpleContent>
       <xs:extension base="msg1026-string" >
          <xs:attribute name="EncodingType" use="required">
            <xs:simpleType>
               <xs:restriction base="xs:NMTOKEN">
                  <xs:enumeration value="base64Binary"/>
               </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
       </xs:extension>
    </xs:simpleContent></xs:complexType>
 </xs:element>
 <!-- Lab Conic Conform Project data -->
 <xs:element name="msg1027"  minOccurs="0">
    <xs:complexType><xs:simpleContent>
       <xs:extension base="msg1027-string" >
          <xs:attribute name="EncodingType" use="required">
            <xs:simpleType>
               <xs:restriction base="xs:NMTOKEN">
                  <xs:enumeration value="base64Binary"/>
               </xs:restriction>
            </xs:simpleType>
```

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```
            </xs:attribute>
         </xs:extension>
      </xs:simpleContent></xs:complexType>
   </xs:element>
   <!-- Ob Mercator Project data
   msg1028 is reserved at this time -->
   <xs:element name="msg1029"  minOccurs="0">
      <xs:complexType><xs:simpleContent>
         <xs:extension base="msg1029-string" >
            <xs:attribute name="EncodingType" use="required">
              <xs:simpleType>
                 <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="base64Binary"/>
                 </xs:restriction>
              </xs:simpleType>
            </xs:attribute>
         </xs:extension>
      </xs:simpleContent></xs:complexType>
   </xs:element>
   <!-- Unicode test type data -->
   <xs:element name="msg1030"  minOccurs="0">
      <xs:complexType><xs:simpleContent>
         <xs:extension base="msg1030-string" >
            <xs:attribute name="EncodingType" use="required">
              <xs:simpleType>
                 <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="base64Binary"/>
                 </xs:restriction>
              </xs:simpleType>
            </xs:attribute>
         </xs:extension>
      </xs:simpleContent></xs:complexType>
   </xs:element>
   <!-- GPS Residuals data -->
   <xs:element name="msg1031"  minOccurs="0">
      <xs:complexType><xs:simpleContent>
         <xs:extension base="msg1031-string" >
            <xs:attribute name="EncodingType" use="required">
              <xs:simpleType>
                 <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="base64Binary"/>
                 </xs:restriction>
              </xs:simpleType>
            </xs:attribute>
         </xs:extension>
      </xs:simpleContent></xs:complexType>
   </xs:element>
   <!-- GLONASS Residuals data -->
   <xs:element name="msg1032"  minOccurs="0">
      <xs:complexType><xs:simpleContent>
         <xs:extension base="msg1032-string" >
            <xs:attribute name="EncodingType" use="required">
              <xs:simpleType>
                 <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="base64Binary"/>
                 </xs:restriction>
              </xs:simpleType>
            </xs:attribute>
         </xs:extension>
      </xs:simpleContent></xs:complexType>
   </xs:element>
```

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```
        <!-- Ref Station Position data
        Proprietary Data content  (msg40xx to msg4095)
        may be added as needed -->
        <xs:element name="localRTCMPackage2" type="local:RTCMPackage2" minOccurs="0"/>
     </xs:sequence>
</xs:complexType>

        <xs:simpleType name="msg1001-string">
           <xs:restriction base="xs:base64Binary">
              <xs:minLength value="22"/>
              <xs:maxLength value="166"/>
           </xs:restriction>
        </xs:simpleType >
        <xs:simpleType name="msg1002-string">
           <xs:restriction base="xs:base64Binary">
              <xs:minLength value="24"/>
              <xs:maxLength value="208"/>
           </xs:restriction>
        </xs:simpleType >
        <xs:simpleType name="msg1003-string">
           <xs:restriction base="xs:base64Binary">
              <xs:minLength value="28"/>
              <xs:maxLength value="280"/>
           </xs:restriction>
        </xs:simpleType >
        <xs:simpleType name="msg1004-string">
           <xs:restriction base="xs:base64Binary">
              <xs:minLength value="32"/>
              <xs:maxLength value="344"/>
           </xs:restriction>
        </xs:simpleType >
        <xs:simpleType name="msg1005-string">
           <xs:restriction base="xs:base64Binary">
              <xs:length value="26"/>
           </xs:restriction>
        </xs:simpleType >
        <xs:simpleType name="msg1006-string">
           <xs:restriction base="xs:base64Binary">
              <xs:length value="28"/>
           </xs:restriction>
        </xs:simpleType >
        <xs:simpleType name="msg1007-string">
           <xs:restriction base="xs:base64Binary">
              <xs:minLength value="7"/>
              <xs:maxLength value="48"/>
           </xs:restriction>
        </xs:simpleType >
        <xs:simpleType name="msg1008-string">
           <xs:restriction base="xs:base64Binary">
              <xs:minLength value="8"/>
              <xs:maxLength value="91"/>
           </xs:restriction>
        </xs:simpleType >
        <xs:simpleType name="msg1009-string">
           <xs:restriction base="xs:base64Binary">
              <xs:minLength value="22"/>
              <xs:maxLength value="182"/>
           </xs:restriction>
        </xs:simpleType >
        <xs:simpleType name="msg1010-string">
           <xs:restriction base="xs:base64Binary">
```

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```
      <xs:minLength value="24"/>
      <xs:maxLength value="222"/>
    </xs:restriction>
  </xs:simpleType >
  <xs:simpleType name="msg1011-string">
    <xs:restriction base="xs:base64Binary">
      <xs:minLength value="28"/>
      <xs:maxLength value="296"/>
    </xs:restriction>
  </xs:simpleType >
  <xs:simpleType name="msg1012-string">
    <xs:restriction base="xs:base64Binary">
      <xs:minLength value="32"/>
      <xs:maxLength value="358"/>
    </xs:restriction>
  </xs:simpleType >
  <xs:simpleType name="msg1013-string">
    <xs:restriction base="xs:base64Binary">
      <xs:minLength value="18"/>
      <xs:maxLength value="36"/>
    </xs:restriction>
  </xs:simpleType >
  <xs:simpleType name="msg1014-string">
    <xs:restriction base="xs:base64Binary">
      <xs:length value="20"/>
    </xs:restriction>
  </xs:simpleType >
  <xs:simpleType name="msg1015-string">
    <xs:restriction base="xs:base64Binary">
      <xs:minLength value="18"/>
      <xs:maxLength value="92"/>
    </xs:restriction>
  </xs:simpleType >
  <xs:simpleType name="msg1016-string">
    <xs:restriction base="xs:base64Binary">
      <xs:minLength value="19"/>
      <xs:maxLength value="108"/>
    </xs:restriction>
  </xs:simpleType >
  <xs:simpleType name="msg1017-string">
    <xs:restriction base="xs:base64Binary">
      <xs:minLength value="22"/>
      <xs:maxLength value="154"/>
    </xs:restriction>
  </xs:simpleType >
  <xs:simpleType name="msg1019-string">
    <xs:restriction base="xs:base64Binary">
      <xs:length value="83"/>
    </xs:restriction>
  </xs:simpleType >
  <xs:simpleType name="msg1020-string">
    <xs:restriction base="xs:base64Binary">
      <xs:length value="60"/>
    </xs:restriction>
  </xs:simpleType >
  <xs:simpleType name="msg1021-string">
    <xs:restriction base="xs:base64Binary">
      <xs:length value="83"/>
    </xs:restriction>
  </xs:simpleType >
  <xs:simpleType name="msg1022-string">
```

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```
            <xs:restriction base="xs:base64Binary">
               <xs:length value="100"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType name="msg1023-string">
            <xs:restriction base="xs:base64Binary">
               <xs:length value="98"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType name="msg1024-string">
            <xs:restriction base="xs:base64Binary">
               <xs:length value="99"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType name="msg1025-string">
            <xs:restriction base="xs:base64Binary">
               <xs:length value="34"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType name="msg1026-string">
            <xs:restriction base="xs:base64Binary">
               <xs:length value="40"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType name="msg1027-string">
            <xs:restriction base="xs:base64Binary">
               <xs:length value="44"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType name="msg1029-string">
            <xs:restriction base="xs:base64Binary">
               <xs:minLength value="14"/>
               <xs:maxLength value="92"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType name="msg1030-string">
            <xs:restriction base="xs:base64Binary">
               <xs:minLength value="19"/>
               <xs:maxLength value="140"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType name="msg1031-string">
            <xs:restriction base="xs:base64Binary">
               <xs:minLength value="20"/>
               <xs:maxLength value="143"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType name="msg1032-string">
            <xs:restriction base="xs:base64Binary">
               <xs:length value="27"/>
            </xs:restriction>
         </xs:simpleType >
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleSafetyExtension <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The octets defined here shall be set in accordance with the presentation layer data values defined by RTCM 10403.1 and its successors.

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6.114 Data Frame: DF_Sample

Use: Allows the Probe Management message to apply its settings to a random sample of vehicles (all vehicles within the stated range). This uses the last single digit of the current probe segment number (PSN) to determine if probe management is to be used. If the current PSN falls between these two (2) values, then the Probe Data Management policy should be applied. The numbers are inclusive e.g. using 0x10 and 0x20 would provide a 1/16th sample and the values 0x00 and 0x80 would provide a 50% sample.

ASN.1 Representation:
```
Sample ::= SEQUENCE {
   sampleStart  INTEGER(0..255),    --  Sample Starting Point
   sampleEnd    INTEGER(0..255)     --  Sample Ending Point
   }
```

XML Representation:
```
<xs:complexType name="Sample" >
      <xs:sequence>
         <xs:element name="sampleStart" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte"/>
            </xs:simpleType>
         </xs:element>
         <!-- Sample Starting Point -->
         <xs:element name="sampleEnd" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte"/>
            </xs:simpleType>
         </xs:element>
         <!-- Sample Ending Point -->
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_ProbeDataManagement (PDM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.115 Data Frame: DF_SegmentAttributeList

Use: The SegmentAttributeList data frame consists of a list of SegmentAttribute entries.

ASN.1 Representation:
```
SegmentAttributeList ::= SEQUENCE (SIZE(1..8)) OF SegmentAttribute
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeAttributeSet <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

6.116 Data Frame: DF_ShapePointSet

Use: The DF_ShapePointSet DF use used to represent a short segment of described roadway. It is typically employed to define a region where signs or advisories would be valid.

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ASN.1 Representation:
```
ShapePointSet ::= SEQUENCE {
   anchor            Position3D     OPTIONAL,
   laneWidth         LaneWidth      OPTIONAL,
   directionality    DirectionOfUse OPTIONAL,
   nodeList          NodeList,      -- path details of the lane and width
   ...
   }
```

XML Representation:
```
<xs:complexType name="ShapePointSet" >
      <xs:sequence>
         <xs:element name="anchor" type="Position3D"  minOccurs="0"/>
         <xs:element name="laneWidth" type="LaneWidth"  minOccurs="0"/>
         <xs:element name="directionality" type="DirectionOfUse"  minOccurs="0"/>
         <xs:element name="nodeList" type="NodeList" />
         <!-- path details of the lane and width -->
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ValidRegion <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.117 Data Frame: DF_SignalControlZone

Use: A data frame used to relate the geo-physical region zones of an intersection to a numbering system used for an approaching vehicle to assert a *preempt* to a signal system or to assert a *priority* request for a signal. The regions work together with the map intersection object to describe the intersections and what SignalReqScheme value is needed to control it to obtain a given movement state.

ASN.1 Representation:
```
SignalControlZone ::= SEQUENCE {
   name            DescriptiveName OPTIONAL,
                   -- used only for debugging
   pValue          SignalReqScheme,
                   -- preempt or priorty value (0..7),
                   -- and any strategy value to be used

   data            CHOICE {

         laneSet   SEQUENCE (SIZE(1..32)) OF LaneNumber,
                   -- a seq of of defined LaneNumbers,
                   -- to be used with this p value
                   -- see thier nodelists for paths

         zones     SEQUENCE (SIZE(1..32)) OF SEQUENCE {

             enclosed  SEQUENCE (SIZE(1..32)) OF LaneNumber OPTIONAL,
                                 -- lanes in this region
             laneWidth           LaneWidth  OPTIONAL,
             nodeList            NodeList,
                                 -- path details of
                                 -- the region starting from
                                 -- the stop line
             ...
             }
             -- Note: unlike a nodelist for lanes,
```

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```
             -- zones may overlap by a considerable degree
         },
   ... -- # LOCAL_CONTENT
   }
```

XML Representation:

```
<xs:complexType name="SignalControlZone" >
      <xs:sequence>
         <xs:element name="name" type="DescriptiveName"  minOccurs="0"/>
         <!-- used only for debugging -->
         <xs:element name="pValue" type="SignalReqScheme" />
         <!-- preempt or priorty value  (0..7) ,
         and any strategy value to be used -->
         <xs:element name="data" >
            <xs:complexType>
               <xs:choice>
                  <xs:element name="laneSet" >
                     <xs:complexType>
                        <xs:sequence minOccurs="1" maxOccurs="32">
                           <xs:element name="laneSet-item" type="LaneNumber" />
                           <!-- a seq of of defined LaneNumbers, to be used with this p
value see thier nodelists for paths -->
                        </xs:sequence>
                     </xs:complexType>
                  </xs:element>
                  <xs:element name="zones" >
                     <xs:complexType>
                        <xs:sequence minOccurs="1" maxOccurs="32">
                           <xs:element name="zone" >
                              <xs:complexType>
                                 <xs:sequence>
                                    <xs:element name="enclosed"  minOccurs="0">
                                       <xs:complexType>
                                          <xs:sequence minOccurs="1" maxOccurs="32">
                                             <xs:element name="enclosed-item"
type="LaneNumber" />
                                             <!-- lanes in this region -->
                                          </xs:sequence>
                                       </xs:complexType>
                                    </xs:element>
                                    <xs:element name="laneWidth" type="LaneWidth"
minOccurs="0"/>
                                    <xs:element name="nodeList" type="NodeList" />
                                    <!-- path details of
                                    the region starting from
                                    the stop line -->
                                 </xs:sequence>
                              </xs:complexType>
                           </xs:element>
                           <!-- Note: unlike a nodelist for lanes, zones may overlap by a
considerable degree -->
                        </xs:sequence>
                     </xs:complexType>
                  </xs:element>
               </xs:choice>
            </xs:complexType>
         </xs:element>
         <xs:element name="localSignalControlZone" type="local:SignalControlZone"
minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

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Remarks: Note that both a *preempt* to a signal system and a *priority* for a signal system are described in the same terms here. The term signal control zone was created to cover both uses.

6.118 Data Frame: DF_SignalRequest

Use: The *SignalRequest* is used (as part of a request message) to request either a priority or a preemption service from a signalized intersection. It relates the intersection ID as well as the specific request (a value of 0~7 for the request and a value of 0~7 for the strategy requested - both in the SignalReqScheme data element). Additional information includes the approach and egress values or lanes to be used.

ASN.1 Representation:

```
SignalRequest ::= SEQUENCE {
   -- the regionally unique ID of the target intersection
   id      IntersectionID,  --  intersection ID

   -- Below present only when canceling a prior request
   isCancel    SignalReqScheme OPTIONAL,

   -- In typical use either a SignalReqScheme
   -- or a lane number would be given, this
   -- indicates the scheme to use or the
   -- path through the intersection
   -- to the degree it is known.
   -- Note that SignalReqScheme can hold either
   -- a preempt or a priority value.
   requestedAction  SignalReqScheme OPTIONAL,
                        --  preempt ID or the
                        --  priority ID
                        --  (and strategy)
   inLane      LaneNumber OPTIONAL,
                        --  approach Lane
   outLane     LaneNumber OPTIONAL,
                        --  egress Lane
   type        NTCIPVehicleclass,
                        --  Two 4 bit nibbles as:
                        --  NTCIP vehicle class type
                        --  NTCIP vehicle class level

   -- any validation string used by the system
   codeWord    CodeWord OPTIONAL,
   ...
   }
```

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XML Representation:

```
<xs:complexType name="SignalRequest" >
   <xs:sequence>
      <!-- the regionally unique ID of the target intersection -->
      <xs:element name="id" type="IntersectionID" />
      <!-- intersection ID
      Below present only when canceling a prior request -->
      <xs:element name="isCancel" type="SignalReqScheme"  minOccurs="0"/>
      <!-- In typical use either a SignalReqScheme
      or a lane number would be given,  this
      indicates the scheme to use or the
      path through the intersection
      to the degree it is known.
      Note that SignalReqScheme can hold either
      a preempt or a priority value. -->
      <xs:element name="requestedAction" type="SignalReqScheme"  minOccurs="0"/>
      <!-- preempt ID or the
```

```
            priority ID
            (and strategy) -->
            <xs:element name="inLane" type="LaneNumber"  minOccurs="0"/>
            <!-- approach Lane -->
            <xs:element name="outLane" type="LaneNumber"  minOccurs="0"/>
            <!-- egress Lane -->
            <xs:element name="type" type="NTCIPVehicleclass" />
            <!-- Two 4 bit nibbles as:
            NTCIP vehicle class type
            NTCIP vehicle class level
            any validation string used by the system -->
            <xs:element name="codeWord" type="CodeWord"  minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_SignalRequestMessage (SRM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.119 Data Frame: DF_SnapshotDistance

Use: To allow Network Users to change the snapshot collection policy based on speed and distance. Two distances and two speeds are included in this Data Frame D1, S1 and D2, S2 to be used by the OBU as follows:

- If speed is ≤ S1 then distance to next snapshot is D1
- If speed is ≥ S2 then distance to next snapshot is D2
- If speed is > S1 and < S2 then distance to snapshot is linearly interpolated between D1 and D2

If S1 is set to zero then the distance to the next snapshot is always D1.

ASN.1 Representation:

```
SnapshotDistance ::= SEQUENCE {
   d1    INTEGER(0..999),    -- meters
   s1    INTEGER(0..50),     -- meters\second
   d2    INTEGER(0..999),    -- meters
   s2    INTEGER(0..50)      -- meters\second
   }
```

XML Representation:

```
<xs:complexType name="SnapshotDistance" >
      <xs:sequence>
         <xs:element name="d1" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedShort">
                  <xs:maxInclusive value="999"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- meters -->
         <xs:element name="s1" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte">
                  <xs:maxInclusive value="50"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- meters\second -->
         <xs:element name="d2" >
            <xs:simpleType>
```

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```
            <xs:restriction base="xs:unsignedShort">
               <xs:maxInclusive value="999"/>
            </xs:restriction>
         </xs:simpleType>
      </xs:element>
      <!-- meters -->
      <xs:element name="s2" >
         <xs:simpleType>
            <xs:restriction base="xs:unsignedByte">
               <xs:maxInclusive value="50"/>
            </xs:restriction>
         </xs:simpleType>
      </xs:element>
      <!-- meters\second -->
   </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_ProbeDataManagement (PDM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.120 Data Frame: DF_Snapshot

Use: A report on one or more status elements in the vehicle which may have changed along with a set of position and heading elements representing the location of the report. Each report can contain status information from a number of defined vehicle devices.

ASN.1 Representation:

```
Snapshot ::= SEQUENCE {
   thePosition  FullPositionVector,
                -- data of the position and speed,
   safetyExt    VehicleSafetyExtension OPTIONAL,
   datSet       VehicleStatus          OPTIONAL,
                -- a seq of data frames
                -- which encodes the data
  ... -- # LOCAL_CONTENT
   }
```

XML Representation:

```
<xs:complexType name="Snapshot" >
      <xs:sequence>
         <xs:element name="thePosition" type="FullPositionVector" />
         <!-- data of the position and speed, -->
         <xs:element name="safetyExt" type="VehicleSafetyExtension"  minOccurs="0"/>
         <xs:element name="datSet" type="VehicleStatus"  minOccurs="0"/>
         <!-- a seq of data frames
         which encodes the data -->
         <xs:element name="localSnapshot" type="local:Snapshot" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_ProbeVehicleData (PVD) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Either the VehicleSafetyExtension or the VehicleStatus must be present in the message.

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6.121 Data Frame: DF_SnapshotTime

Use: To allow Network Users to change the snapshot collection policy based in elapsed time. Two times and two speeds are included in the message T1, S1 and T2, S2 to be used by the OBU as follows:

- If speed is ≤ S1 then time to next snapshot is T1 - default 20 mph (8.9 m/s) and 6 secs
- If speed is ≥ S2 then time to next snapshot is T2 - default 60 mph (26.8 m/s) and 20 secs
- If speed is > S1 and < S2 then time to snapshot is linearly interpolated between T1 and T2

If S1 is set to zero then the time to the next snapshot is always T1

ASN.1 Representation:
```
SnapshotTime ::= SEQUENCE {
   t1   INTEGER(1..99),
        -- m/sec - the instantaneous speed when the
        -- calculation is performed
   s1   INTEGER(0..50),
        -- seconds
   t2   INTEGER(1..99),
        -- m/sec - the instantaneous speed when the
        -- calculation is performed
   s2   INTEGER(0..50)
        -- seconds
   }
```

XML Representation:
```
<xs:complexType name="SnapshotTime" >
      <xs:sequence>
         <xs:element name="t1" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte">
                  <xs:minInclusive value="1"/>
                  <xs:maxInclusive value="99"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- m/sec - the instantaneous speed when the
         calculation is performed -->
         <xs:element name="s1" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte">
                  <xs:maxInclusive value="50"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- seconds -->
         <xs:element name="t2" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte">
                  <xs:minInclusive value="1"/>
                  <xs:maxInclusive value="99"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- m/sec - the instantaneous speed when the
         calculation is performed -->
         <xs:element name="s2" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte">
                  <xs:maxInclusive value="50"/>
```

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```
            </xs:restriction>
         </xs:simpleType>
      </xs:element>
      <!-- seconds -->
   </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_ProbeDataManagement (PDM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.122 Data Element: DF_Speed_Heading_Throttle_Confidence

Use: A single byte long data frame combining multiple related bit fields into one byte.

ASN.1 Representation:

```
SpeedandHeadingandThrottleConfidence ::= OCTET STRING (SIZE(1))
-- to be packed as follows:
-- SEQUENCE {
--   heading   HeadingConfidence,   -x- 3 bits
--   speed     SpeedConfidence,     -x- 3 bits
--   throttle  ThrottleConfidence   -x- 2 bits
--   }
```

XML Representation:

```
<xs:complexType name="SpeedandHeadingandThrottleConfidence" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            to be packed as follows:
            SEQUENCE  {
            heading   HeadingConfidence,   -x- 3 bits
            speed     SpeedConfidence,     -x- 3 bits
            throttle  ThrottleConfidence   -x- 2 bits
            }
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="SpeedandHeadingandThrottleConfidence-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="SpeedandHeadingandThrottleConfidence-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="2"/>
   </xs:restriction>
</xs:simpleType >
```

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Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_ConfidenceSet	<ASN>	<XML>, and
DF	DF_FullPositionVector	<ASN>	<XML>, and
DF	DF_VehicleStatus	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

6.123 Data Frame: DF_SpeedLimitList

Use: The SpeedLimitList data frame consists of a list of SpeedLimit entries.

ASN.1 Representation:
```
SpeedLimitList ::= SEQUENCE (SIZE(1..9)) OF RegulatorySpeedLimit
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_IntersectionGeometry CHANGED	<ASN>	<>, and
DF	DF_LaneDataAttribute	<ASN>	<>, and
DF	DF_RoadSegment CHANGED	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

6.124 Data Frame: DF_TimeChangeDetails

Use: The DF_TimeChangeDetails data concept conveys details about the timing of a phase within a movement. The core data concept expressed is the time stamp (time mark) at which the related phase will change to the next state. This is often found in the *MinEndTime* element, but the other elements may be needed to convey the full concept when adaptive timing is employed.

The *StartTime* element is used to relate when the phase itself started or is expected to start. This in turn allows detecting that a set of time change detail refers to a future phase, rather than a currently active phase.

By this method, timing about "pre" phase events (which are the short transitional phase used to alert OBEs to an impending green/go or yellow/caution phase) and the longer yellow-caution phase data is supported in the same form as various green/go phases. In theory the time change details could be sent for a large sequence of phases if the signal timing was not adaptive and the operator wished to do so. In practice, it is expected only the "next" future phase will commonly be sent. Note that this also supports sending time periods regarding various red phases; however, this is not expected to be commonly done.

The element *MinEndTime* is used to convey the minimum time remaining or possible in a phase. In a phase where the time is fixed (as in a fixed yellow or clearance time), this element shall be used alone. This value can be viewed as the earliest possible time at which the phase could change, except when unpredictable events relating to a preemption or priority call come into play and disrupt a currently active timing plan.

The element *MaxEndTime* is used to convey the longest time remaining (or possible) in a phase that the signal controller wishes to inform users about.

The element *likelyTime* is used to convey the most likely time the phase changes, it is between MinEndTime and MaxEndTime and is only relevant for traffic actuated control programs. This time might be calculated out of logged historical values, detected events e.g. from inductive loops or from other sources. The element *confidence* is used to convey basic confidence data about the likelyTime.

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The final element *nextTime* is used to express a general (and presumed to be less precise) value regarding when this phase will next occur. This is intended to be used to alert the OBE when the next green/go may occur so that various ECO driving applications can better manage the vehicle during the intervening stopped time.

ASN.1 Representation:

```
TimeChangeDetails ::= SEQUENCE {
   startTime    TimeMark              OPTIONAL,
                -- When this phase 1st started
   minEndTime   TimeMark,
                -- Expected shortest end time
   maxEndTime   TimeMark              OPTIONAL,
                -- Expected longer end time

   likelyTime   TimeMark              OPTIONAL,
                -- Best predicted value based on other data
   confidence   TimeIntervalConfidence OPTIONAL,
                -- Applies to above time element only

   nextTime     TimeMark              OPTIONAL
                -- A rough estimate of time when
                -- this phase may next occur again
                -- used to support various ECO driving power
                -- management needs.
   }
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_MovementEvent CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that all times are expressed as absolute values and not as countdown timer values. When the stated time mark is reached, the state changes to the next state. Several technical reasons led to this choice; among these was that with a countdown embodiment, there is an inherent need to update the remaining time every time a SPAT message would be issued. This would require re-formulating the message content as as well as cryptographically signing the message each time. With the use of absolute values (time marks) chosen here, the current count down time when the message is created is added to the then current time to create the absolute value and can be used thereafter without change. The message content need only change with the signal controller makes a timing decision to be published. This allows a clean separation of the logical functions of message creation from the logical functions of message scheduling and sending and fulfills the need to minimize further real time processing when possible. This standard sets no limits on where each of these functions is performed in the overall roadside system.

6.125 Data Frame: DF_TransmissionAndSpeed

Use: The vehicle DF_TransmissionAndSpeed shall be expressed as a speed value in unsigned units of 0.02 meters per second combined with a 3 bit transmission state data value to indicate the transmission state. The transmission data state value shall occupy the first three MSB of the octets. The combined data concept shall occupy 2 bytes.

ASN.1 Representation:

```
TransmissionAndSpeed ::= OCTET STRING (SIZE(2))
    -- Bits 14~16 to be made up of the data element
    -- DE_TransmissionState
    -- Bits 1~13 to be made up of the data element
    -- DE_Speed
```

XML Representation:

```
<xs:complexType name="TransmissionAndSpeed" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            bits 13~15 to be made up of the data element
            DE_TransmissionState
            bits 0~12 to be made up of the data element
```

```
            DE_Speed
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="TransmissionAndSpeed-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="TransmissionAndSpeed-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="3"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_FullPositionVector	<ASN>	<XML>, and
DF	DF_PathHistoryPointType-01	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_Verbose (VBSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

6.126 Data Frame: DF_ValidRegion

Use: The ValidRegion DF is used to describe one or more geographic locations to which a message (typically road signs or advisories of some sort) is applied or considered valid.

ASN.1 Representation:

```
ValidRegion ::= SEQUENCE {

   direction         HeadingSlice,
                     -- field of view over which this applies,
   extent            Extent OPTIONAL,
                     -- the spatial distance over which this
                     -- message applies and should be presented
                     -- to the driver
   area     CHOICE  {
      shapePointSet  ShapePointSet,
                     -- A short road segment
      circle         Circle,
                     -- A point and radius
      regionPointSet RegionPointSet
                     -- Wide area enclosed regions
      }
   }
```

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XML Representation:
```
<xs:complexType name="ValidRegion" >
      <xs:sequence>
         <xs:element name="direction" type="HeadingSlice" />
         <!-- field of view over which this applies, -->
         <xs:element name="extent" type="Extent"  minOccurs="0"/>
         <!-- the spatial distance over which this
         message applies and should be presented
         to the driver -->
         <xs:element name="area" >
            <xs:complexType>
               <xs:choice>
                  <xs:element name="shapePointSet" type="ShapePointSet" />
                  <!-- A short road segment -->
                  <xs:element name="circle" type="Circle" />
                  <!-- A point and radius -->
                  <xs:element name="regionPointSet" type="RegionPointSet" />
                  <!-- Wide area enclosed regions -->
               </xs:choice>
            </xs:complexType>
         </xs:element>
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_TravelerInformation Message (TIM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

6.127 Data Frame: DF_VehicleIdent

Use: The VehicleIdent data frame is used to provide identity information about a selected vehicle. This data frame is typical used with fleet type vehicles who can (or who must) safely release such information for use with probe measurements or with other interactions (such as a signal request). At least one of the optional data elements shall be present in the data frame.

ASN.1 Representation:
```
VehicleIdent ::= SEQUENCE {
   name            DescriptiveName OPTIONAL,
                   -- a human readable name for debugging use
   vin             VINstring OPTIONAL,
                   -- vehicle VIN value
   ownerCode       IA5String(SIZE(1..32)) OPTIONAL,
                   -- vehicle owner code
   id              TemporaryID OPTIONAL,
                   -- same value used in the BSM

   vehicleType     VehicleType  OPTIONAL,
   vehicleClass    CHOICE
                   {
                   vGroup ITIS.VehicleGroupAffected,
                   rGroup ITIS.ResponderGroupAffected,
                   rEquip ITIS.IncidentResponseEquipment
                   } OPTIONAL,
   ... -- # LOCAL_CONTENT
   }
```

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XML Representation:

```
<xs:complexType name="VehicleIdent" >
      <xs:sequence>
         <xs:element name="name" type="DescriptiveName"  minOccurs="0"/>
         <!-- a human readable name for debugging use -->
         <xs:element name="vin" type="VINstring"  minOccurs="0"/>
         <!-- vehicle VIN value -->
         <xs:element name="ownerCode"  minOccurs="0">
            <xs:simpleType>
               <xs:restriction base="xs:string">
                  <xs:minLength value="1"/>
                  <xs:maxLength value="32"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- vehicle owner code -->
         <xs:element name="id" type="TemporaryID"  minOccurs="0"/>
         <!-- same value used in the BSM -->
         <xs:element name="vehicleType" type="VehicleType"  minOccurs="0"/>
         <xs:element name="vehicleClass"  minOccurs="0">
            <xs:complexType>
               <xs:choice>
                  <xs:element name="vGroup" type="itis:VehicleGroupAffected" />
                  <xs:element name="rGroup" type="itis:ResponderGroupAffected" />
                  <xs:element name="rEquip" type="itis:IncidentResponseEquipment" />
               </xs:choice>
            </xs:complexType>
         </xs:element>
         <xs:element name="localVehicleIdent" type="local:VehicleIdent" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleStatus	<ASN>	<XML>, and
MSG	MSG_ProbeVehicleData (PVD)	<ASN>	<XML>, and
MSG	MSG_SignalRequestMessage (SRM)	<ASN>	<XML>, and
MSG	MSG_SignalStatusMessage (SSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

6.128 Data Frame: DF_VehicleSafetyExtension

Use: The VehicleSafetyExtension data frame is used to send various additional details about the vehicle. This data frame is used for vehicle safety applications to exchange safety information such as event flag and detailed positional information. This data frame is typically sent in conjunction with BSM Part I at the same or reduced frequency (it is typically not present in every message).

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ASN.1 Representation:

```
VehicleSafetyExtension ::= SEQUENCE {
   events             EventFlags     OPTIONAL,
   pathHistory        PathHistory    OPTIONAL,
   pathPrediction     PathPrediction OPTIONAL,
   theRTCM            RTCMPackage    OPTIONAL,
   ... -- # LOCAL_CONTENT
   }
```

XML Representation:

```
<xs:complexType name="VehicleSafetyExtension" >
      <xs:sequence>
         <xs:element name="events" type="EventFlags"  minOccurs="0"/>
         <xs:element name="pathHistory" type="PathHistory"  minOccurs="0"/>
         <xs:element name="pathPrediction" type="PathPrediction"  minOccurs="0"/>
         <xs:element name="theRTCM" type="RTCMPackage"  minOccurs="0"/>
         <xs:element name="localVehicleSafetyExtension"
type="local:VehicleSafetyExtension" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_Snapshot	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_(BSM)	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_Verbose_(VBSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

6.129 Data Frame: DF_VehicleSize

Use: The VehicleSize is a data frame representing the vehicle length and vehicle width in a three byte value.

ASN.1 Representation:

```
VehicleSize ::= SEQUENCE {
   width      VehicleWidth,
   length     VehicleLength
   }  -- 3 bytes in length
```

XML Representation:

```
<xs:complexType name="VehicleSize" >
      <xs:annotation>
         <xs:documentation>
            3 bytes in length
         </xs:documentation>
      </xs:annotation>
      <xs:sequence>
         <xs:element name="width" type="VehicleWidth" />
         <xs:element name="length" type="VehicleLength" />
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_BasicSafetyMessage_Verbose_(VBSM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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Remarks: Note that besides the width and length, which are always present in the BSM Part I, other vehicle data, for example vehicle mass and bumper heights, can be included in Part II.

6.130 Data Frame: DF_VehicleStatusRequest

Use: The VehicleStatusRequest is used to request complex content along with threshold settings in the vehicle probe management process.

ASN.1 Representation:
```
VehicleStatusRequest ::= SEQUENCE {
   dataType              VehicleStatusDeviceTypeTag,
   subType               INTEGER (1..15)   OPTIONAL,
   sendOnLessThenValue   INTEGER (-32767..32767) OPTIONAL,
   sendOnMoreThenValue   INTEGER (-32767..32767) OPTIONAL,
   sendAll               BOOLEAN OPTIONAL,
   ...
   }
```

XML Representation:
```
<xs:complexType name="VehicleStatusRequest" >
      <xs:sequence>
         <xs:element name="dataType" type="VehicleStatusDeviceTypeTag" />
         <xs:element name="subType"  minOccurs="0">
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte">
                  <xs:minInclusive value="1"/>
                  <xs:maxInclusive value="15"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="sendOnLessThenValue"  minOccurs="0">
            <xs:simpleType>
               <xs:restriction base="xs:short">
                  <xs:minInclusive value="-32767"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="sendOnMoreThenValue"  minOccurs="0">
            <xs:simpleType>
               <xs:restriction base="xs:short">
                  <xs:minInclusive value="-32767"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="sendAll"  minOccurs="0">
            <xs:simpleType>
               <xs:restriction base="xs:boolean"/>
            </xs:simpleType>
         </xs:element>
      </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_ProbeDataManagement (PDM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Range settings must match the range allowed by the subject data item. Units are as defined by the subject data item.

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6.131 Data Frame: DF_VehicleStatus

Use: A data frame that is used to relate specific items of the vehicle's status. This structure relates all the different types of information that can be related about the vehicle inside a probe message or in a BSM part II section. Typically these are used in data event snapshots which are gathered and periodically reported to an RSU or as part of the BSM Part II content.

Observe that this data structure makes use of other defined data elements and data frames, enclosing them in a sequence structure so that a number of such items can be sent within the VehicleStatus instance and that this data follows the definition of each defined elsewhere.

ASN.1 Representation:
```
VehicleStatus ::= SEQUENCE {
   lights          ExteriorLights OPTIONAL,                 -- Exterior Lights
   lightBar        LightbarInUse  OPTIONAL,                 -- PS Lights

   wipers   SEQUENCE {
         statusFront    WiperStatusFront,
         rateFront      WiperRate,
         statusRear     WiperStatusRear         OPTIONAL,
         rateRear       WiperRate               OPTIONAL
         } OPTIONAL,                                        -- Wipers

   brakeStatus  BrakeSystemStatus OPTIONAL,
                -- 2 bytes with the following in it:
                --   wheelBrakes         BrakeAppliedStatus,
                --                       -x- 4 bits
                --   traction            TractionControlState,
                --                       -x- 2 bits
                --   abs                 AntiLockBrakeStatus,
                --                       -x- 2 bits
                --   scs                 StablityControlStatus,
                --                       -x- 2 bits
                --   brakeBoost          BrakeBoostApplied,
                --                       -x- 2 bits
                --   spareBits
                --                       -x- 4 bits
                -- Note that is present in BSM Part I
                                                            -- Braking Data
   brakePressure   BrakeAppliedPressure   OPTIONAL,         -- Braking Pressure
   roadFriction    CoefficientOfFriction  OPTIONAL,         -- Roadway Friction


   sunData         SunSensor              OPTIONAL,         -- Sun Sensor
   rainData        RainSensor             OPTIONAL,         -- Rain Sensor
   airTemp         AmbientAirTemperature  OPTIONAL,         -- Air Temperature
   airPres         AmbientAirPressure     OPTIONAL,         -- Air Pressure

   steering    SEQUENCE {
         angle      SteeringWheelAngle,
         confidence SteeringWheelAngleConfidence    OPTIONAL,
         rate       SteeringWheelAngleRateOfChange  OPTIONAL,
         wheels     DrivingWheelAngle               OPTIONAL
         } OPTIONAL,                                        -- steering data

   accelSets   SEQUENCE {
         accel4way        AccelerationSet4Way             OPTIONAL,
         vertAccelThres   VerticalAccelerationThreshold   OPTIONAL,
                                                          -- Wheel Exceeded point
         yawRateCon       YawRateConfidence               OPTIONAL,
```

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```
                                                    -- Yaw Rate Confidence
        hozAccelCon     AccelerationConfidence     OPTIONAL,
                                                    -- Acceleration Confidence
        confidenceSet   ConfidenceSet              OPTIONAL
                                                   -- general ConfidenceSet
        } OPTIONAL,


   object      SEQUENCE {
        obDist          ObstacleDistance,         -- Obstacle Distance
        obDirect        ObstacleDirection,        -- Obstacle Direction
        dateTime        DDateTime                 -- time detected
        } OPTIONAL,                                       -- detected Obstacle data



   fullPos        FullPositionVector OPTIONAL,    -- complete set of time and
                                                  -- position, speed, heading
   throttlePos    ThrottlePosition OPTIONAL,
   speedHeadC     SpeedandHeadingandThrottleConfidence OPTIONAL,
   speedC         SpeedConfidence OPTIONAL,

   vehicleData    SEQUENCE {
        height         VehicleHeight,
        bumpers        BumperHeights,
        mass           VehicleMass,
        trailerWeight  TrailerWeight,
        type           VehicleType
        -- values for width and length are sent in BSM part I as well.
        } OPTIONAL,                                       -- vehicle data

   vehicleIdent   VehicleIdent OPTIONAL,                  -- comm vehicle data

   j1939data      J1939data OPTIONAL,           -- Various SAE J1938 data items

   weatherReport SEQUENCE {
        isRaining         NTCIP.EssPrecipYesNo,
        rainRate          NTCIP.EssPrecipRate         OPTIONAL,
        precipSituation   NTCIP.EssPrecipSituation    OPTIONAL,
        solarRadiation    NTCIP.EssSolarRadiation     OPTIONAL,
        friction          NTCIP.EssMobileFriction     OPTIONAL
        } OPTIONAL,                                       -- local weather data

   gpsStatus      GPSstatus          OPTIONAL,            -- vehicle's GPS

   ... -- # LOCAL_CONTENT OPTIONAL,
   }
```

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XML Representation:

```
<xs:complexType name="VehicleStatus" >
      <xs:sequence>
         <xs:element name="lights" type="ExteriorLights"  minOccurs="0"/>
         <!-- Exterior Lights -->
         <xs:element name="lightBar" type="LightbarInUse"  minOccurs="0"/>
         <!-- PS Lights -->
         <xs:element name="wipers"  minOccurs="0">
            <xs:complexType>
               <xs:sequence>
                  <xs:element name="statusFront" type="WiperStatusFront" />
                  <xs:element name="rateFront" type="WiperRate" />
                  <xs:element name="statusRear" type="WiperStatusRear"  minOccurs="0"/>
```

```
            <xs:element name="rateRear" type="WiperRate"  minOccurs="0"/>
         </xs:sequence>
      </xs:complexType>
   </xs:element>
   <!-- Wipers -->
   <xs:element name="brakeStatus" type="BrakeSystemStatus"  minOccurs="0"/>
   <!-- 2 bytes with the following in it:
   wheelBrakes        BrakeAppliedStatus,
   -x- 4 bits
   traction           TractionControlState,
   -x- 2 bits
   abs                AntiLockBrakeStatus,
   -x- 2 bits
   scs                StablityControlStatus,
   -x- 2 bits
   brakeBoost         BrakeBoostApplied,
   -x- 2 bits
   spareBits
   -x- 4 bits
   Note that is present in BSM Part I
   Braking Data -->
   <xs:element name="brakePressure" type="BrakeAppliedPressure"  minOccurs="0"/>
   <!-- Braking Pressure -->
   <xs:element name="roadFriction" type="CoefficientOfFriction"  minOccurs="0"/>
   <!-- Roadway Friction -->
   <xs:element name="sunData" type="SunSensor"  minOccurs="0"/>
   <!-- Sun Sensor -->
   <xs:element name="rainData" type="RainSensor"  minOccurs="0"/>
   <!-- Rain Sensor -->
   <xs:element name="airTemp" type="AmbientAirTemperature"  minOccurs="0"/>
   <!-- Air Temperature -->
   <xs:element name="airPres" type="AmbientAirPressure"  minOccurs="0"/>
   <!-- Air Pressure -->
   <xs:element name="steering"  minOccurs="0">
      <xs:complexType>
         <xs:sequence>
            <xs:element name="angle" type="SteeringWheelAngle" />
            <xs:element name="confidence" type="SteeringWheelAngleConfidence"
minOccurs="0"/>
            <xs:element name="rate" type="SteeringWheelAngleRateOfChange"
minOccurs="0"/>
            <xs:element name="wheels" type="DrivingWheelAngle"  minOccurs="0"/>
         </xs:sequence>
      </xs:complexType>
   </xs:element>
   <!-- steering data -->
   <xs:element name="accelSets"  minOccurs="0">
      <xs:complexType>
         <xs:sequence>
            <xs:element name="accel4way" type="AccelerationSet4Way"
minOccurs="0"/>
            <xs:element name="vertAccelThres" type="VerticalAccelerationThreshold"
minOccurs="0"/>
            <!-- Wheel Exceeded point -->
            <xs:element name="yawRateCon" type="YawRateConfidence"  minOccurs="0"/>
            <!-- Yaw Rate Confidence -->
            <xs:element name="hozAccelCon" type="AccelerationConfidence"
minOccurs="0"/>
            <!-- Acceleration Confidence -->
            <xs:element name="confidenceSet" type="ConfidenceSet"  minOccurs="0"/>
            <!-- general ConfidenceSet -->
```

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```
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <xs:element name="object"  minOccurs="0">
            <xs:complexType>
               <xs:sequence>
                  <xs:element name="obDist" type="ObstacleDistance" />
                  <!-- Obstacle Distance -->
                  <xs:element name="obDirect" type="ObstacleDirection" />
                  <!-- Obstacle Direction -->
                  <xs:element name="dateTime" type="DDateTime" />
                  <!-- time detected -->
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <!-- detected Obstacle data -->
         <xs:element name="fullPos" type="FullPositionVector"  minOccurs="0"/>
         <!-- complete set of time and
         position,  speed,  heading -->
         <xs:element name="throttlePos" type="ThrottlePosition"  minOccurs="0"/>
         <xs:element name="speedHeadC" type="SpeedandHeadingandThrottleConfidence"
minOccurs="0"/>
         <xs:element name="speedC" type="SpeedConfidence"  minOccurs="0"/>
         <xs:element name="vehicleData"  minOccurs="0">
            <xs:complexType>
               <xs:sequence>
                  <xs:element name="height" type="VehicleHeight" />
                  <xs:element name="bumpers" type="BumperHeights" />
                  <xs:element name="mass" type="VehicleMass" />
                  <xs:element name="trailerWeight" type="TrailerWeight" />
                  <xs:element name="type" type="VehicleType" />
                  <!-- values for width and length are sent in BSM part I as well. -->
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <!-- vehicle data -->
         <xs:element name="vehicleIdent" type="VehicleIdent"  minOccurs="0"/>
         <!-- comm vehicle data -->
         <xs:element name="j1939data" type="J1939data"  minOccurs="0"/>
         <!-- Various SAE J1938 data items -->
         <xs:element name="weatherReport"  minOccurs="0">
            <xs:complexType>
               <xs:sequence>
                  <xs:element name="isRaining" type="ntcip:EssPrecipYesNo" />
                  <xs:element name="rainRate" type="ntcip:EssPrecipRate"  minOccurs="0"/>
                  <xs:element name="precipSituation" type="ntcip:EssPrecipSituation"
minOccurs="0"/>
                  <xs:element name="solarRadiation" type="ntcip:EssSolarRadiation"
minOccurs="0"/>
                  <xs:element name="friction" type="ntcip:EssMobileFriction"
minOccurs="0"/>
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <!-- local weather data -->
         <xs:element name="gpsStatus" type="GPSstatus"  minOccurs="0"/>
         <!-- vehicle&apos;s GPS -->
         <xs:element name="localVehicleStatus" type="local:VehicleStatus" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

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Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_Snapshot	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage (BSM)	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_Verbose (VBSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: See also the VehicleSafetyExtension data frame for additional content.

6.132 Data Frame: DF_WiperStatus

Use: The current status of the wiper systems on the subject vehicle, including front and rear wiper systems (where equipped)

ASN.1 Representation:

```
WiperStatus ::= SEQUENCE {
   statusFront     WiperStatusFront,
   rateFront       WiperRate,
   statusRear      WiperStatusRear        OPTIONAL,
   rateRear        WiperRate              OPTIONAL
   }
```

XML Representation:

```
<xs:complexType name="WiperStatus" >
      <xs:sequence>
         <xs:element name="statusFront" type="WiperStatusFront" />
         <xs:element name="rateFront" type="WiperRate" />
         <xs:element name="statusRear" type="WiperStatusRear"  minOccurs="0"/>
         <xs:element name="rateRear" type="WiperRate"  minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

Remarks: Note that when the state changes an event flag may be raised in the BSM and this data frame may be transmitted in Part II of that message to relate the new state.

7. DATA ELEMENTS

This section defines the precise structure of the data elements defined by this standard. The DSRC message content defined by this standard is further divided into specific messages, data frames, and elements as defined in this clause and in others of this standard. Typically, these messages are made up of content further defined in this document (i.e. made up of entries that are either atomic or complex but which are also defined in this document) and message content defined externally to this document. Such external content is reused from other functional areas and standards developed by other groups and SDOs. The contents of this standard (both at the complete message level and its component parts) may be reused by other efforts elsewhere.

All text in this clause is considered normative unless expressly marked otherwise. Definitions for this message set are presented in the following subclauses. The ASN.1 is presented in a section titled ASN.1 Representation. The equivalent XML expression is presented in a section titled XML Representation which follows the translation rule set cited in Clause Two (SAE Standard J2630). Should the two sections conflict in some way, the ASN.1 expression shall take precedence.

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The productions of ASN.1 which follow shall be considered normative in nature. While the majority of the normative content is reflected in the actual syntax of the ASN.1, some entries also have additional statements in the ASN.1 comments which shall be considered normative as well. In addition, the textual commentary provided with each entry (in sections marked "use" and "remarks") may also provide additional normative restrictions on the proper use of the entry being described. The XML productions follow directly from the ASN.1 specifications and the same rules shall be applied. Users of this standard seeking to be in conformance with it shall follow the normative text outlined here.

7.1 Data Element: DE_Acceleration

Use: A data element representing the signed acceleration of the vehicle along some known axis in units of 0.01 meters per second squared. A range of over 2Gs is supported. Accelerations in the directions of forward and to the right are taken as positive. A 2 byte long value when sent.

Longitudinal acceleration is the acceleration along the X axis or the vehicle's direction of travel in parallel with a front to rear centerline. Negative values indicate braking action.

Lateral acceleration is the acceleration along the Y axis or perpendicular to the vehicle's direction of travel in parallel with a left-to right centerline. Negative values indicate left turning action and positive values indicate right-turning action.

ASN.1 Representation:
```
Acceleration ::= INTEGER (-2000..2001)
    -- LSB units are 0.01 m/s^2
   -- the value 2000 shall be used for values greater than 2000
   -- the value -2000 shall be used for values less than -2000
   -- a value of 2001 shall be used for Unavailable
```

XML Representation:
```
<xs:simpleType name="Acceleration" >
      <xs:annotation>
         <xs:documentation>
            LSB units are 0.01 m/s^2
            the value 2000 shall be used for values greater than 2000
            the value -2000 shall be used for values less than -2000
            a value of 2001 shall be used for Unavailable
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:short">
         <xs:minInclusive value="-2000"/>
         <xs:maxInclusive value="2001"/>
      </xs:restriction>
</xs:simpleType>
```

Remarks: The upper four bits of this 2 byte value are reserved and should not be used.

7.2 Data Element: DE_AccelerationConfidence

Use: This DE is used to provide the confidence interval of the 95% confidence level for the currently reported value of DE_Acceleration, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

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ASN.1 Representation:

```
AccelerationConfidence ::= ENUMERATED {
   unavailable  (0), -- B'000  Not Equipped or data is unavailable
   accl-100-00  (1), -- B'001  100  meters / second squared
   accl-010-00  (2), -- B'010  10   meters / second squared
   accl-005-00  (3), -- B'011  5    meters / second squared
   accl-001-00  (4), -- B'100  1    meters / second squared
   accl-000-10  (5), -- B'101  0.1  meters / second squared
   accl-000-05  (6), -- B'110  0.05 meters / second squared
   accl-000-01  (7)  -- B'111  0.01 meters / second squared
   }
   -- Encoded as a 3 bit value
```

XML Representation:

```
<xs:simpleType name="AccelerationConfidence" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- B&apos;000  Not Equipped or data is unavailable
            accl 100 00 (1) -- B&apos;001  100  meters / second squared
            accl 010 00 (2) -- B&apos;010  10   meters / second squared
            accl 005 00 (3) -- B&apos;011  5    meters / second squared
            accl 001 00 (4) -- B&apos;100  1    meters / second squared
            accl 000 10 (5) -- B&apos;101  0.1  meters / second squared
            accl 000 05 (6) -- B&apos;110  0.05 meters / second squared
            accl 000 01 (7) -- B&apos;111  0.01 meters / second squared
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 3 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="accl 100 00"/>
               <xs:enumeration value="accl 010 00"/>
               <xs:enumeration value="accl 005 00"/>
               <xs:enumeration value="accl 001 00"/>
               <xs:enumeration value="accl 000 10"/>
               <xs:enumeration value="accl 000 05"/>
               <xs:enumeration value="accl 000 01"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_AccelSteerYawRateConfidence	<ASN>	<XML>, and
DF	DF_VehicleStatus	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.3 Data Element: DE_AdvisorySpeedType

Use: The AdvisorySpeedType data element relates the type of travel to which a given speed refers. Typically used as part of an AdvisorySpeed data frame for signal phase and timing data.

ASN.1 Representation:

```
AdvisorySpeedType ::= ENUMERATED {
    none,
    greenwave,
    ecoDrive,
    transit,
    ...
    }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_AdvisorySpeed <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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7.4 Data Element: DE_AllowedManeuvers

Use: The AllowedMovements data element relates the allowed (possible) maneuvers from a lane, typically a motorized vehicle lane. Note that in practice these values may be further restricted by vehicle class, local regulatory environment and other changing conditions.

ASN.1 Representation:

```
AllowedManeuvers ::= BIT STRING {
    -- With bits as defined:
    -- Allowed and maneuvers at path end (stop line)
    -- All maneuvers with bits not set are therefore prohibited !
    -- A value of zero shall be used for unknown, indicating no Maneuver
    maneuverStraightAllowed      (0),
                                  -- a Straight movement is allowed in this lane
    maneuverLeftAllowed          (1),
                                 -- a Left Turn movement is allowed in this lane
    maneuverRightAllowed         (2),
                                 -- a Right Turn movement is allowed in this lane
    maneuverUTurnAllowed         (3),
                                 -- a U turn movement is allowed in this lane
    maneuverLeftTurnOnRedAllowed (4),
                                 -- a Stop, and then proceed when safe movement
                                 -- is allowed in this lane
    maneuverRightTurnOnRedAllowed (5),
                                 -- a Stop, and then proceed when safe movement
                                 -- is allowed in this lane
    maneuverLaneChangeAllowed    (6),
                                 -- a movement which changes to an outer lane
                                 -- on the egress side is allowed in this lane
                                 -- (example: left into either outbound lane)
    maneuverNoStoppingAllowed    (7),
                                 -- the vehicle should not stop at the stop line
```

```
                                   -- (example: a flashing green arrow)
     yieldAllwaysRequired          (8),
                                   -- the allowed movements above are not protected
                                   -- (example: an permanent yellow condition)
     goWithHalt                    (9),
                                   -- after making a full stop, may proceed
     caution                       (10),
                                   -- proceed past stop line with caution
     reserved1                     (11)
                                   -- used to align to 12 Bit Field

    } (SIZE(12))
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_ConnectingLane <ASN> <>, and

DF DF_GenericLane_CHANGED <ASN> <>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: When used, the AllowedManeuvers data concept is used in two places. Optionally in the generic lane structure to list all possible maneuvers (as in what that lane can do at its stop line point). Within a each ConnectsTo structure in a list it used to provide a single valid maneuver in the context of one lane connecting to another in the context of a signal phase that applies to that maneuver. Observe that in some intersections multiple outbound lanes can be reached by the same maneuver (for example two independent left turns might be found in a 5-legged intersection) but that to reach any given lane from the stop line of another lane is always a single maneuver item (hence the use of a list). Not all intersection make contains an exhaustive set of ConnectTo information (un signalized intersections for example) and in such cases the AllowedManeuvers in the generic lane structure is used. If used in both places, the data expressed in the generic lane shall not conflict with the data found in the collection of ConnectsTo entries.

7.5 Data Element: DE_AmbientAirPressure (Barometric Pressure)

Use: This data element is used to relate the measured Ambient Pressure (Barometric Pressure) from a vehicle or other device. The value of zero shall be used when not equipped. The value of one indicates a pressure of 580 hPa.

ASN.1 Representation:

```
AmbientAirPressure ::= INTEGER (0..255)
   -- 8 Bits in hPa starting at 580 with a resolution of
   -- 2 hPa resulting in a range of 580 to 1090
```

XML Representation:

```
<xs:simpleType name="AmbientAirPressure" >
      <xs:annotation>
         <xs:documentation>
            8 Bits in hPa starting at 580 with a resolution of
            2 hPa resulting in a range of 580 to 1090
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte"/>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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Remarks: Definition: The pressure exerted by the weight of the earth's atmosphere, equal to one bar, 100 kilopascals, or 14.7 psi (often rounded off to 15 psi) at sea level. Barometric pressure changes with the weather and with altitude. Since it affects the density of the air entering the engine and ultimately the air/fuel ratio, some computerized emissions control systems use a barometric pressure sensor so that the spark advance and EGR flow can be regulated to control emissions more precisely.

Note that 1 kPa = 10 hPa,
To convert pounds per square inch to kilopascals, multiply the PSI value by 6.894757293168361.
To convert kilopascals to pounds per square inch, multiply the kpa value by .14503773773020923.

7.6 Data Element: DE_AmbientAirTemperature

Use: This data element is used to relate the measured Ambient Air Temperature from a vehicle or other device. Its measurement range and precision follows that defined by the relevant ODB-II standards. This provides for a precision of one degree centigrade and a range of -40 to +150 degrees encoded in a one byte value. The value of -40 deg C is encoded as zero and every degree above that increments the transmitted value by one resulting in a transmission range of 0 to 191. Hence, a measurement value representing 25 degrees centigrade is transmitted as 40+25=65 or Hex 0x41.

ASN.1 Representation:
```
AmbientAirTemperature ::= INTEGER (0..191) -- in deg C with a -40 offset
```

XML Representation:
```
<xs:simpleType name="AmbientAirTemperature" >
      <xs:annotation>
         <xs:documentation>
            in deg C with a -40 offset
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="191"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.7 Data Element: DE_Angle

Use: The data element Angle is used to describe an angular measurement in units of degrees. Often this is used as a heading direction when in motion. Is this use, the current heading of the sending device. It is expressed in unsigned units of 0.0125 degrees from North (such that 28799 such degrees represent 359.9875 degrees). North shall be defined as the axis defined by the WGS-84 coordinate system and its reference ellipsoid. Any angle "to the east" is defined as the positive direction. A 2 byte value when sent in some encoding systems. A value of 28800 shall be used when unavailable. When sent by a vehicle, this element indicates the orientation of the front of the vehicle.

ASN.1 Representation:
```
Angle ::= INTEGER (0..28800)
   -- LSB of 0.0125 degrees
   -- A range of 0 to 359.9875 degrees
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ComputedLane CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that other one byte heading or angle data elements are found in other parts of ITS.

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7.8 Data Element: DE_AntiLockBrakeStatus

Use: The DE_AntiLockBrakeStatus data element conveys in two bits the state of the sender's anti-lock braking system. The four defined states are: Vehicle not equipped with anti-lock braking system (00), an anti-lock braking system is off (01), an anti-lock braking system is on but not engaged (10), and an anti-lock braking system is on and engaged (11). An anti-lock braking system, if available, detects a situation that may indicate loss of control. A report of an engaged anti-lock braking system can be useful in identifying a hazardous situation involving a specific vehicle or road location.

ASN.1 Representation:

```
AntiLockBrakeStatus ::= ENUMERATED {
   unavailable (0), -- B'00  Vehicle Not Equipped with ABS
                    -- or ABS status is unavailable
   off         (1), -- B'01  Vehicle's ABS is Off
   on          (2), -- B'10  Vehicle's ABS is On (but not engaged)
   engaged     (3)  -- B'11  Vehicle's ABS is Engaged
   }
   -- Encoded as a 2 bit value
```

XML Representation:

```
<xs:simpleType name="AntiLockBrakeStatus" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- B&apos;00  Vehicle Not Equipped with ABS
             -- or ABS status is unavailable
            off (1) -- B&apos;01  Vehicle&apos;s ABS is Off
            on (2) -- B&apos;10  Vehicle&apos;s ABS is On  (but not engaged)
            engaged (3) -- B&apos;11  Vehicle&apos;s ABS is Engaged
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 2 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="off"/>
               <xs:enumeration value="on"/>
               <xs:enumeration value="engaged"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

Remarks: The value for notEquipped shall be used when data is not available.

7.9 Data Element: DE_ApproachID

Use: The Approach ID data element is used to relate the index of an approach, either ingress or egress within the subject lane. In general an approach in the concept of a timing movement is not of value in the MAP and SPAT process because the lane ID and signal group ID concepts handle this with more precision. This value can also be useful as an aid as it created a fallback solution to indicate the gross position of a moving object (vehicle) when its lane level accuracy is unknown. This value is also of some use when a deployment represents sets of lanes as groups without further details (as is done in Japan).

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ASN.1 Representation:

```
ApproachID ::= INTEGER (0..15) -- zero to be used when valid value is unknown
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_GenericLane CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.10 Data Element: DE_AuxiliaryBrakeStatus

Use: The AuxiliaryBrakeStatus data element conveys in two bits the state of the sender's Auxiliary Brake system (often also called a parking brake). The three defined states are: Vehicle not equipped (00), Aux Brake not applied (01), and Aux Brake System applied (10). The state 11 is reserved.

ASN.1 Representation:

```
AuxiliaryBrakeStatus ::= ENUMERATED {
   unavailable (0), -- B'00  Vehicle Not Equipped with Aux Brakes
                    -- or Aux Brakes status is unavailable
   off         (1), -- B'01  Vehicle's Aux Brakes are Off
   on          (2), -- B'10  Vehicle's Aux Brakes are On ( Engaged )
   reserved    (3)  -- B'11
   }
   -- Encoded as a 2 bit value
```

XML Representation:

```
<xs:simpleType name="AuxiliaryBrakeStatus" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- B&apos;00  Vehicle Not Equipped with Aux Brakes
             -- or Aux Brakes status is unavailable
            off (1) -- B&apos;01  Vehicle&apos;s Aux Brakes are Off
            on (2) -- B&apos;10  Vehicle&apos;s Aux Brakes are On  ( Engaged )
            reserved (3) -- B&apos;11
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 2 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="off"/>
               <xs:enumeration value="on"/>
               <xs:enumeration value="reserved"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

Remarks: The value for notEquipped shall be used when data is not available.

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7.11 Data Element: DE_BrakeAppliedPressure

Use: The applied pressure of the vehicle brake system.

ASN.1 Representation:

```
BrakeAppliedPressure ::= ENUMERATED {
   unavailable  (0),  -- B'0000 Not Equipped
                      -- or Brake Pres status is unavailable
   minPressure  (1),  -- B'0001 Minimum Braking Pressure
   bkLvl-2      (2),  -- B'0010
   bkLvl-3      (3),  -- B'0011
   bkLvl-4      (4),  -- B'0100
   bkLvl-5      (5),  -- B'0101
   bkLvl-6      (6),  -- B'0110
   bkLvl-7      (7),  -- B'0111
   bkLvl-8      (8),  -- B'1000
   bkLvl-9      (9),  -- B'1001
   bkLvl-10     (10), -- B'1010
   bkLvl-11     (11), -- B'1011
   bkLvl-12     (12), -- B'1100
   bkLvl-13     (13), -- B'1101
   bkLvl-14     (14), -- B'1110
   maxPressure  (15)  -- B'1111 Maximum Braking Pressure
   }
   -- Encoded as a 4 bit value
```

XML Representation:

```
<xs:simpleType name="BrakeAppliedPressure" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- B&apos;0000 Not Equipped
             -- or Brake Pres status is unavailable
            minPressure (1) -- B&apos;0001 Minimum Braking Pressure
            bkLvl 2 (2) -- B&apos;0010
            bkLvl 3 (3) -- B&apos;0011
            bkLvl 4 (4) -- B&apos;0100
            bkLvl 5 (5) -- B&apos;0101
            bkLvl 6 (6) -- B&apos;0110
            bkLvl 7 (7) -- B&apos;0111
            bkLvl 8 (8) -- B&apos;1000
            bkLvl 9 (9) -- B&apos;1001
            bkLvl 10 (10) -- B&apos;1010
            bkLvl 11 (11) -- B&apos;1011
            bkLvl 12 (12) -- B&apos;1100
            bkLvl 13 (13) -- B&apos;1101
            bkLvl 14 (14) -- B&apos;1110
            maxPressure (15) -- B&apos;1111 Maximum Braking Pressure
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 4 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="15"/>
            </xs:restriction>
         </xs:simpleType>
```

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```
            <xs:simpleType>
               <xs:restriction base="xs:string">
                  <xs:enumeration value="unavailable"/>
                  <xs:enumeration value="minPressure"/>
                  <xs:enumeration value="bkLvl 2"/>
                  <xs:enumeration value="bkLvl 3"/>
                  <xs:enumeration value="bkLvl 4"/>
                  <xs:enumeration value="bkLvl 5"/>
                  <xs:enumeration value="bkLvl 6"/>
                  <xs:enumeration value="bkLvl 7"/>
                  <xs:enumeration value="bkLvl 8"/>
                  <xs:enumeration value="bkLvl 9"/>
                  <xs:enumeration value="bkLvl 10"/>
                  <xs:enumeration value="bkLvl 11"/>
                  <xs:enumeration value="bkLvl 12"/>
                  <xs:enumeration value="bkLvl 13"/>
                  <xs:enumeration value="bkLvl 14"/>
                  <xs:enumeration value="maxPressure"/>
               </xs:restriction>
            </xs:simpleType >
         </xs:union>
   </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.12 Data Element: DE_BrakeAppliedStatus

Use: The Brake Applied Status data element indicates independently for each of four wheels whether braking is currently active. The four wheels are designated Left Front, Right Front, Left Rear, and Right Rear. The indicated status of a wheel is set to 1 if brakes are active on that wheel, or to 0 if brakes are inactive on that wheel. On a vehicle with only one front wheel, the brake-applied status is represented by the Left Front wheel indicator and the Right Front indicator is always set to zero. Similarly, on a vehicle with only one rear wheel the brake-applied status is represented by the Left Rear wheel indicator and the Right Rear indicator is always set to zero. If a vehicle has more than two front wheels (respectively more than two rear wheels) with independent braking, the collective brake-applied status of these wheels is mapped to the Left Front and Right Front (respectively Left Rear and Right Rear) indicators in a locally defined manner. Brake Applied Status could be used by a traffic management center to determine that an incident has occurred or congestion may be present. It is possible for some vehicles to provide an indication of how hard the braking action, this is handled in another data element (DE_BrakeAppliedPressure).

ASN.1 Representation:

```
   BrakeAppliedStatus ::= BIT STRING {
      allOff      (0), -- B'0000  The condition All Off
      leftFront   (1), -- B'0001  Left Front Active
      leftRear    (2), -- B'0010  Left Rear Active
      rightFront  (4), -- B'0100  Right Front Active
      rightRear   (8)  -- B'1000  Right Rear Active
      } -- to fit in 4 bits
```

XML Representation:

```
   <xs:simpleType name="BrakeAppliedStatus-item" >
         <xs:annotation>
            <xs:appinfo>
               allOff (0) -- B&apos;0000  The condition All Off
               leftFront (1) -- B&apos;0001  Left Front Active
               leftRear (2) -- B&apos;0010  Left Rear Active
               rightFront (4) -- B&apos;0100  Right Front Active
               rightRear (8) -- B&apos;1000  Right Rear Active
            </xs:appinfo>
            <xs:documentation>
```

```
            to fit in 4 bits
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:int">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="8"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="allOff"/>
               <xs:enumeration value="leftFront"/>
               <xs:enumeration value="leftRear"/>
               <xs:enumeration value="rightFront"/>
               <xs:enumeration value="rightRear"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
   </xs:simpleType>
   <xs:simpleType name="BrakeAppliedStatus">
      <xs:list itemType="BrakeAppliedStatus-item"/>
   </xs:simpleType>
```

Remarks: On vehicles with only 2 wheels, the left side values shall be used and the right side set to zero. Deployments may wish to define additional combinations such as "all on" here.

7.13 Data Element: DE_BrakeBoostApplied

Use: This is a data element which, when set to the "on" state, indicates emergency braking. This data element is an on/off value which indicates engagement of the vehicle's brake boost assist function (as well as an unavailable state). Brake boost assist is available on some vehicles. It detects the potential of a situation requiring maximum braking and pre-charges the brake system even before the driver presses the brake pedal. This situation is detected either by measuring a rapid release of the accelerator pedal or via a forward sensing system. Some systems also apply full braking when the driver presses the pedal, even with a light force. Multiple probe data reports re activation of brake boost at the same location is an indication of an emergency situation on the road and is therefore of use to road authorities.

ASN.1 Representation:

```
BrakeBoostApplied ::= ENUMERATED {
   unavailable   (0), -- Vehicle not equipped with brake boost
                      -- or brake boost data is unavailable
   off           (1), -- Vehicle's brake boost is off
   on            (2)  -- Vehicle's brake boost is on (applied)
   }
   -- Encoded as a 2 bit value
```

XML Representation:

```
<xs:simpleType name="BrakeBoostApplied" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- Vehicle not equipped with brake boost
             -- or brake boost data is unavailable
            off (1) -- Vehicle&apos;s brake boost is off
            on (2) -- Vehicle&apos;s brake boost is on  (applied)
         </xs:appinfo>
         <xs:documentation>
```

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```
            Encoded as a 2 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="2"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="off"/>
               <xs:enumeration value="on"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
   </xs:simpleType>
```

7.14 Data Element: DE_BumperHeightFront

Use: The DE_Bumper Height Front data element conveys the height of the front bumper of the vehicle. In cases of vehicles with complex bumper shapes, the center of the mass of the bumper (where the bumper can best absorb an impact) should be used.

ASN.1 Representation:

```
BumperHeightFront ::= INTEGER (0..127) -- in units of 0.01 meters from ground surface.
```

XML Representation:

```
<xs:simpleType name="BumperHeightFront" >
      <xs:annotation>
         <xs:documentation>
            in units of 0.01 meters from ground surface.
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="127"/>
      </xs:restriction>
   </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_BumperHeights <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.15 Data Element: DE_BumperHeightRear

Use: The DE_Bumper Height Rear data element conveys the height of the rear bumper of the vehicle. In cases of vehicles with complex bumper shapes, the center of the mass of the bumper (where the bumper can best absorb an impact) should be used.

ASN.1 Representation:

```
BumperHeightRear ::= INTEGER (0..127) -- in units of 0.01 meters from ground surface.
```

XML Representation:

```
<xs:simpleType name="BumperHeightRear" >
      <xs:annotation>
         <xs:documentation>
            in units of 0.01 meters from ground surface.
         </xs:documentation>
      </xs:annotation>
```

```
        <xs:restriction base="xs:unsignedByte">
           <xs:maxInclusive value="127"/>
        </xs:restriction>
    </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_BumperHeights <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.16 Data Element: DE_CodeWord

Use: The DE_CodeWord is used to convey a prior known string of bytes between systems, typically to establish trust or validity of the message request in which it is found. The use and setting of these words, as well as any policy regarding changing the value over time, is up to the participants.

ASN.1 Representation:

```
CodeWord ::= OCTET STRING (SIZE(1..16))
   -- any octect string up to 16 bytes
```

XML Representation:

```
<xs:complexType name="CodeWord" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            any octect string up to 16 bytes
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="CodeWord-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="CodeWord-string">
   <xs:restriction base="xs:base64Binary">
      <xs:minLength value="2"/>
      <xs:maxLength value="22"/>
   </xs:restriction>
</xs:simpleType >
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_SignalRequest <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.17 Data Element: DE_CoefficientOfFriction

Use: Coefficient of Friction of an object, typical a wheel in contact with the ground. This DE is typically used in sets where the value of each wheel is provided in turn as a measure of relative local traction.

ASN.1 Representation:

```
CoefficientOfFriction ::= INTEGER (0..50)
   -- where 0 = 0.00 micro (frictonless)
   -- and 50 = 0.98 micro, in steps of 0.02
```

XML Representation:

```
<xs:simpleType name="CoefficientOfFriction" >
      <xs:annotation>
         <xs:documentation>
            where 0 = 0.00 micro  (frictonless)
            and 50 = 0.98 micro,  in steps of 0.02
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="50"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.18 Data Element: DE_Count

Use: The DE_Count data element provides a count of items to follow in the message.

ASN.1 Representation:

```
Count ::= INTEGER (0..32)
```

XML Representation:

```
<xs:simpleType name="Count" >
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="32"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_PathHistory	<ASN>	<XML>, and
MSG	MSG_ProbeDataManagement (PDM)	<ASN>	<XML>, and
MSG	MSG_ProbeVehicleData (PVD)	<ASN>	<XML>, and
MSG	MSG_TravelerInformation Message (TIM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

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7.19 Data Element: DE_DDay

Use: The DSRC style day is a simple value consisting of integer values from zero to 31. The value of zero shall represent an unknown value.

ASN.1 Representation:

```
DDay ::= INTEGER (0..31)   -- units of days
```

XML Representation:

```
<xs:simpleType name="DDay" >
      <xs:annotation>
         <xs:documentation>
            units of days
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="31"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_DDate	<ASN>	<XML>, and
DF	DF_DDateTime	<ASN>	<XML>, and
DF	DF_DFullTime	<ASN>	<XML>, and
DF	DF_DMonthDay	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.20 Data Element: DE_DeltaAngle

Use: The DeltaAngle data element provides the final angle used in last point of the path. Used to "cant" the stop line of the lane.

ASN.1 Representation:

```
DeltaAngle ::= INTEGER (-150..150)
   -- With an angle range from
   -- negative 150 to positive 150
   -- in one degree steps where zero is directly
   -- along the lane center line as defined by the
   -- two closest points
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneDataAttribute <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.21 Data Element: DE_DescriptiveName

Use: The DescriptiveName data concept is used in maps and intersections to provide an (optional) human readable and recognizable name for the feature that follows. It is typically used when debugging a data flow, and not in production use. One key exception to this general rule is to provide a human readable string for disabled travelers in the case of crosswalks and sidewalk lane objects.

ASN.1 Representation:

```
DescriptiveName ::= IA5String (SIZE(1..63))
```

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Used By: This entry is directly used by the following 8 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_GenericLane_CHANGED	<ASN>	<>, and
DF	DF_IntersectionGeometry CHANGED	<ASN>	<>, and
DF	DF_IntersectionState CHANGED	<ASN>	<>, and
DF	DF_MovementState	<ASN>	<>, and
DF	DF_RoadSegment CHANGED	<ASN>	<>, and
DF	DF_SignalControlZone	<ASN>	<XML>, and
DF	DF_VehicleIdent	<ASN>	<XML>, and
MSG	MSG_SignalPhaseAndTiming Message_(SPAT)		<ASN><>.

In addition, this item may be used by data structures in other ITS standards.

7.22 Data Element: DE_DHour

Use: The DSRC style hour is a simple value consisting of integer values from zero to 23 representing the hours within a day. The value of 31 SHALL represent an unknown value, the range 24 to 30 is reserved.

ASN.1 Representation:

```
DHour ::= INTEGER (0..31) -- units of hours
```

XML Representation:

```
<xs:simpleType name="DHour" >
      <xs:annotation>
         <xs:documentation>
            units of hours
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="31"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_DDateTime	<ASN>	<XML>, and
DF	DF_DFullTime	<ASN>	<XML>, and
DF	DF_DTime	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

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7.23 Data Element: DE_DirectionOfUse

Use: The allowed direction of travel on a street lane or path described by shape points. The presumed (default) direction is outward, away from the initial set of points. However this data element can be used to overcome that and indicate a reverse direction or both directions as well as the original outward direction.

ASN.1 Representation:

```
DirectionOfUse ::= ENUMERATED {
   forward    (0), -- direction of travel follows node ordering
   reverse    (1), -- direction of travel is the reverse of node ordering
   both       (2), -- direction of travel allowed in both directions
   ...
   }
```

XML Representation:

```
<xs:simpleType name="DirectionOfUse" >
      <xs:annotation>
         <xs:appinfo>
            forward (0) -- direction of travel follows node ordering
            reverse (1) -- direction of travel is the reverse of node ordering
            both (2) -- direction of travel allowed in both directions
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="2"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="forward"/>
               <xs:enumeration value="reverse"/>
               <xs:enumeration value="both"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_ShapePointSet	<ASN>	<XML>, and
MSG	MSG_TravelerInformation Message (TIM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.24 Data Element: DE_DMinute

Use: The DSRC style minute is a simple value consisting of integer values from zero to 59 representing the minutes within an hour. The value of 63 SHALL represent an unknown value, the range 60 to 62 is reserved.

ASN.1 Representation:

```
DMinute ::= INTEGER (0..63) -- units of minutes
```

XML Representation:

```
<xs:simpleType name="DMinute" >
      <xs:annotation>
         <xs:documentation>
            units of minutes
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="63"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_DDateTime	<ASN>	<XML>, and
DF	DF_DFullTime	<ASN>	<XML>, and
DF	DF_DTime	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.25 Data Element: DE_DMonth

Use: The DSRC style month is a simple value consisting of integer values from one to 12 representing the month within a year. The value of 15 SHALL represent an unknown value. The range 13 to 14 and the value zero are all reserved.

ASN.1 Representation:

```
DMonth ::= INTEGER (0..15) -- units of months
```

XML Representation:

```
<xs:simpleType name="DMonth" >
      <xs:annotation>
         <xs:documentation>
            units of months
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="15"/>
      </xs:restriction>
</xs:simpleType>
```

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Used By: This entry is directly used by the following 5 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_DDate	<ASN>	<XML>, and
DF	DF_DDateTime	<ASN>	<XML>, and
DF	DF_DFullTime	<ASN>	<XML>, and
DF	DF_DMonthDay	<ASN>	<XML>, and
DF	DF_DYearMonth	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.26 Data Element: DE_DOffset

Use: The DSRC style (time zone) offset is a simple value consisting of a signed integer representing an hour and minute value set from -14:00 to +14:00 representing all the worlds local time zones in units of minutes. The value of zero (00:00) may represent an unknown value. Note some time zones are do not align to hourly boundaries.

ASN.1 Representation:

```
DOffset ::= INTEGER (-840..840) -- units of minutes from UTC time
```

XML Representation:

```
<xs:simpleType name="DOffset" >
      <xs:annotation>
         <xs:documentation>
            units of minutes from UTC time
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:short">
         <xs:minInclusive value="-840"/>
         <xs:maxInclusive value="840"/>
      </xs:restriction>
</xs:simpleType>
```

7.27 Data Element: DE_DrivenLineOffsetLarge

Use: The DrivenLineOffsetSmall is an integer value expressing the offset in a defined axis from a reference lane number that a computed lane is offset from. The measurement is taken from the reference lane center line to the new center line, independent of any width values. The units are a signed value with an LSB of 1 cm.

ASN.1 Representation:

```
DrivenLineOffsetLg ::= INTEGER (-32767..32767)
   -- LSB units are 1 cm.
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ComputedLane CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: See also DE_DrivenLineOffsetSmall

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7.28 Data Element: DE_DrivenLineOffsetSmall

Use: The DrivenLineOffsetSmall is an integer value expressing the offset in a defined axis from a reference lane number that a computed lane is offset from. The measurement is taken from the reference lane center line to the new center line, independent of any width values. The units are a signed value with an LSB of 1 cm.

ASN.1 Representation:

```
DrivenLineOffsetSm ::= INTEGER (-2047..2047)
    -- LSB units are 1 cm.
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ComputedLane CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: See also DE_DrivenLineOffsetLarge

7.29 Data Element: DE_DrivingWheelAngle

Use: The angle of the front (steering) wheel, expressed in a signed (to the right being positive) value with units of 0.3333 degrees and a range of plus or minus 42.33 degrees. The value of zero shall be when both wheels are pointed such as to drive the vehicle in a straight ahead direction (the tow-in angle of each side being equal and canceling each other out). A value of zero shall be sent when unavailable.

ASN.1 Representation:

```
DrivingWheelAngle ::= INTEGER (-127..127)
    -- LSB units of 0.3333 degrees.
    -- a range of 42.33 degrees each way
```

XML Representation:

```
<xs:simpleType name="DrivingWheelAngle" >
      <xs:annotation>
         <xs:documentation>
            LSB units of 0.3333 degrees.
            a range of 42.33 degrees each way
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:byte">
         <xs:minInclusive value="-127"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.30 Data Element: DE_DSecond2

Use: The DSRC style second expressed in this data element is a simple value consisting of integer values from zero to 60999 representing the milliseconds within a minute. A leap second is represented by the value range 60000 to 60999. The value of 65535 SHALL represent an unavailable value in the range of the minute, other values from 61000 to 65534 are reserved.

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ASN.1 Representation:

```
DSecond2 ::= INTEGER (0..65535) -- units of miliseconds
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_IntersectionState CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The value contained in the DSecond data element must refer to a known point in time within the DSRC system that is shared or understood by the user community. This point in time is typically the moment when the position determination was made for most messages (such as the BSM). Other measurements present in the same message (speed, heading etc.) should be aligned to that moment insofar as possible in the implementation.

The need for a leap second arises from the difference between solar time and UTC time. Here is a useful reference on this topic: <http://tycho.usno.navy.mil/leapsec.html>

7.31 Data Element: DE_DSecond

Use: The DSRC style second expressed in this data element is a simple value consisting of integer values from zero to 60999 representing the milliseconds within a minute. A leap second is represented by the value range 60001 to 60999. The value of 65535 SHALL represent an unavailable value in the range of the minute, other values from 61000 to 65534 are reserved.

ASN.1 Representation:

```
DSecond ::= INTEGER (0..65535) -- units of miliseconds
```

XML Representation:

```
<xs:simpleType name="DSecond" >
      <xs:annotation>
         <xs:documentation>
            units of miliseconds
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_DDateTime	<ASN>	<XML>, and
DF	DF_DTime	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_Verbose_(VBSM)	<ASN>	<XML>, and
MSG	MSG_IntersectionCollisionAvoidance_(ICA)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: The value contained in the DSecond data element must refer to a known point in time within the DSRC system that is shared or understood by the user community. This point in time is typically the moment when the position determination was made for most messages (such as the BSM). Other measurements present in the same message (speed, heading etc.) should be aligned to that moment insofar as possible in the implementation.

The need for a leap second arises from the difference between solar time and UTC time. Here is a useful reference on this topic: <http://tycho.usno.navy.mil/leapsec.html>

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7.32 Data Element: DE_DSRC_MessageID2

Use: The DSRC Message ID2 is a data element used in each message to define which type of message follows from the message set defined by this Standard. This data element is always the first value inside the message and is used to tell the receiving application how to interpret the remaining bytes (i.e. what message structure has been used).

ASN.1 Representation:

```
DSRCmsgID2 ::= INTEGER (0..255)
   -- DER forms
   reservedMessageId-D              DSRCmsgID2 ::=  0 --'00'H
   alaCarteMessage-D                DSRCmsgID2 ::=  1 --'01'H ACM
   -- alaCarteMessage-D is Retired, not to be used
   basicSafetyMessage-D             DSRCmsgID2 ::=  2 --'02'H BSM, heartbeat msg
   basicSafetyMessageVerbose-D      DSRCmsgID2 ::=  3 --'03'H For testing only
   commonSafetyRequest-D            DSRCmsgID2 ::=  4 --'04'H CSR
   emergencyVehicleAlert-D          DSRCmsgID2 ::=  5 --'05'H EVA
   intersectionCollisionAlert-D     DSRCmsgID2 ::=  6 --'06'H ICA
   mapData-D                        DSRCmsgID2 ::=  7 --'07'H MAP, intersections
   -- mapData-D is Retired, not to be used
   nmeaCorrections-D                DSRCmsgID2 ::=  8 --'08'H NMEA
   probeDataManagement-D            DSRCmsgID2 ::=  9 --'09'H PDM
   probeVehicleData-D               DSRCmsgID2 ::= 10 --'0A'H PVD
   roadSideAlert-D                  DSRCmsgID2 ::= 11 --'0B'H RSA
   rtcmCorrections-D                DSRCmsgID2 ::= 12 --'0C'H RTCM
   signalPhaseAndTimingMessage-D    DSRCmsgID2 ::= 13 --'0D'H SPAT
   -- signalPhaseAndTimingMessage-D is Retired, not to be used
   signalRequestMessage-D           DSRCmsgID2 ::= 14 --'0E'H SRM
   signalStatusMessage-D            DSRCmsgID2 ::= 15 --'0F'H SSM
   travelerInformation-D            DSRCmsgID2 ::= 16 --'10'H TIM
   uperFrame-D                      DSRCmsgID2 ::= 17 --'11'H UPER frame
   -- UPER forms
   mapData-P                        DSRCmsgID2 ::= 18 --'12'H MAP, intersections
   signalPhaseAndTimingMessage-P    DSRCmsgID2 ::= 19 --'13'H SPAT

   -- values to 127 reserved for std use
   -- values 128 to 255 reserved for local use
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

MSG MSG_MapData (MAP) <ASN> <>, and

MSG MSG_SignalPhaseAndTiming Message (SPAT) <ASN><>, and

MSG MSG_UPER_Frame_USA (UPER) CHANGED <ASN> <>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: Note: The three/four letter abbreviations shown in the ASN comments are sometimes used as shorthand terms for the subject messages in the documentation.

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7.33 Data Element: DE_DSRC_MessageID

Use: The DSRC Message ID is a data element used in each message to define which type of message follows from the message set defined by this Standard. This data element is always the first value inside the message and is used to tell the receiving application how to interpret the remaining bytes (i.e. what message structure has been used).

ASN.1 Representation:

```
DSRCmsgID ::= ENUMERATED {
   reserved                          (0),
   alaCarteMessage                   (1),  -- ACM
   basicSafetyMessage                (2),  -- BSM, heartbeat msg
   basicSafetyMessageVerbose         (3),  -- used for testing only
   commonSafetyRequest               (4),  -- CSR
   emergencyVehicleAlert             (5),  -- EVA
   intersectionCollisionAlert        (6),  -- ICA
   mapData                           (7),  -- MAP, GID, intersections
   nmeaCorrections                   (8),  -- NMEA
   probeDataManagement               (9),  -- PDM
   probeVehicleData                  (10), -- PVD
   roadSideAlert                     (11), -- RSA
   rtcmCorrections                   (12), -- RTCM
   signalPhaseAndTimingMessage       (13), -- SPAT
   signalRequestMessage              (14), -- SRM
   signalStatusMessage               (15), -- SSM
   travelerInformation               (16), -- TIM

   ... -- # LOCAL_CONTENT
   }
   -- values to 127 reserved for std use
   -- values 128 to 255 reserved for local use
```

XML Representation:

```
<xs:simpleType name="DSRCmsgID" >
      <xs:annotation>
         <xs:appinfo>
            reserved (0)
            alaCarteMessage (1) -- ACM
            basicSafetyMessage (2) -- BSM ,
            basicSafetyMessageVerbose (3) -- used for testing only
            commonSafetyRequest (4) -- CSR
            emergencyVehicleAlert (5) -- EVA
            intersectionCollisionAlert (6) -- ICA
            mapData (7) -- MAP ,
            nmeaCorrections (8) -- NMEA
            probeDataManagement (9) -- PDM
            probeVehicleData (10) -- PVD
            roadSideAlert (11) -- RSA
            rtcmCorrections (12) -- RTCM
            signalPhaseAndTimingMessage (13) -- SPAT
            signalRequestMessage (14) -- SRM
            signalStatusMessage (15) -- SSM
            travelerInformation (16) -- TIM
         </xs:appinfo>
         <xs:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xs:documentation>
      </xs:annotation>
      <xs:union>
```

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```
        <xs:simpleType>
           <xs:restriction base="xs:unsignedInt">
              <xs:minInclusive value="0"/>
              <xs:maxInclusive value="16"/>
           </xs:restriction>
        </xs:simpleType>
        <xs:simpleType>
           <xs:restriction base="xs:string">
              <xs:enumeration value="reserved"/>
              <xs:enumeration value="alaCarteMessage"/>
              <xs:enumeration value="basicSafetyMessage"/>
              <xs:enumeration value="basicSafetyMessageVerbose"/>
              <xs:enumeration value="commonSafetyRequest"/>
              <xs:enumeration value="emergencyVehicleAlert"/>
              <xs:enumeration value="intersectionCollisionAlert"/>
              <xs:enumeration value="mapData"/>
              <xs:enumeration value="nmeaCorrections"/>
              <xs:enumeration value="probeDataManagement"/>
              <xs:enumeration value="probeVehicleData"/>
              <xs:enumeration value="roadSideAlert"/>
              <xs:enumeration value="rtcmCorrections"/>
              <xs:enumeration value="signalPhaseAndTimingMessage"/>
              <xs:enumeration value="signalRequestMessage"/>
              <xs:enumeration value="signalStatusMessage"/>
              <xs:enumeration value="travelerInformation"/>
           </xs:restriction>
        </xs:simpleType >
        <xs:simpleType>
           <xs:restriction base="local:DSRCmsgID" />
        </xs:simpleType>
     </xs:union>
  </xs:simpleType>
```

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Used By: This entry is directly used by the following 14 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

MSG	MSG_BasicSafetyMessage (BSM)	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_Verbose (VBSM)	<ASN>	<XML>, and
MSG	MSG_CommonSafetyRequest (CSR)	<ASN>	<XML>, and
MSG	MSG_EmergencyVehicleAlert (EVA)	<ASN>	<XML>, and
MSG	MSG_IntersectionCollisionAvoidance (ICA)	<ASN>	<XML>, and
MSG	MSG_NMEA_Corrections (NMEA)	<ASN>	<XML>, and
MSG	MSG_ProbeDataManagement (PDM)	<ASN>	<XML>, and
MSG	MSG_ProbeVehicleData (PVD)	<ASN>	<XML>, and
MSG	MSG_RoadSideAlert (RSA)	<ASN>	<XML>, and
MSG	MSG_RTCM_Corrections (RTCM)	<ASN>	<XML>, and
MSG	MSG_SignalRequestMessage (SRM)	<ASN>	<XML>, and
MSG	MSG_SignalStatusMessage (SSM)	<ASN>	<XML>, and

MSG MSG_TravelerInformation Message (TIM) <ASN> <XML>, and

MSG MSG_UPER_Frame_USA (UPER) CHANGED <ASN> <>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: Note: The three letter abbreviations shown in the ASN comments are sometimes used as shorthand terms for the subject messages in the documentation.

7.34 Data Element: DE_DSRC_MessageSubID

Use: The DSRCmsgSubID data element conveys information about the sub message ID of a message. The precise use of this data element remains to be further defined, and it shall be set to zero at this time. In future editions of the standard may be used as a means to indicate a revision of the structure details of a message in those cases when a new message id has not been assigned. In such a case, the unique combination of the message ID and the message sub ID would be used to specify the precise encoding details found in a given message definition.

ASN.1 Representation:

```
DSRCmsgSubID ::= INTEGER (0..255) -- to be set to zero when used at this time
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

MSG MSG_MapData (MAP) <ASN> <>, and

MSG MSG_SignalPhaseAndTiming Message (SPAT) <ASN><>, and

MSG MSG_UPER_Frame_USA (UPER) CHANGED <ASN> <>.

In addition, this item may be used by data structures in other ITS standards.

7.35 Data Element: DE_DYear

Use: The DSRC style year is a simple value consisting of integer values from zero to 9999 representing the year according to the Gregorian calendar date system. The value of zero SHALL represent an unknown value.

ASN.1 Representation:

```
DYear ::= INTEGER (0..9999) -- units of years
```

XML Representation:

```
<xs:simpleType name="DYear" >
      <xs:annotation>
         <xs:documentation>
            units of years
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="9999"/>
      </xs:restriction>
</xs:simpleType>
```

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Used By: This entry is directly used by the following 5 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_DDate	<ASN>	<XML>, and
DF	DF_DDateTime	<ASN>	<XML>, and
DF	DF_DFullTime	<ASN>	<XML>, and
DF	DF_DYearMonth	<ASN>	<XML>, and
MSG	MSG_TravelerInformation Message (TIM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.36 Data Element: DE_Elevation2

Use: The Elevation data element represents the geographic position above or below the reference ellipsoid (typically WGS-84). The number has a resolution of 1 decimeter and represents an asymmetric range of positive and negative values. Any elevation higher than +6143.9 meters is represented as +61439. Any elevation lower than -409.5 meters is represented as -4095 . If the sending device does not know its elevation it shall encode the Elevation data element with -4096.

ASN.1 Representation:

```
Elevation2 ::= INTEGER (-4096..61439)
    -- In units of 10 cm steps above or below the reference ellipsoid
    -- Providing a range of -409.5 to + 6143.9 meters
    -- The value -4096 shall be used when Unknown is to be sent
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Position3D_2_CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The Elevation shall be taken from the spatial center of the vehicle, when a vehicle is being measured.

7.37 Data Element: DE_ElevationConfidence

Use: This DE is used to provide the confidence interval of the 95% confidence level for the currently reported value of DE_Elevation, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

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ASN.1 Representation:

```
ElevationConfidence ::= ENUMERATED {
   unavailable (0),  -- B'0000  Not Equipped or unavailable
   elev-500-00 (1),  -- B'0001  (500 m)
   elev-200-00 (2),  -- B'0010  (200 m)
   elev-100-00 (3),  -- B'0011  (100 m)
   elev-050-00 (4),  -- B'0100  (50 m)
   elev-020-00 (5),  -- B'0101  (20 m)
   elev-010-00 (6),  -- B'0110  (10 m)
   elev-005-00 (7),  -- B'0111  (5 m)
   elev-002-00 (8),  -- B'1000  (2 m)
   elev-001-00 (9),  -- B'1001  (1 m)
   elev-000-50 (10), -- B'1010  (50 cm)
   elev-000-20 (11), -- B'1011  (20 cm)
   elev-000-10 (12), -- B'1100  (10 cm)
   elev-000-05 (13), -- B'1101  (5 cm)
   elev-000-02 (14), -- B'1110  (2 cm)
   elev-000-01 (15)  -- B'1111  (1 cm)
   }
   -- Encoded as a 4 bit value
```

XML Representation:

```
<xs:simpleType name="ElevationConfidence" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- B&apos;0000  Not Equipped or unavailable
            elev 500 00 (1) -- B&apos;0001   (500 m)
            elev 200 00 (2) -- B&apos;0010   (200 m)
            elev 100 00 (3) -- B&apos;0011   (100 m)
            elev 050 00 (4) -- B&apos;0100   (50 m)
            elev 020 00 (5) -- B&apos;0101   (20 m)
            elev 010 00 (6) -- B&apos;0110   (10 m)
            elev 005 00 (7) -- B&apos;0111   (5 m)
            elev 002 00 (8) -- B&apos;1000   (2 m)
            elev 001 00 (9) -- B&apos;1001   (1 m)
            elev 000 50 (10) -- B&apos;1010   (50 cm)
            elev 000 20 (11) -- B&apos;1011   (20 cm)
            elev 000 10 (12) -- B&apos;1100   (10 cm)
            elev 000 05 (13) -- B&apos;1101   (5 cm)
            elev 000 02 (14) -- B&apos;1110   (2 cm)
            elev 000 01 (15) -- B&apos;1111   (1 cm)
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 4 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="15"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="elev 500 00"/>
               <xs:enumeration value="elev 200 00"/>
               <xs:enumeration value="elev 100 00"/>
               <xs:enumeration value="elev 050 00"/>
```

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```
                <xs:enumeration value="elev 020 00"/>
                <xs:enumeration value="elev 010 00"/>
                <xs:enumeration value="elev 005 00"/>
                <xs:enumeration value="elev 002 00"/>
                <xs:enumeration value="elev 001 00"/>
                <xs:enumeration value="elev 000 50"/>
                <xs:enumeration value="elev 000 20"/>
                <xs:enumeration value="elev 000 10"/>
                <xs:enumeration value="elev 000 05"/>
                <xs:enumeration value="elev 000 02"/>
                <xs:enumeration value="elev 000 01"/>
             </xs:restriction>
          </xs:simpleType >
       </xs:union>
   </xs:simpleType>
```

7.38 Data Element: DE_Elevation

Use: The Elevation data element represents the geographic position above or below the reference ellipsoid (typically WSG-84). The 16-bit number has a resolution of 1 decimeter and represents an asymmetric range of positive and negative values. The encoding is as follows: the range 0x0000 to 0xEFFF (0 to 61439 decimal) are positive numbers representing elevations from 0 to +6143.9 meters, i.e. above the reference ellipsoid. The range 0xF001 to 0xFFFF are negative numbers representing elevations from -409.5 meters to -0.1 meters, i.e. below the reference ellipsoid. An elevation higher than +6143.9 meters is represented 0xEFFF. An elevation lower than -409.5 meters is represented 0xF001. If the sending device does not know its elevation it shall encode the Elevation data element with 0xF000.

Examples of this encoding are: the elevation 0 meters is encoded as 0x0000. The elevation -0.1 meters is encoded as 0xFFFF. The elevation +100.0 meters is encoded as 0x03E8.

ASN.1 Representation:

```
   Elevation ::= OCTET STRING (SIZE(2))
      -- 1 decimeter LSB (10 cm)
      -- Encode elevations from 0 to 6143.9 meters
      -- above the reference ellipsoid as 0x0000 to 0xEFFF.
      -- Encode elevations from -409.5 to -0.1 meters,
      -- i.e. below the reference ellipsoid, as 0xF001 to 0xFFFF
      -- unknown as 0xF000
```

XML Representation:

```
   <xs:complexType name="Elevation" >
      <xs:simpleContent>
         <xs:annotation>
            <xs:documentation>
               1 decimeter LSB  (10 cm)
               Encode elevations from 0 to 6143.9 meters
               above the reference ellipsoid as 0x0000 to 0xEFFF.
               Encode elevations from -409.5 to -0.1 meters,
               i.e. below the reference ellipsoid,  as 0xF001 to 0xFFFF
               unknown as 0xF000
            </xs:documentation>
         </xs:annotation>
         <xs:extension base="Elevation-string" >
            <xs:attribute name="EncodingType" use="required">
              <xs:simpleType>
                 <xs:restriction base="xs:NMTOKEN">
                    <xs:enumeration value="base64Binary"/>
                 </xs:restriction>
              </xs:simpleType>
            </xs:attribute>
         </xs:extension>
```

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```
      </xs:simpleContent>
   </xs:complexType>
   <xs:simpleType name="Elevation-string">
      <xs:restriction base="xs:base64Binary">
         <xs:length value="3"/>
      </xs:restriction>
   </xs:simpleType >
```

Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_FullPositionVector	<ASN>	<XML>, and
DF	DF_Position3D	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_Verbose (VBSM)	<ASN>	<XML>, and
DF	DF_REG_Position3D_JPN	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: The Elevation shall be taken from the spatial center of the vehicle, when a vehicle is being measured.

7.39 Data Element: DE_EmergencyDetails

Use: The EmergencyDetails data element combines several bit level items into a single word for efficient transmission.

ASN.1 Representation:

```
   EmergencyDetails ::= INTEGER (0..63)
      -- First two bit (MSB set to zero.
      -- Combining these 3 items in the remaning 6 bits
      -- sirenUse        SirenInUse
      -- lightsUse       LightbarInUse
      -- multi           MultiVehicleReponse
```

XML Representation:

```
   <xs:simpleType name="EmergencyDetails" >
         <xs:annotation>
            <xs:documentation>
               First two bit  (MSB set to zero.
               Combining these 3 items in the remaning 6 bits
               sirenUse        SirenInUse
               lightsUse       LightbarInUse
               multi           MultiVehicleReponse
            </xs:documentation>
         </xs:annotation>
         <xs:restriction base="xs:unsignedByte">
            <xs:maxInclusive value="63"/>
         </xs:restriction>
   </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_EmergencyVehicleAlert (EVA) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.40 Data Element: DE_EventFlags

Use: The Event Flags data element conveys the sender's state with regard to a set of events. For each event, the sender has the option to set the flag to 1 if the stated criteria are met, but it is not required to do so. The set of event flags and their respective minimum criteria are listed below. These definitions and criteria are normative. The Event Flag data element should not be included in a Basic Safety Message unless at least one event flag is set to 1. When one or more criteria associated with an event are no longer satisfied the sender shall set the flag to zero in any Event Flag data element it sends. The presence of the Event Flag element in a message indicates that an unusual event has occurred. A vehicle receiving such a message might decide to process it differently than a message that does not include the Event Flag element. When a given event flag is set to 1 the message might include related optional data as well. Consult each specific application for further details and rules.

Further normative definitions of when to assert each event are given below.

- Hazard Lights: The hazard lights are active.
- ·Stop Line Violation: The vehicle anticipates it will pass the line without coming to a full stop before reaching it.
- ABS: system activated exceeding 100 mSec in length and active
- Traction Control: system activated exceeding 100 mSec in length and active
- Stability Control: system activated exceeding 100 mSec in length and active
- ·Hazardous Materials The vehicle known to be carrying hazardous material and is placarded as such.
- Emergency Response: The vehicle is a properly authorized public safety vehicle, is engaged in a service call, and is currently moving (lights and sirens may not be evident).
- Hard Braking: The vehicle has (or is) decelerated at a rate of greater than 0.4g
- Lights Changed: The status of the external lighting of the vehicle has changed recently (the new state of the lights is presented in another element).
- Wipers Changed: The status of wipers (font or rear) of the vehicle has changed recently (the new state of the wipers is presented in another element).
- Flat tire: The vehicle has determined that at least one tire has run flat.
- Disabled Vehicle: Any vehicle that considers itself disabled.
- ·Air Bag Deployment: At least one airbag has been deployed.

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ASN.1 Representation:

```
EventFlags ::= INTEGER (0..8192)
-- With bits as defined:
   eventHazardLights               EventFlags ::= 1
   eventStopLineViolation          EventFlags ::= 2 -- Intersection Violation
   eventABSactivated               EventFlags ::= 4
   eventTractionControlLoss        EventFlags ::= 8
   eventStabilityControlactivated  EventFlags ::= 16
   eventHazardousMaterials         EventFlags ::= 32
   eventEmergencyResponse          EventFlags ::= 64
   eventHardBraking                EventFlags ::= 128
   eventLightsChanged              EventFlags ::= 256
   eventWipersChanged              EventFlags ::= 512
   eventFlatTire                   EventFlags ::= 1024
   eventDisabledVehicle            EventFlags ::= 2048
   eventAirBagDeployment           EventFlags ::= 4096
```

XML Representation:

```
<xs:simpleType name="EventFlags" >
      <xs:annotation>
         <xs:documentation>
            With bits as defined:
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="8192"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleSafetyExtension	<ASN>	<XML>, and
MSG	MSG_IntersectionCollisionAvoidance (ICA)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: This data element appears in the Part II section of the BSM, and is expected to be present when various potential dangerous events (such as hard braking) have been declared by the sender. Additional data elements in the message may provide more detail on the cause of this event.

7.41 Data Element: DE_Extent

Use: The spatial distance over which this message applies and should be presented to the driver. Under certain conditions some messages may never be shown to the driver of a vehicle if they are short in duration and other conflicting needs supercede the display until such time as the subject message is no longer relevant.

ASN.1 Representation:

```
Extent ::= ENUMERATED {
    useInstantlyOnly   (0),
    useFor3meters      (1),
    useFor10meters     (2),
    useFor50meters     (3),
    useFor100meters    (4),
    useFor500meters    (5),
    useFor1000meters   (6),
    useFor5000meters   (7),
    useFor10000meters  (8),
```

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```
    useFor50000meters  (9),
    useFor100000meters (10),
    forever            (127)  -- very wide area
    }
    -- encode as a single byte
```

XML Representation:

```
<xs:simpleType name="Extent" >
      <xs:annotation>
         <xs:appinfo>
            useInstantlyOnly (0)
            useFor3meters (1)
            useFor10meters (2)
            useFor50meters (3)
            useFor100meters (4)
            useFor500meters (5)
            useFor1000meters (6)
            useFor5000meters (7)
            useFor10000meters (8)
            useFor50000meters (9)
            useFor100000meters (10)
            forever (127) -- very wide area
         </xs:appinfo>
         <xs:documentation>
            encode as a single byte
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="127"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="useInstantlyOnly"/>
               <xs:enumeration value="useFor3meters"/>
               <xs:enumeration value="useFor10meters"/>
               <xs:enumeration value="useFor50meters"/>
               <xs:enumeration value="useFor100meters"/>
               <xs:enumeration value="useFor500meters"/>
               <xs:enumeration value="useFor1000meters"/>
               <xs:enumeration value="useFor5000meters"/>
               <xs:enumeration value="useFor10000meters"/>
               <xs:enumeration value="useFor50000meters"/>
               <xs:enumeration value="useFor100000meters"/>
               <xs:enumeration value="forever"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_ValidRegion	<ASN>	<XML>, and
MSG	MSG_RoadSideAlert_(RSA)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.42 Data Element: DE_ExteriorLights

Use: The status of various exterior lights encoded in a bit string which can be used to relate the current vehicle settings.

The "Vehicle Exterior Lights" Probe Data Element provides the status of all exterior lights on the vehicle. As currently defined, these are: parking lights, headlights (*lo* and *hi* beam, automatic light control), fog lights, daytime running lights, turn signals (right / left) and hazard signals. Should the need for additional types of light be needed, a new data element will be added.

ASN.1 Representation:

```
ExteriorLights ::= INTEGER (0..256)
-- With bits as defined:
   allLightsOff              ExteriorLights ::= 0
                             -- B'0000-0000
   lowBeamHeadlightsOn       ExteriorLights ::= 1
                             -- B'0000-0001
   highBeamHeadlightsOn      ExteriorLights ::= 2
                             -- B'0000-0010
   leftTurnSignalOn          ExteriorLights ::= 4
                             -- B'0000-0100
   rightTurnSignalOn         ExteriorLights ::= 8
                             -- B'0000-1000
   hazardSignalOn            ExteriorLights ::= 12
                             -- B'0000-1100
   automaticLightControlOn   ExteriorLights ::= 16
                             -- B'0001-0000
   daytimeRunningLightsOn    ExteriorLights ::= 32
                             -- B'0010-0000
   fogLightOn                ExteriorLights ::= 64
                             -- B'0100-0000
   parkingLightsOn           ExteriorLights ::= 128
                             -- B'1000-0000
```

XML Representation:

```
<xs:simpleType name="ExteriorLights" >
      <xs:annotation>
         <xs:documentation>
            With bits as defined:
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="256"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.43 Data Element: DE_FurtherInfoID

Use: This data element provides a link number to other messages (described here and in other message set standards) which relate to the same event. Use zero when unkown or not present.

ASN.1 Representation:

```
FurtherInfoID ::= OCTET STRING (SIZE(2))
   -- a link to any other incident
   -- information data that may be available
   -- in the normal ATIS incident description
   -- or other messages
   -- two value bytes in length
```

XML Representation:

```
<xs:complexType name="FurtherInfoID" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            a link to any other incident
            information data that may be available
            in the normal ATIS incident description
            or other messages
            two value bytes in length
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="FurtherInfoID-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="FurtherInfoID-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="3"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

MSG	MSG_RoadSideAlert (RSA)	<ASN>	<XML>, and
MSG	MSG_TravelerInformation Message (TIM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: Some message sets allow a request of other relevant messages by use of this ID, some others do not. Some messages do not yet support this ID and force the message receiver to sort the recovered message to align event geographically. This is expected to be an area of harmonization. Developers should also note that data from different source agencies can vary with the numbering used as well.

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7.44 Data Element: DE_GPSstatus

Use: The DE_GPSstatus data element is used to relate the current state of a GPS system in terms of its general health, lock on satellites in view, and use of any correction information. Various bits can be asserted (made to a value of one) to reflect these values.

ASN.1 Representation:

```
GPSstatus ::= BIT STRING {
   unavailable               (0), -- Not Equipped or unavailable
   isHealthy                 (1),
   isMonitored               (2),
   baseStationType           (3), -- Set to zero if a moving base station,
                                  -- set to one if it is a fixed base station
   aPDOPofUnder5             (4), -- A dilution of precision greater then 5
   inViewOfUnder5            (5), -- Less then 5 satellites in view
   localCorrectionsPresent   (6),
   networkCorrectionsPresent (7)
   } -- (SIZE(1))
```

XML Representation:

```
<xs:simpleType name="GPSstatus-item" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- Not Equipped or unavailable
            isHealthy (1)
            isMonitored (2)
            baseStationType (3) -- Set to zero if a moving base station ,
             -- set to one if it is a fixed base station
            aPDOPofUnder5 (4) -- A dilution of precision greater then 5
            inViewOfUnder5 (5) -- Less then 5 satellites in view
            localCorrectionsPresent (6)
            networkCorrectionsPresent (7)
         </xs:appinfo>
         <xs:documentation>
            (SIZE (1) )
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:int">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="isHealthy"/>
               <xs:enumeration value="isMonitored"/>
               <xs:enumeration value="baseStationType"/>
               <xs:enumeration value="aPDOPofUnder5"/>
               <xs:enumeration value="inViewOfUnder5"/>
               <xs:enumeration value="localCorrectionsPresent"/>
               <xs:enumeration value="networkCorrectionsPresent"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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```
<xs:simpleType name="GPSstatus">
   <xs:list itemType="GPSstatus-item"/>
</xs:simpleType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_PathHistory <ASN> <XML>, and

DF DF_VehicleStatus <ASN> <XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: A GPS set with unknown health and not tracking or corrections would be represented by all zeros. A value of zero shall be used when the data is unavailable.

7.45 Data Element: DE_HeadingConfidence

Use: This DE is used to provide the confidence interval of the 95% confidence level for the currently reported value of DE_Heading, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be in accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

ASN.1 Representation:

```
HeadingConfidence ::= ENUMERATED {
   unavailable (0), -- B'000  Not Equipped or unavailable
   prec45deg   (1), -- B'001  45   degrees
   prec10deg   (2), -- B'010  10   degrees
   prec05deg   (3), -- B'011  5    degrees
   prec01deg   (4), -- B'100  1    degrees
   prec0-1deg  (5), -- B'101  0.1  degrees
   prec0-05deg (6), -- B'110  0.05 degrees
   prec0-01deg (7)  -- B'111  0.01 degrees
   }
   -- Encoded as a 3 bit value
```

XML Representation:

```
<xs:simpleType name="HeadingConfidence" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- B&apos;000  Not Equipped or unavailable
            prec45deg (1) -- B&apos;001  45   degrees
            prec10deg (2) -- B&apos;010  10   degrees
            prec05deg (3) -- B&apos;011  5    degrees
            prec01deg (4) -- B&apos;100  1    degrees
            prec0 1deg (5) -- B&apos;101  0.1  degrees
            prec0 05deg (6) -- B&apos;110  0.05 degrees
            prec0 01deg (7) -- B&apos;111  0.01 degrees
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 3 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
```

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```
        <xs:simpleType>
           <xs:restriction base="xs:unsignedInt">
              <xs:minInclusive value="0"/>
              <xs:maxInclusive value="7"/>
           </xs:restriction>
        </xs:simpleType>
        <xs:simpleType>
           <xs:restriction base="xs:string">
              <xs:enumeration value="unavailable"/>
              <xs:enumeration value="prec45deg"/>
              <xs:enumeration value="prec10deg"/>
              <xs:enumeration value="prec05deg"/>
              <xs:enumeration value="prec01deg"/>
              <xs:enumeration value="prec0 1deg"/>
              <xs:enumeration value="prec0 05deg"/>
              <xs:enumeration value="prec0 01deg"/>
           </xs:restriction>
        </xs:simpleType >
     </xs:union>
</xs:simpleType>
```

7.46 Data Element: DE_Heading

Use: The current heading of the sending device, expressed in unsigned units of 0.0125 degrees from North (such that 28799 such degrees represent 359.9875 degrees). North shall be defined as the axis defined by the WSG-84 coordinate system and its reference ellipsoid. Headings "to the east" are defined as the positive direction. A 2 byte value when sent, a value of 28800 shall be used when unavailable. When sent by a vehicle, this element indicates the orientation of the front of the vehicle.

ASN.1 Representation:

```
Heading ::= INTEGER (0..28800)
   -- LSB of 0.0125 degrees
   -- A range of 0 to 359.9875 degrees
```

XML Representation:

```
<xs:simpleType name="Heading" >
      <xs:annotation>
         <xs:documentation>
            LSB of 0.0125 degrees
            A range of 0 to 359.9875 degrees
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="28800"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_FullPositionVector	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_Verbose_(VBSM)	<ASN>	<XML>.

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In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that other one byte heading data elements are found in other parts of ITS.

7.47 Data Element: DE_HeadingSlice

Use: A DE used to define a set of sixteen 22.5 degree slices of a unit circle (defined as 0~360 degrees of heading) which, when set to one, indicate that travel or motion along that angle is allowed. Typically used to indicate a gross direction of travel to which the enclosing message or data frame applies. For example a value of 0x8181 would indicate travel both directions due East and due West. A 2 byte value.

ASN.1 Representation:
```
HeadingSlice ::= OCTET STRING (SIZE(2))
   -- Each bit 22.5 degree starting from
   -- North and moving Eastward (clockwise)

   --  Define global enums for this entry
   noHeading                 HeadingSlice ::= '0000'H
   allHeadings               HeadingSlice ::= 'FFFF'H

   from000-0to022-5degrees  HeadingSlice ::= '0001'H
   from022-5to045-0degrees  HeadingSlice ::= '0002'H
   from045-0to067-5degrees  HeadingSlice ::= '0004'H
   from067-5to090-0degrees  HeadingSlice ::= '0008'H

   from090-0to112-5degrees  HeadingSlice ::= '0010'H
   from112-5to135-0degrees  HeadingSlice ::= '0020'H
   from135-0to157-5degrees  HeadingSlice ::= '0040'H
   from157-5to180-0degrees  HeadingSlice ::= '0080'H

   from180-0to202-5degrees  HeadingSlice ::= '0100'H
   from202-5to225-0degrees  HeadingSlice ::= '0200'H
   from225-0to247-5degrees  HeadingSlice ::= '0400'H
   from247-5to270-0degrees  HeadingSlice ::= '0800'H

   from270-0to292-5degrees  HeadingSlice ::= '1000'H
   from292-5to315-0degrees  HeadingSlice ::= '2000'H
   from315-0to337-5degrees  HeadingSlice ::= '4000'H
   from337-5to360-0degrees  HeadingSlice ::= '8000'H
```

XML Representation:
```
<xs:complexType name="HeadingSlice" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            Each bit 22.5 degree starting from
            North and moving Eastward  (clockwise)
            Define global enums for this entry
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="HeadingSlice-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
```

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```
      </xs:simpleContent>
   </xs:complexType>
   <xs:simpleType name="HeadingSlice-string">
      <xs:restriction base="xs:base64Binary">
         <xs:length value="3"/>
      </xs:restriction>
   </xs:simpleType >
```

Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_RoadSignID	<ASN>	<XML>, and
DF	DF_ValidRegion	<ASN>	<XML>, and
MSG	MSG_ProbeDataManagement (PDM)	<ASN>	<XML>, and
MSG	MSG_RoadSideAlert (RSA)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: See also the heading DE used to define a specific single heading value found in other parts of the DSRC message set.

7.48 Data Element: DE_IntersectionID

Use: The IntersectionID is used within a region to uniquely define an intersection within that country or region in a 16-bit field. Assignment rules are established by the regional authority associated with the RegionalID under which this IntersectionID is assigned.

ASN.1 Representation:

```
   IntersectionID ::= INTEGER (0..65535)
      -- The values zero through 255 are allocated for testing purposes
      -- Note that the value assign to an intersection will be
      -- unique within a given regional ID only
```

Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_IntersectionReferenceID_CHANGED	<ASN>	<>, and
DF	DF_SignalRequest	<ASN>	<XML>, and
MSG	MSG_IntersectionCollisionAvoidance (ICA)	<ASN>	<XML>, and
MSG	MSG_SignalStatusMessage (SSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.49 Data Element: DE_IntersectionStatusObject

Use: The Intersection Status Object contains Advanced Traffic Controller (ATC) status information that may be sent to local OBUs as part of the SPAT process.

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ASN.1 Representation:

```
IntersectionStatusObject ::= BIT STRING {
    manualControlIsEnabled                (0),
      -- Timing reported is per programmed values, etc but person
      -- at cabinet can manually request that certain intervals are
      -- terminated early (e.g. green).
    stopTimeIsActivated                   (1),
      -- And all counting/timing has stopped.
    failureFlash                          (2),
      -- Above to be used for any detected hardware failures,
      -- e.g. conflict monitor as well as for police flash
    preemptIsActive                       (3),
    transitSignalPriorityIsActive         (4),
      -- Refered to as TSP

    -- Additional states
    fixedTimeOperation                    (5),
      -- Schedule of signals is based on time only
      -- (i.e. the state can be calculated)
    trafficDependentOperation             (6),
      -- Operation is based on different levels of traffic parameters
      -- (requests, duration of gaps or more complex parameters)
    standbyOperation                      (7),
      -- Controller: partially switched off or partially amber flashing
    failureMode                           (8),
      -- Controller has a problem or failure in operation
    off                                   (9),
      -- Controller is switched off

    -- Related to MAP an SPAT bindings
    recentMAPmessageUpdate                (10),
      -- Map revision with content changes
    recentChangeInMAPassignedLanesIDsUsed (11),
      -- Change in MAP's assigned lanes used (lane changes)
      -- Changes in the active lane list description
    noValidMAPisAvailableAtThisTime       (12),
      -- MAP (and vaious lanes indexes) not available
    noValidSPATisAvailableAtThisTime      (13)
      -- SPAT system is not working at this time

    -- Bit values (14,15) reserved at ths time and shall be zero
    } (SIZE(16))
```

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Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_IntersectionState CHANGED	<ASN>	<>, and
MSG	MSG_SignalStatusMessage (SSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: All zero indicates normal operating mode with no recent changes. The duration of the term 'recent' is defined by the system performance requirement in use.

7.50 Data Element: DE_J1939-71-Axle Location

Use: A data element reused from the SAE J1939 standard and to be encoded as: Low order 4 bits represent a position number, counting left to right when facing the direction of normal vehicle travel. The high order 4 bits represent a position number, counting front to back on the vehicle. 256 states/8 bit, 0 offset, Range: 0-255.

ASN.1 Representation:

```
AxleLocation ::= INTEGER (0..127)
```

XML Representation:

```
<xs:simpleType name="AxleLocation" >
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="127"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.51 Data Element: DE_J1939-71-Axle Weight

Use: A data element reused from the SAE J1939 standard and to be encoded as: 0.5kg/bit, 0deg offset Range: 0 - 32,127.5kg.

ASN.1 Representation:

```
AxleWeight ::= INTEGER (0..65535)
```

XML Representation:

```
<xs:simpleType name="AxleWeight" >
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.52 Data Element: DE_J1939-71-Cargo Weight

Use: A data element reused from the SAE J1939 standard and encoded as: 2kg/bit, 0deg offset Range: 0 - 128,510kg.

ASN.1 Representation:

```
CargoWeight ::= INTEGER (0..65535)
```

XML Representation:

```
<xs:simpleType name="CargoWeight" >
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.53 Data Element: DE_J1939-71-Drive Axle Lift Air Pressure

Use: A data element reused from the SAE J1939 standard and encoded as: Units of kPa/bit, 0 offset, 0-1000kPa.

ASN.1 Representation:
```
DriveAxleLiftAirPressure ::= INTEGER (0..1000)
```

XML Representation:
```
<xs:simpleType name="DriveAxleLiftAirPressure" >
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="1000"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.54 Data Element: DE_J1939-71-Drive Axle Location

Use: A data element reused from the SAE J1939 standard and encoded as: Low order 4 bits represent a position number, counting left to right when facing the direction of normal vehicle travel. The high order 4 bits represent a position number, counting front to back on the vehicle. 256 states/8 bit, 0 offset, Range: 0-255.

ASN.1 Representation:
```
DriveAxleLocation ::= INTEGER (0..255)
```

XML Representation:
```
<xs:simpleType name="DriveAxleLocation" >
      <xs:restriction base="xs:unsignedByte"/>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.55 Data Element: DE_J1939-71-Drive Axle Lube Pressure

Use: A data element reused from the SAE J1939 standard and encoded units of: 4 kPa/bit, 0 offset, 0-1000kPa.

ASN.1 Representation:
```
DriveAxleLubePressure ::= INTEGER (0..1000)
```

XML Representation:
```
<xs:simpleType name="DriveAxleLubePressure" >
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="1000"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.56 Data Element: DE_J1939-71-Drive Axle Temperature

Use: A data element reused from the SAE J1939 standard and encoded as: 1 deg C/bit, -40 deg C/bit offset -40 - 210 deg C.

ASN.1 Representation:
```
DriveAxleTemperature ::= INTEGER (-40..210)
```

XML Representation:
```
<xs:simpleType name="DriveAxleTemperature" >
      <xs:restriction base="xs:short">
         <xs:minInclusive value="-40"/>
         <xs:maxInclusive value="210"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.57 Data Element: DE_J1939-71-Steering Axle Lube Pressure

Use: A data element reused from the SAE J1939 standard and encoded as: 4 kPa/bit, 0 offset, 0-1000kPa.

ASN.1 Representation:
```
SteeringAxleLubePressure ::= INTEGER (0..255)
```

XML Representation:
```
<xs:simpleType name="SteeringAxleLubePressure" >
      <xs:restriction base="xs:unsignedByte"/>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.58 Data Element: DE_J1939-71-Steering Axle Temperature

Use: A data element reused from the SAE J1939 standard and encoded as: 1 deg C/bit, -40 deg C/bit offset -40 - 210 deg C.

ASN.1 Representation:
```
SteeringAxleTemperature ::= INTEGER (0..255)
```

XML Representation:
```
<xs:simpleType name="SteeringAxleTemperature" >
      <xs:restriction base="xs:unsignedByte"/>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.59 Data Element: DE_J1939-71-Tire Leakage Rate

Use: A data element reused from the SAE J1939 standard and encoded as: 0.1 Pa/s per bit, 0 offset, Range: 0 Pa/s - 6425.5 Pa/s.

ASN.1 Representation:

```
TireLeakageRate ::= INTEGER (0..65535)
```

XML Representation:

```
<xs:simpleType name="TireLeakageRate" >
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.60 Data Element: DE_J1939-71-Tire Location

Use: A data element reused from the SAE J1939 standard and encoded as: Low order 4 bits represent a position number, counting left to right when facing the direction of normal vehicle travel. The high order 4 bits represent a position number, counting front to back on the vehicle. 256 states/8 bit, 0 offset, Range: 0-255.

ASN.1 Representation:

```
TireLocation ::= INTEGER (0..255)
```

XML Representation:

```
<xs:simpleType name="TireLocation" >
      <xs:restriction base="xs:unsignedByte"/>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.61 Data Element: DE_J1939-71-Tire Pressure Threshold Detection

Use: A measure of the relative tire pressure observed. Encoded as per the value set used in SAE J1939.

ASN.1 Representation:

```
TirePressureThresholdDetection ::= ENUMERATED {
   noData                 (0),   -- B'000'
   overPressure           (1),   -- B'001'
   noWarningPressure      (2),   -- B'010'
   underPressure          (3),   -- B'011'
   extremeUnderPressure   (4),   -- B'100'
   undefined              (5),   -- B'101'
   errorIndicator         (6),   -- B'110'
   notAvailable           (7),   -- B'111'
   ... -- # LOCAL_CONTENT
   }
```

XML Representation:

```
<xs:simpleType name="TirePressureThresholdDetection" >
      <xs:annotation>
         <xs:appinfo>
            noData (0) -- B&apos;000&apos;
            overPressure (1) -- B&apos;001&apos;
            noWarningPressure (2) -- B&apos;010&apos;
            underPressure (3) -- B&apos;011&apos;
            extremeUnderPressure (4) -- B&apos;100&apos;
            undefined (5) -- B&apos;101&apos;
            errorIndicator (6) -- B&apos;110&apos;
            notAvailable (7) -- B&apos;111&apos;
         </xs:appinfo>
      </xs:annotation>
```

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```
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="noData"/>
               <xs:enumeration value="overPressure"/>
               <xs:enumeration value="noWarningPressure"/>
               <xs:enumeration value="underPressure"/>
               <xs:enumeration value="extremeUnderPressure"/>
               <xs:enumeration value="undefined"/>
               <xs:enumeration value="errorIndicator"/>
               <xs:enumeration value="notAvailable"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType>
            <xs:restriction base="local:TirePressureThresholdDetection" />
         </xs:simpleType>
      </xs:union>
   </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.62 Data Element: DE_J1939-71-Tire Pressure

Use: A data element reused from the SAE J1939 standard and encoded as: 4 kPa/bit, 0 offset, 0-1000kPa.

ASN.1 Representation:

```
TirePressure ::= INTEGER (0..1000)
```

XML Representation:

```
<xs:simpleType name="TirePressure" >
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="1000"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.63 Data Element: DE_J1939-71-Tire Temp

Use: A data element reused from the SAE J1939 standard and encoded as: .03125 deg C/bit, -273 deg C offset, Range: -273 - 1735 deg C.

ASN.1 Representation:

```
TireTemp ::= INTEGER (0..65535)
```

XML Representation:

```
<xs:simpleType name="TireTemp" >
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.64 Data Element: DE_J1939-71-Trailer Weight

Use: A data element reused from the SAE J1939 standard and encoded as: 2kg/bit, 0deg offset Range: 0 - 128,510kg.

ASN.1 Representation:
```
TrailerWeight ::= INTEGER (0..65535)
```

XML Representation:
```
<xs:simpleType name="TrailerWeight" >
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_J1939-Data Items	<ASN>	<XML>, and
DF	DF_VehicleStatus	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: The term "weight" is used in J1939, while the term "mass" is used in J2735.

7.65 Data Element: DE_J1939-71-Wheel End Elect. Fault

Use: A data element reused from the SAE J1939 standard and encoded as defined in that standard.

ASN.1 Representation:
```
WheelEndElectFault ::= BIT STRING {
   bitOne      (1),
   bitTwo      (2),
   bitThree    (3),
   bitFour     (4)
   }
```

XML Representation:
```
<xs:simpleType name="WheelEndElectFault-item" >
      <xs:annotation>
         <xs:appinfo>
            bitOne (1)
            bitTwo (2)
            bitThree (3)
            bitFour (4)
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:int">
               <xs:minInclusive value="1"/>
               <xs:maxInclusive value="4"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="bitOne"/>
```

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```
                <xs:enumeration value="bitTwo"/>
                <xs:enumeration value="bitThree"/>
                <xs:enumeration value="bitFour"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
   </xs:simpleType>
   <xs:simpleType name="WheelEndElectFault">
      <xs:list itemType="WheelEndElectFault-item"/>
   </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.66 Data Element: DE_J1939-71-Wheel Sensor Status

Use: A data element reused from the SAE J1939 standard and encoded as: 00:Off, 01:On, 10: Not defined, 11: Not supported.

ASN.1 Representation:

```
   WheelSensorStatus ::= ENUMERATED {
        off            (0),
        on             (1),
        notDefined     (2),
        notSupoprted   (3)
        }
```

XML Representation:

```
   <xs:simpleType name="WheelSensorStatus" >
         <xs:annotation>
            <xs:appinfo>
               off (0)
               on (1)
               notDefined (2)
               notSupoprted (3)
            </xs:appinfo>
         </xs:annotation>
         <xs:union>
            <xs:simpleType>
               <xs:restriction base="xs:unsignedInt">
                  <xs:minInclusive value="0"/>
                  <xs:maxInclusive value="3"/>
               </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
               <xs:restriction base="xs:string">
                  <xs:enumeration value="off"/>
                  <xs:enumeration value="on"/>
                  <xs:enumeration value="notDefined"/>
                  <xs:enumeration value="notSupoprted"/>
               </xs:restriction>
            </xs:simpleType >
         </xs:union>
   </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_J1939-Data Items <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.67 Data Element: DE_LaneAttributes-Barrier

Use: The LaneAttributes- Barrier data element relates specific properties found in a Barrier or Median lane type (a type of lane object used to separate traffic lanes). Note that various common lane attribute properties (such as travel directions and allowed movements or maneuvers) can be found in other entries.

ASN.1 Representation:
```
LaneAttributes-Barrier ::= BIT STRING {
   -- With bits as defined:
   median-RevocableLane      (0),
                             -- this lane may be activated or not based
                             -- on the current SPAT message contents
                             -- if not asserted, the lane is ALWAYS present
   median                    (1),
   whiteLineHashing          (2),
   stripedLines              (3),
   doubleStripedLines        (4),
   trafficCones              (5),
   constructionBarrier       (6),
   trafficChannels           (7),
   lowCurbs                  (8),
   highCurbs                 (9)
   -- Bits 10~15 reserved and set to zero
   } (SIZE (16))
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneTypeAttributes <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.68 Data Element: DE_LaneAttributes-Bike

Use: The LaneAttributes-Bike data element relates specific properties found in a bicycle lane type. Note that various common lane attribute properties (such as travel directions and allowed movements or maneuvers) can be found in other entries.

ASN.1 Representation:
```
LaneAttributes-Bike ::= BIT STRING {
   -- With bits as defined:
   bikeRevocableLane        (0),
                            -- this lane may be activated or not based
                            -- on the current SPAT message contents
                            -- if not asserted, the lane is ALWAYS present
   pedestrianUseAllowed     (1),
                            -- The path allows pedestrian traffic,
                            -- if not set, this mode is prohibited
   isBikeFlyOverLane        (2),
                            -- path of lane is not at grade
   fixedCycleTime           (3),
                            -- the phases use preset times
                            -- i.e. there is not a 'push to cross' button
   biDirectionalCycleTimes (4),
                            -- ped walk phases use different SignalGroupID
                            -- for each direction. The first SignalGroupID
                            -- in the first Connection represents 'inbound'
                            -- flow (the direction of travel towards the first
                            -- node point) while second SignalGroupID in the
                            -- next Connection entry represents the 'outbound'
                            -- flow. And use of RestrictionClassID entires
                            -- in the Connect follow this same pattern in pairs.
   isolatedByBarrier        (5),
   unsignalizedSegmentsPresent  (6)
```

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```
                                   -- The lane path consists of one of more segments
                                   -- which are not part of a signal group ID

      -- Bits 7~15 reserved and set to zero
      } (SIZE (16))
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneTypeAttributes <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.69 Data Element: DE_LaneAttributes-Crosswalk

Use: The LaneAttributes-Crosswalk data element relates specific properties found in a crosswalk lane type. Note that various common lane attribute properties (such as travel directions and allowed movements or maneuvers) can be found in other entries.

ASN.1 Representation:

```
   LaneAttributes-Crosswalk ::= BIT STRING {
      -- With bits as defined:
      -- MUTCD provides no suitable "types" to use here
      crosswalkRevocableLane  (0),
                               -- this lane may be activated or not based
                               -- on the current SPAT message contents
                               -- if not asserted, the lane is ALWAYS present
      bicyleUseAllowed        (1),
                               -- The path allows bicycle traffic,
                               -- if not set, this mode is prohibited
      isXwalkFlyOverLane      (2),
                               -- path of lane is not at grade
      fixedCycleTime          (3),
                               -- ped walk phases use preset times
                               -- i.e. there is not a 'push to cross' button
      biDirectionalCycleTimes (4),
                               -- ped walk phases use different SignalGroupID
                               -- for each direction. The first SignalGroupID
                               -- in the first Connection represents 'inbound'
                               -- flow (the direction of travel towards the first
                               -- node point) while second SignalGroupID in the
                               -- next Connection entry represents the 'outbound'
                               -- flow. And use of RestrictionClassID entires
                               -- in the Connect follow this same pattern in pairs.
      hasPushToWalkButton     (5),
                               -- Has a demand input
      audioSupport            (6),
                               -- audio crossing cues present
      rfSignalRequestPresent  (7),
                               -- Supports RF push to walk technologies
      unsignalizedSegmentsPresent  (8)
                               -- The lane path consists of one of more segments
                               -- which are not part of a signal group ID
      -- Bits 9~15 reserved and set to zero
      } (SIZE (16))
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneTypeAttributes <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: NOTE: Have now divided bike and ped lanes types at this point, so need to rethink elements to contain in this entry but still also some sharing to occur when a single lane has both types of users (it may be more common that a bike lane does not allow peds than the alternative).

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7.70 Data Element: DE_LaneAttributes-ParkingLane

Use: The LaneAttributes-Parking data element relates specific properties found in a vehicle parking lane type. Note that various common lane attribute properties can be found in other entries.

ASN.1 Representation:
```
LaneAttributes-Parking ::= BIT STRING {
    -- With bits as defined:
    -- Parking use details, note that detailed restrictions such as
    -- allowed hours are sent by way of ITIS codes in the TIM message
    parkingRevocableLane         (0),
                                 -- this lane may be activated or not based
                                 -- on the current SPAT message contents
                                 -- if not asserted, the lane is ALWAYS present
    parallelParkingInUse         (1),
    headInParkingInUse           (2),
    doNotParkZone                (3),
                                 -- used to denote fire hydrants as well
                                 -- short disruptions in a parking zone
    parkingForBusUse             (4),
    parkingForTaxiUse            (5),
    noPublicParkingUse           (6)
                                 -- private parking, as in front of
                                 -- private property
   -- Bits 7~15 reserved and set to zero
   } (SIZE (16))
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneTypeAttributes <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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7.71 Data Element: DE_LaneAttributes-Sidewalk

Use: The LaneAttributes- Sidewalk data element relates specific properties found in a sidewalk lane type. Note that various common lane attribute properties (such as travel directions and allowed movements or maneuvers) can be found in other entries.

ASN.1 Representation:
```
LaneAttributes-Sidewalk ::= BIT STRING {
   -- With bits as defined:
   sidewalk-RevocableLane  (0),
                           -- this lane may be activated or not based
                           -- on the current SPAT message contents
                           -- if not asserted, the lane is ALWAYS present
   bicyleUseAllowed        (1),
                           -- The path allows bicycle traffic,
                           -- if not set, this mode is prohibited
   isSidewalkFlyOverLane   (2),
                           -- path of lane is not at grade
   walkBikes               (3)
                           -- bike traffic must dismount and walk
   -- Bits 4~15 reserved and set to zero
   } (SIZE (16))
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneTypeAttributes <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.72 Data Element: DE_LaneAttributes-Striping

Use: The LaneAttributes-Striping data element relates specific properties found in various types of ground stripping lane types. This includes various types of painted lane ground striping and iconic information needs to convey information in a complex intersection. Typically this consists of visual guidance for drivers to assist them to connect across the intersection to the correct lane. Such markings are typically used with restraint and only under conditions when the geometry of the intersection makes them more beneficial than distracting. Note that various common lane attribute properties (such as travel directions and allowed movements or maneuvers) can be found in other entries.

ASN.1 Representation:

```
LaneAttributes-Striping ::= BIT STRING {
    -- With bits as defined:
     stripToConnectingLanesRevocableLane (0),
        -- this lane may be activated or not based
        -- on the current SPAT message contents
        -- if not asserted, the lane is ALWAYS present
     stripDrawOnLeft                (1),
     stripDrawOnRight               (2),
         -- which side of lane to mark
     stripToConnectingLanesLeft     (3),
     stripToConnectingLanesRight    (4),
     stripToConnectingLanesAhead    (5)
         -- the stripe type should be
         -- presented to the user visually
         -- to reflect stripes in the
         -- intersection for the type of
         -- movement indicated
    -- Bits 6~15 reserved and set to zero
    } (SIZE (16))
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneTypeAttributes <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.73 Data Element: DE_LaneAttributes-TrackedVehicle

Use: The LaneAttributes-Special data element relates specific properties found in a tracked vehicle lane types (trolley and train lanes). Note that various common lane attribute properties (such as travel directions and allowed movements or maneuvers) can be found in other entries. Note that often this type of lane object does clearly relate to an approach in the traditional traffic engineering sense, although the message set allows assigning a value when desired.

ASN.1 Representation:

```
LaneAttributes-TrackedVehicle ::= BIT STRING {
    -- With bits as defined:
     spec-RevocableLane          (0),
                                 -- this lane may be activated or not based
                                 -- on the current SPAT message contents
                                 -- if not asserted, the lane is ALWAYS present
     spec-commuterRailRoadTrack (1),
     spec-lightRailRoadTrack    (2),
     spec-heavyRailRoadTrack    (3),
     spec-otherRailType         (4)
    -- Bits 5~15 reserved and set to zero
    } (SIZE (16))
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneTypeAttributes <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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7.74 Data Element: DE_LaneAttributes-Vehicle

Use: The LaneAttributes-Vehicle data element relates specific properties found in a vehicle lane type. Note that various common lane attribute properties (such as travel directions and allowed movements or maneuvers) can be found in other entries.

ASN.1 Representation:

```
LaneAttributes-Vehicle ::= BIT STRING {
    -- With bits as defined:
    isVehicleRevocableLane      (0),
                                -- this lane may be activated or not based
                                -- on the current SPAT message contents
                                -- if not asserted, the lane is ALWAYS present
    isVehicleFlyOverLane        (1),
                                -- path of lane is not at grade
    hovLaneUseOnly              (2),
    restrictedToBusUse          (3),
    restrictedToTaxiUse         (4),
    restrictedFromPublicUse     (5),
    hasIRbeaconCoverage         (6)

  -- Bits 7~15 reserved and set to zero
  } (SIZE (16))
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneTypeAttributes <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.75 Data Element: DE_LaneConnectionID

Use: The LaneConnectionID data entry is used to state a connection index for a *lane to lane* connection. It is used to relate this connection between the lane (defined in the MAP) and any dynamic clearance data sent in the SPAT. Note that the index may be shared with other lanes (for example two left turn lanes may share the same dynamic clearance data). Note that a given lane to lane connection may be part of more than one GroupID due to signal phases consideration but will only have one ConnectionID. The ConnectionID concept is not used (is not present) when dynamic clearance data is not provided in the SPAT.

ASN.1 Representation:

```
LaneConnectionID ::= INTEGER (0..255)
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_Connection	<ASN>	<>, and
DF	DF_ConnectionManeuverAssist	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that the LaneConnectionID is used as a means to index to a connection description between two lanes, it is not the same as the laneID which is the unique index to each lane itself.

7.76 Data Element: DE_LaneDirection

Use: The LaneDirection data concept is used to denote the allowed direction of travel over a lane object. By convention, the lane object is always described from the stop line outwards away from the intersection. Therefore the ingress direction is from the end of the path to the stop line and the egress direction is from the stop line outwards. Note that some lane objects are not used for travel and that some lane objects allow bi-directional travel.

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ASN.1 Representation:

```
LaneDirection ::= BIT STRING {
    -- With bits as defined:
    -- Allowed directions of travel in the lane object
    -- All lanes are described from the stop line outwards
    ingressPath                 (0),
                                -- travel from rear of path to front
                                -- is allowed
    egressPath                  (1)
                                -- travel from front of path to rear
                                -- is allowed
    -- Notes:  No Travel, i.e. the lane object type does not support
    --         travel (medians, curbs, etc.) is indicated by not
    --         asserting any bit value
    --         Bi-Directional Travel (such as a ped crosswalk) is
    --         indicated by asserting both of the bits
    } (SIZE (2))
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneAttributes <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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7.77 Data Element: DE_LaneId

Use: The LaneID data element conveys an index assigned that is unique within an intersection. It is used to refer to that lane by other objects in the intersection map data structure. Lanes may be ingress (inbound traffic) or egress (outbound traffic) in nature, as well as barriers and other types of specialty lanes. Each lane (each lane object) is assigned a unique ID. The Lane ID, in conjunction with the intersection ID, forms a regionally unique way to address a specific lane in that regional.

ASN.1 Representation:

```
LaneID ::= INTEGER (0..255)
   -- the value 0 shall be used when the lane ID is
   -- not available or not known
   -- the value 255 is reserved for future use
```

Used By: This entry is directly used by the following 6 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_ComputedLane CHANGED	<ASN>	<>, and
DF	DF_ConnectingLane	<ASN>	<>, and
DF	DF_EnabledLaneList	<ASN>	<>, and
DF	DF_GenericLane_CHANGED	<ASN>	<>, and
DF	DF_OverlayLaneList	<ASN>	<>, and
DF	DF_VehicleToLanePosition_EU	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: In this edition of the standard the data concept "LaneNumber" has been renamed "LaneID" to more clearly state its use as an index and to remain consistent with the naming of similar indexes used elsewhere in the standard. The terminology "Lane Number" often used by traffic engineers to refer to a single lane within a given approach. For example the "number one lane" may refer to the right-most or left-most lane (this varies with the conventions of the region) of an inbound approach. In such a case a similar terminology would be assigned to other lanes in other approaches within the same single intersection. By contrast, the LaneID value is a unique value assignment to single a lane object within the intersection. Deployments should remain aware of this distinction to avoid confusion. Note that the entry for *LaneNumber* remains in this standard to support other older messages, but should not be used for new work.

7.78 Data Element: DE_LaneNumber

Use: The LaneNumber data element conveys a unique index value for a lane used to refer to that lane by other objects in the intersection map data structure. Lanes may be ingress (inbound traffic) or egress (outbound traffic) in nature, as well as barriers and other types of specialty lanes. All lanes are numbered. The LaneNumber, in conjunction with the intersection ID, forms a regionally unique way to address a specific lane in that intersection.

ASN.1 Representation:

```
LaneNumber ::= OCTET STRING (SIZE(1))
```

XML Representation:

```
<xs:complexType name="LaneNumber" >
   <xs:simpleContent>
      <xs:extension base="LaneNumber-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="LaneNumber-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="2"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_SignalControlZone	<ASN>	<XML>, and
DF	DF_SignalRequest	<ASN>	<XML>, and
MSG	MSG_IntersectionCollisionAvoidance (ICA)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: If a globally unique lane number is needed, this can be obtained by combining the complete intersection ID with the lane number.

NOTE: The entry for *LaneNumber* should not be used for new work, the entry *LaneID* should be used.

7.79 Data Element: DE_LaneSharing

Use: The LaneSharing data concept is used to denote the presence of other user types (travel modes) who have an equal right to access and use the lane. There may be another lane object describing their use of a lane. This data concept is used to indicate lanes and/or users that travel along the same path, and not those that simply cross over the lane's segments path (such as a pedestrian crosswalk crossing a lane for motor vehicle use). The typical use is to alert the user of the MAP data that additional traffic of another mode may be present in the same spatial lane.

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ASN.1 Representation:

```
LaneSharing ::= BIT STRING {
    -- With bits as defined:
    overlappingLaneDescriptionProvided  (0),
    -- Assert when another lane object is present to describe the
    -- path of the overlapping shared lane
    -- this construct is not used for lane objects which simply cross
    multipleLanesTreatedAsOneLane       (1),
    -- Assert if the lane object path and width details represents
    -- multiple lanes within it that are not further described

    -- Various modes and type of traffic whhc may share this lane:
    otherNonMotorizedTrafficTypes       (2), -- horse drawn etc.
    individualMotorizedVehicleTraffic   (3),
    busVehicleTraffic                   (4),
    taxiVehicleTraffic                  (5),
    pedestriansTraffic                  (6),
    cyclistVehicleTraffic               (7),
    trackedVehicleTraffic               (8),
    pedestrianTraffic                   (9)
    } (SIZE (10))
    -- All zeros would indicate 'not shared' and 'not overlapping'
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneAttributes <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.80 Data Element: DE_LaneWidth

Use: The LaneWidth data concept conveys the width of a lane in LSB units of 1 cm. Maximum value for a lane is 327.67meters.

ASN.1 Representation:

```
LaneWidth ::= INTEGER (0..32767) -- units of 1 cm
```

Used By: This entry is directly used by the following 5 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_IntersectionGeometry CHANGED	<ASN>	<>, and
DF	DF_RoadSegment CHANGED	<ASN>	<>, and
DF	DF_ShapePointSet	<ASN>	<XML>, and
DF	DF_SignalControlZone	<ASN>	<XML>, and
MSG	MSG_TravelerInformation Message (TIM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that one half the lane width is used to find the outer "edges" of the lane, as measured from its center, described by the corner points of the polygon region defined by the current segment (the last two centerline node points projected by the lane width) as described in the node list for the lane object in question. For lane width values which are odd values, the value use for representing one half the width may round up to the next whole centimeter value.

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7.81 Data Element: DE_Latitude

Use: The geographic latitude of an object, expressed in 1/10th integer microdegrees, as a 32 bit value and with reference to the horizontal datum then in use. The value 900000001 shall be used when unavailable

ASN.1 Representation:

```
Latitude ::= INTEGER (-900000000..900000001)
    -- LSB = 1/10 micro degree
    -- Providing a range of plus-minus 90 degrees
```

XML Representation:

```
<xs:simpleType name="Latitude" >
      <xs:annotation>
         <xs:documentation>
            LSB = 1/10 micro degree
            Providing a range of plus-minus 90 degrees
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:int">
         <xs:minInclusive value="-900000000"/>
         <xs:maxInclusive value="900000001"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is directly used by the following 5 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_FullPositionVector	<ASN>	<XML>, and
DF	DF_Node_LLmD_64b	<ASN>	<>, and
DF	DF_Position3D	<ASN>	<XML>, and
DF	DF_Position3D_2 CHANGED	<ASN>	<>, and
MSG	MSG_BasicSafetyMessage_Verbose_(VBSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.82 Data Element: DE_LayerID

Use: The LayerID is a data concept used to uniquely identify the layers of a geographic map fragment such as an intersection. Note that the layer ID is used simply as a means to express a layer within a transmitted message; it has no value as a unique or permanent naming system for the map object (such as an intersection or any of its component parts).

ASN.1 Representation:

```
LayerID ::= INTEGER (0..100)
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_MapData_(MAP) <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: There remains debate regarding if this data concept is of value and needed.

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7.83 Data Element: DE_LayerType

Use: The LayerType is a data concept used to uniquely identify the type of information to be found in a layer of a geographic map fragment such as an intersection. This Data Element is not used at this time.

ASN.1 Representation:
```
LayerType ::= ENUMERATED {
     none,
     mixedContent, -- two or more of the below types
     generalMapData,
     intersectionData,
     curveData,
     roadwaySectionData,
     parkingAreaData,
     sharedLaneData,
     ...
     }
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_MapData (MAP) <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.84 Data Element: DE_LightbarInUse

Use: A data element in which the named bits are set to one if any sort of additional visible lighting-alerting system is currently in use. This includes light bars and the various symbols they can indicate as well as arrow boards, flashing lights, (including back up alerts) and any other form of lighting not found on normal vehicles of this type or related to safety systems. Used to reflect any type or style of visual alerting when a vehicle is progressing and transmitting DSRC messages to other nearby vehicles about its path.

ASN.1 Representation:
```
LightbarInUse ::= ENUMERATED {
     unavailable          (0),  -- Not Equipped or unavailable
     notInUse             (1),  -- none active
     inUse                (2),
     sirenInUse           (3),
     yellowCautionLights  (4),
     schooldBusLights     (5),
     arrowSignsActive     (6),
     slowMovingVehicle    (7),
     freqStops            (8),
     reserved             (9)   -- for future use
     }
```

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XML Representation:
```
<xs:simpleType name="LightbarInUse" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- Not Equipped or unavailable
            notInUse (1) -- none active
            inUse (2)
            sirenInUse (3)
            yellowCautionLights (4)
            schooldBusLights (5)
            arrowSignsActive (6)
            slowMovingVehicle (7)
            freqStops (8)
            reserved (9) -- for future use
         </xs:appinfo>
      </xs:annotation>
```

```
        <xs:union>
           <xs:simpleType>
              <xs:restriction base="xs:unsignedInt">
                 <xs:minInclusive value="0"/>
                 <xs:maxInclusive value="9"/>
              </xs:restriction>
           </xs:simpleType>
           <xs:simpleType>
              <xs:restriction base="xs:string">
                 <xs:enumeration value="unavailable"/>
                 <xs:enumeration value="notInUse"/>
                 <xs:enumeration value="inUse"/>
                 <xs:enumeration value="sirenInUse"/>
                 <xs:enumeration value="yellowCautionLights"/>
                 <xs:enumeration value="schooldBusLights"/>
                 <xs:enumeration value="arrowSignsActive"/>
                 <xs:enumeration value="slowMovingVehicle"/>
                 <xs:enumeration value="freqStops"/>
                 <xs:enumeration value="reserved"/>
              </xs:restriction>
           </xs:simpleType >
        </xs:union>
     </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: See also the entry for ExteriorLights.

7.85 Data Element: DE_Longitude

Use: The geographic longitude of an object, expressed in 1/10th integer microdegrees, as a 32-bit value and with reference to the horizontal datum then in use. The value 1800000001 shall be used when unavailable.

ASN.1 Representation:

```
   Longitude ::= INTEGER (-1799999999..1800000001)
      -- LSB = 1/10 micro degree
      -- Providing a range of plus-minus 180 degrees
```

Used By: This entry is directly used by the following 5 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_FullPositionVector	<ASN>	<XML>, and
DF	DF_Node_LLmD_64b	<ASN>	<>, and
DF	DF_Position3D	<ASN>	<XML>, and
DF	DF_Position3D_2 CHANGED	<ASN>	<>, and
MSG	MSG_BasicSafetyMessage_Verbose (VBSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

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7.86 Data Element: DE_MAYDAY_Location_quality_code

Use: A value representing the "goodness" of the position estimate (accuracy). The element is used to convey the relative quality of a GPS generated location. This quality value is enumerated as shown, as follows below.

ASN.1 Representation:

```
Location-quality ::= ENUMERATED {
     loc-qual-bt1m       (0), -- quality better than 1 meter
     loc-qual-bt5m       (1), -- quality better than 5 meters
     loc-qual-bt12m      (2), -- quality better than 12.5 meters
     loc-qual-bt50m      (3), -- quality better than 50 meters
     loc-qual-bt125m     (4), -- quality better than 125 meters
     loc-qual-bt500m     (5), -- quality better than 500 meters
     loc-qual-bt1250m    (6), -- quality better than 1250 meters
     loc-qual-unknown    (7)  -- quality value unknown
     } -- 3 bits, appends with loc-tech to make one octet (0..7)
```

XML Representation:

```
<xs:simpleType name="Location-quality" >
      <xs:annotation>
         <xs:appinfo>
            loc qual bt1m (0) -- quality better than 1 meter
            loc qual bt5m (1) -- quality better than 5 meters
            loc qual bt12m (2) -- quality better than 12.5 meters
            loc qual bt50m (3) -- quality better than 50 meters
            loc qual bt125m (4) -- quality better than 125 meters
            loc qual bt500m (5) -- quality better than 500 meters
            loc qual bt1250m (6) -- quality better than 1250 meters
            loc qual unknown (7) -- quality value unknown
         </xs:appinfo>
         <xs:documentation>
            3 bits,  appends with loc-tech to make one octet  (0..7)
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="loc qual bt1m"/>
               <xs:enumeration value="loc qual bt5m"/>
               <xs:enumeration value="loc qual bt12m"/>
               <xs:enumeration value="loc qual bt50m"/>
               <xs:enumeration value="loc qual bt125m"/>
               <xs:enumeration value="loc qual bt500m"/>
               <xs:enumeration value="loc qual bt1250m"/>
               <xs:enumeration value="loc qual unknown"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

Remarks: This element was originally defined in J2313. From Section 8.35 "Location-Quality." This element is used by the IEEE IM effort relating to the accuracy of location information.

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7.87 Data Element: DE_MAYDAY_Location_tech_code

Use: The technology used to determine the position of the vehicle. This element is used to convey what type of technology was used to determine the position (other elements it is used with in messages). The nav-system flag in the sender flag word shall be set to reflect the device technologies available.

ASN.1 Representation:
```
Location-tech ::= ENUMERATED {
     loc-tech-unknown    (0), -- technology type unknown
     loc-tech-GPS        (1), -- GPS technology only
     loc-tech-DGPS       (2), -- differential GPS (DGPS) technology
     loc-tech-drGPS      (3), -- dead reckoning system w/GPS
     loc-tech-drDGPS     (4), -- dead reckoning system w/DGPS
     loc-tech-dr         (5), -- dead reckoning only
     loc-tech-nav        (6), -- autonomous navigation system on-board
     ...,
     loc-tech-fault      (31) -- feature is not working
     }    -- (0..31) 5 bits, appends with loc-quality to make one octet
```

XML Representation:
```
<xs:simpleType name="Location-tech" >
      <xs:annotation>
         <xs:appinfo>
            loc tech unknown (0) -- technology type unknown
            loc tech GPS (1) -- GPS technology only
            loc tech DGPS (2) -- differential GPS (DGPS)  technology
            loc tech drGPS (3) -- dead reckoning system w/GPS
            loc tech drDGPS (4) -- dead reckoning system w/DGPS
            loc tech dr (5) -- dead reckoning only
            loc tech nav (6) -- autonomous navigation system on-board
            loc tech fault (31) -- feature is not working
         </xs:appinfo>
         <xs:documentation>
            (0..31)  5 bits,  appends with loc-quality to make one octet
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="31"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="loc tech unknown"/>
               <xs:enumeration value="loc tech GPS"/>
               <xs:enumeration value="loc tech DGPS"/>
               <xs:enumeration value="loc tech drGPS"/>
               <xs:enumeration value="loc tech drDGPS"/>
               <xs:enumeration value="loc tech dr"/>
               <xs:enumeration value="loc tech nav"/>
               <xs:enumeration value="loc tech fault"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

Remarks: This element was originally defined in J2313. From Section 8.15 "Location-Tech."

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7.88 Data Element: DE_MergeDivergeNodeAngle

Use: The angle with which another lane path meets the current lanes at the node point. Typically found in the node attributes and used to describe the angle of the departing or merging lane. Note that oblique and obtuse angles are allowed.

ASN.1 Representation:
```
MergeDivergeNodeAngle ::= INTEGER (-180..180)
    -- In units of 1.5 degrees for north
    -- the value -180 shall be used to represent
    -- data is not available or unknown
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneDataAttribute <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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7.89 Data Element: DE_MinuteOfTheYear

Use: The DE_MinuteOfTheYear data concept expresses the number of elapsed minutes of the current year in the time system being used (typically UTC time). It is typically used to provide a longer range time stamp when a message was created. Taken together with the DSecond data element, it provides a range of one full year with a resolution of 1mSecond.

ASN.1 Representation:
```
MinuteOfTheYear ::= INTEGER (0..527040)
    -- the value 527040 shall be used for invalid
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_IntersectionState CHANGED	<ASN>	<>, and
MSG	MSG_TravelerInformation Message (TIM)	<ASN>	<XML>, and
MSG	MSG_UPER_Frame_USA (UPER) CHANGED	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that at the yearly roll over point there is no "zero" minute similar to the concept that there is was never a "year zero" at the very start of the common era (BC -> AD). By using the number of elapsed whole minutes here this issue is avoided and the first valid value of every new year is zero, followed by one etc. Leap years are accommodated, as are leap seconds in the DSecond data concept.

7.90 Data Element: DE_MinutesDuration

Use: The duration, in units of whole minutes, that a object persists for. A value of 32000 means that the object persists forever. The range 0..32000 provide for about 22.2 days of maximum duration.

ASN.1 Representation:
```
MinutesDuration ::= INTEGER (0..32000) -- units of minutes
```

XML Representation:

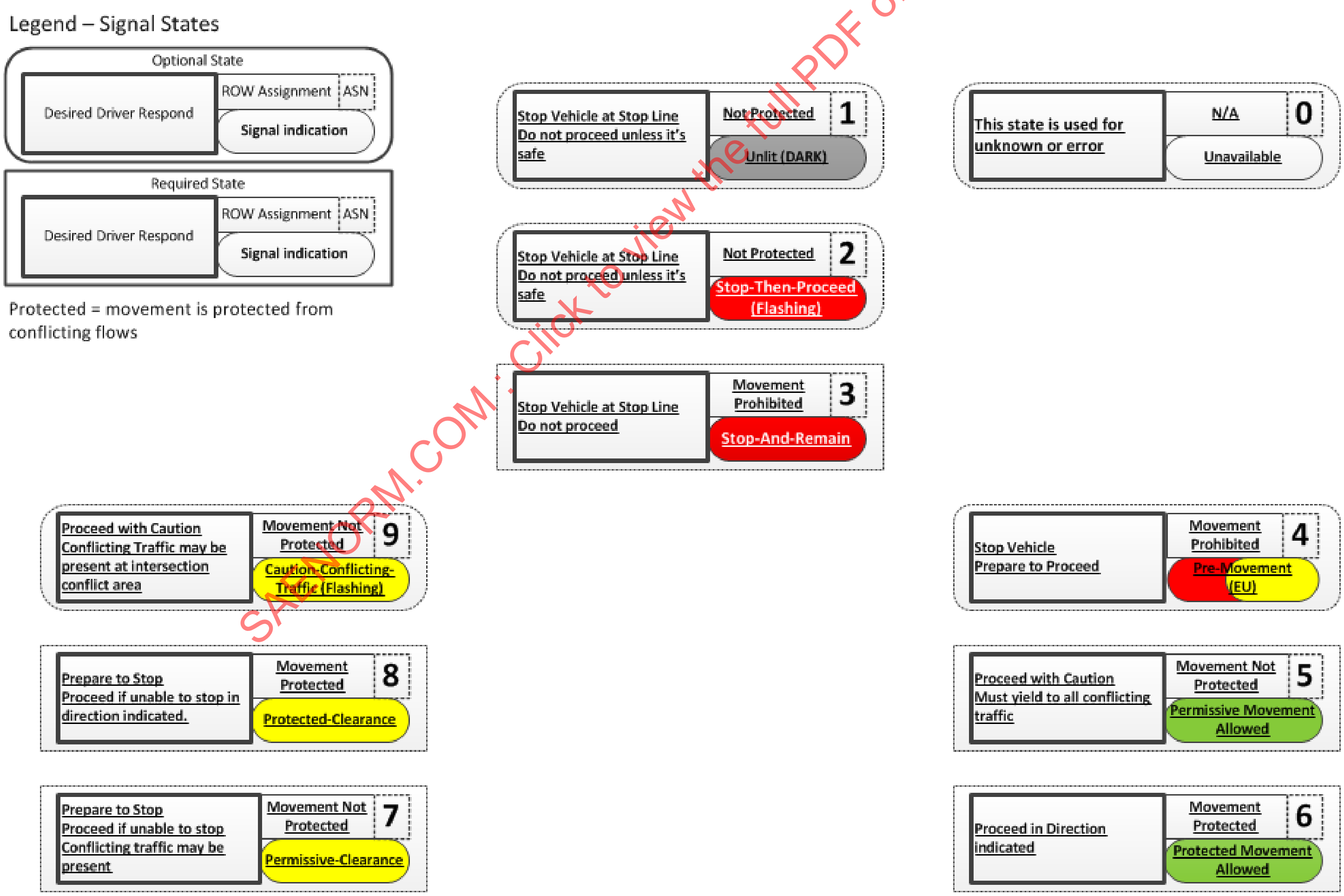
```
<xs:simpleType name="MinutesDuration" >
      <xs:annotation>
         <xs:documentation>
            units of minutes
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="32000"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_TravelerInformation Message (TIM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Note also the DE_Extent element used for spatial duration.

7.91 Data Element: DE_MovementPhaseState

Use: The DE_MovementPhaseState data concept provides the overall current state of the movement (in many cases a signal state) including its core phase state and an indication if this state is permissive or protected.



State Diagram

This diagram represents a possible state for a **single** movement group. These states shall be combined in order of precedence to create a state sequence for a movement group. Additionally, the state sequence shall be used along with the corresponding MAP data for any given Intersection.

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It is expected that the allowed transitions from one state to another will be defined by regional deployments. Not all regions will use all states, however no new states are to be defined. In most regions a regulatory body provides precise legal definitions of these state changes. For example in the US the MUTCD is used and this is indicated in the US regional variant of the above image. In various regions and modes of transportation, the visual expression of these states varies (the precise meaning of various color combinations, shapes, and/or flashing etc.). The below definition is designed to to be independent of these regional conventions.

In the US *permissive* is often referred to as a "round ball" while *protected* implies it has a directional arrow associated with it. The allowed single maneuver for a given *lane to lane* connection can be used to disambiguate this in the *ConnectsTo* data frame for that lane.

ASN.1 Representation:

```
MovementPhaseState ::= ENUMERATED {
    -- Note that based on the regions and the operating mode not every
    -- phase will be used in all transportation modes and that not
    -- every phase will be used in all transportation modes

    unavailable (0),
      -- This state is used for unknown or error
    dark (1),
      -- The signal head is dark (unlit)

   -- Reds
    stop-Then-Proceed (2),
      -- Often called 'flashing red' in US
      -- Driver Action:
      --   Stop vehicle at stop line.
      --   Do not proceed unless it is safe.
      -- Note that the right to proceed either right or left when
      -- it is safe may be contained in the lane description to
      -- handle what is called a 'right on red'
    stop-And-Remain (3),
      -- e.g. called 'red light' in US
      -- Driver Action:
      --   Stop vehicle at stop line.
      --   Do not proceed.
      -- Note that the right to proceed either right or left when
      -- it is safe may be contained in the lane description to
      -- handle what is called a 'right on red'

   -- Greens
    pre-Movement (4),
      -- Not used in the US, red+yellow partly in EU
      -- Driver Action:
      --   Stop vehicle.
      --   Prepare to proceed (pending green)
      --   (Prepare for transition to green/go)
    permissive-Movement-Allowed (5),
      -- Often called 'permissive green' in US
      -- Driver Action:
      --   Proceed with caution,
      --   must yield to all conflicting traffic
      -- Conflicting traffic may be present
      -- in the intersection conflict area
    protected-Movement-Allowed (6),
      -- Often called 'protected green' in US
      -- Driver Action:
      --   Proceed, tossing caution to the wind,
      --   in indicated (allowed) direction.
```

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```
-- Yellows / Ambers
-- The vehicle is not allowed to cross the stop bar if it is possible
-- to stop without danger.
permissive-clearance (7),
  -- Often called 'permissive yellow' in US
  -- Driver Action:
  --   Prepare to stop.
  --   Proceed if unable to stop,
  --   Clear Intersection.
  -- Conflicting traffic may be present
  -- in the intersection conflict area
protected-clearance (8),
  -- Often called 'protected yellow' in US
  -- Driver Action:
  --   Prepare to stop.
  --   Proceed if unable to stop,
  --   in indicated direction (to connected lane)
  --   Clear Intersection.

caution-Conflicting-Traffic (9)
  -- Often called 'flashing yellow' in US
  -- Often used for extended periods of time
  -- Driver Action:
  --   Proceed with caution,
  -- Conflicting traffic may be present
  -- in the intersection conflict area
}
-- The above number assignments are not used with UPER encoding
-- and are only to be used with DER or implicit encoding
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_MovementEvent CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The value assigned to each enumerated MovementPhaseState state is normative. Those transport layers that may reassign these values over the air for effective bandwidth reduction (such as UPER) may need to restore these values when the message value is exchanged with others in the higher layers (the application layers).

7.92 Data Element: DE_MsgCount

Use: The MsgCount data element is used to provide a sequence number within a stream of messages with the same DSRCmsgID and from the same sender. A sender may initialize this element to any value in the range 0-127 when sending the first message with a given DSRCmsgID, or if the sender has changed identity (e.g. by changing its TemporaryID) since sending the most recent message with that DSRCmsgID. Two further use cases exist when the sender has not changed identity: When the rest of the message content to be sent changes, the MsgCount shall be set equal to one greater than the value used in the most recent message sent with the same DSRCmsgID When the message content has not changed, the MsgCount is not changed. For this element the value after 127 is zero.

The receipt of a non-sequential MsgCount value (from the same sending device and message type) implies that one or more messages from that sending device may have been lost, unless MsgCount has been reinitialized due to an identity change.

ASN.1 Representation:

```
MsgCount ::= INTEGER (0..127)
```

XML Representation:

```
<xs:simpleType name="MsgCount" >
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="127"/>
      </xs:restriction>
</xs:simpleType>
```

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Used By: This entry is directly used by the following 11 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_IntersectionGeometry CHANGED	<ASN>	<>, and
DF	DF_IntersectionState CHANGED	<ASN>	<>, and
DF	DF_RoadSegment CHANGED	<ASN>	<>, and
MSG	MSG_BasicSafetyMessage_Verbose (VBSM)	<ASN>	<XML>, and
MSG	MSG_CommonSafetyRequest (CSR)	<ASN>	<XML>, and
MSG	MSG_IntersectionCollisionAvoidance (ICA)	<ASN>	<XML>, and
MSG	MSG_MapData (MAP)	<ASN>	<>, and
MSG	MSG_RoadSideAlert (RSA)	<ASN>	<XML>, and
MSG	MSG_RTCM_Corrections (RTCM)	<ASN>	<XML>, and
MSG	MSG_SignalRequestMessage (SRM)	<ASN>	<XML>, and
MSG	MSG_SignalStatusMessage (SSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: In usage, some devices change their Temporary ID frequently, to prevent identity tracking, while others do not. A change in Temporary ID data element value (which also changes the message contents in which it appears) implies that the MsgCount may also change value.

If a sender is composing a message with new content with a given DSRCmsgID, and the TemporaryID has not changed since it sent the previous message, the sender shall increment the previous value.

If a sender is composing a message with new content with a given DSRCmsgID, and the TemporaryID has changed since it sent the previous message, the sender may set the MsgCount element to any valid value in the range (including incrementing the previous value).

If a sender is composing a message with the same content as the most recent message with the same DSRCmsgID, and less than 10 seconds have elapsed since it sent the previous message with that DSRCmsgID, the sender will use the same MsgCount as sent in the previous message.

If a sender is composing a message with the same content as the most recent message with the same DSRCmsgID, and at least 10 seconds have elapsed since it sent the previous message with that DSRCmsgID, the sender may set the MsgCount element to any valid value in the range; this includes the reuse of the previous value.

If a sending device sends more than one stream of messages from message types that utilize the MsgCount element, it shall maintain a separate MsgCount state for each message type so that the MsgCount value in a given message identifies its place in the stream of that message type. The MsgCount element is a function only of the message type in a given sending device, not of the one or more applications in that device which may be sending the same type of message.

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7.93 Data Element: DE_MsgCRC

Use: A two byte data element calculated over the payload bytes of the message (starting with the initial sequence and ending with the last data element before the CRC itself and including all tag, length, and values bytes found in between). Always placed as the very last data element in the message. The generating polynomial used is the "CRC-CCITT" commonly expressed as x^16 + x^12 + x^5 + 1. An initial seed value of zero shall be used. Note that because the first byte of every DSRC message is never zero (it is 0x30), framing errors due to incorrectly clocking initial zero values cannot occur. Note that the MSB byte is always transmitted first, following the typical ASN bytes order. When a well formed DSRC message (including its last two bytes holding the CRC value) is decoded and input to the CRC process, the resulting CRC should always be the value zero.

ASN.1 Representation:

```
MsgCRC ::= OCTET STRING (SIZE(2)) -- created with the CRC-CCITT polynomial
```

XML Representation:

```
<xs:complexType name="MsgCRC" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            created with the CRC-CCITT polynomial
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="MsgCRC-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="MsgCRC-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="3"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is directly used by the following 6 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_RoadSignID	<ASN>	<XML>, and
MSG	MSG_EmergencyVehicleAlert (EVA)	<ASN>	<XML>, and
MSG	MSG_MapData (MAP)	<ASN>	<>, and
MSG	MSG_RoadSideAlert (RSA)	<ASN>	<XML>, and
MSG	MSG_TravelerInformation Message (TIM)	<ASN>	<XML>, and
MSG	MSG_UPER_Frame_USA (UPER) CHANGED	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

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7.94 Data Element: DE_MultiVehicleResponse

Use: A data element which is set if the vehicle transmitting believes that more than one vehicle (regardless of the dispatch or command and control organization of those vehicles or their agency) are currently in-route or involved in the response to the event. When received in a message by another vehicle OBU, this data element indicates to other vehicles that additional response vehicles may be converging to the same location and that additional caution is warranted.

Used to indicate that more that one vehicle is responding and traveling in a closely aligned fashion (one after the other in a loose platoon formation). This DE is intended to be used with the DSRC public safety vehicle operating in the area use case.

ASN.1 Representation:

```
MultiVehicleResponse ::= ENUMERATED {
     unavailable   (0), -- Not Equipped or unavailable
     singleVehicle (1),
     multiVehicle  (2),
     reserved      (3)  -- for future use
     }
```

XML Representation:

```
<xs:simpleType name="MultiVehicleResponse" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- Not Equipped or unavailable
            singleVehicle (1)
            multiVehicle (2)
            reserved (3) -- for future use
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="singleVehicle"/>
               <xs:enumeration value="multiVehicle"/>
               <xs:enumeration value="reserved"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

7.95 Data Element: DE_MUTCDCode

Use: The DE_MUTCDCode data element is used to defined what basic MUTCD type a sign expression falls into.

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ASN.1 Representation:

```
MUTCDCode ::= ENUMERATED {
   none             (0), -- non-MUTCD information
   regulatory       (1), -- "R" Regulatory signs
   warning          (2), -- "W" warning signs
   maintenance      (3), -- "M" Maintenance and construction
   motoristService  (4), -- Motorist Services
   guide            (5), -- "G" Guide signs
   rec              (6), -- Recreation and Cultural Interest
   ... -- # LOCAL_CONTENT
   }
     -- values to 127 reserved for std use
     -- values 128 to 255 reserved for local use
```

XML Representation:

```
<xs:simpleType name="MUTCDCode" >
      <xs:annotation>
         <xs:appinfo>
            none (0) -- non-MUTCD information
            regulatory (1) -- &quot;R&quot; Regulatory signs
            warning (2) -- &quot;W&quot; warning signs
            maintenance (3) -- &quot;M&quot; Maintenance and construction
            motoristService (4) -- Motorist Services
            guide (5) -- &quot;G&quot; Guide signs
            rec (6) -- Recreation and Cultural Interest
         </xs:appinfo>
         <xs:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="6"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="none"/>
               <xs:enumeration value="regulatory"/>
               <xs:enumeration value="warning"/>
               <xs:enumeration value="maintenance"/>
               <xs:enumeration value="motoristService"/>
               <xs:enumeration value="guide"/>
               <xs:enumeration value="rec"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType>
            <xs:restriction base="local:MUTCDCode" />
         </xs:simpleType>
      </xs:union>
</xs:simpleType>
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RoadSignID <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: If sent, a value of zero shall be used (for "generic sign") general ITIS codes not meeting a MUTCD definition.

7.96 Data Element: DE_NMEA_MsgType

Use: The NMEA-MsgType provides the--- value defined in the 0183 NMEA standards for each message.

ASN.1 Representation:

```
NMEA-MsgType ::= INTEGER (0..32767)
```

XML Representation:

```
<xs:simpleType name="NMEA-MsgType" >
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="32767"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_NMEA_Corrections (NMEA) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.97 Data Element: DE_NMEA_Payload

Use: The NMEA Payload element contains the stream of bytes in the actual NEMA 0183 message that is being sent.

ASN.1 Representation:

```
NMEA-Payload ::= OCTET STRING (SIZE(1..1023))
```

XML Representation:

```
<xs:complexType name="NMEA-Payload" >
   <xs:simpleContent>
      <xs:extension base="NMEA-Payload-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="NMEA-Payload-string">
   <xs:restriction base="xs:base64Binary">
      <xs:minLength value="2"/>
      <xs:maxLength value="1364"/>
   </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_NMEA_Corrections (NMEA) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.98 Data Element: DE_NMEA_Revision

Use: The specific revision of the NMEA standard which is being used (if present). This is needed to know precisely the mapping of the messages types to their definitions, as well as some minor transport layer ordering details when received in the mobile unit.

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ASN.1 Representation:

```
NMEA-Revision ::= ENUMERATED {
     unknown       (0),
     reserved      (1),
     rev1          (10),
     rev2          (20),
     rev3          (30),
     rev4          (40),
     rev5          (50),
     ... -- # LOCAL_CONTENT
     }
     -- values to 127 reserved for std use
     -- values 128 to 255 reserved for local use
```

XML Representation:

```
<xs:simpleType name="NMEA-Revision" >
      <xs:annotation>
         <xs:appinfo>
            unknown (0)
            reserved (1)
            rev1 (10)
            rev2 (20)
            rev3 (30)
            rev4 (40)
            rev5 (50)
         </xs:appinfo>
         <xs:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="50"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unknown"/>
               <xs:enumeration value="reserved"/>
               <xs:enumeration value="rev1"/>
               <xs:enumeration value="rev2"/>
               <xs:enumeration value="rev3"/>
               <xs:enumeration value="rev4"/>
               <xs:enumeration value="rev5"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType>
            <xs:restriction base="local:NMEA-Revision" />
         </xs:simpleType>
      </xs:union>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_NMEA_Corrections (NMEA) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.99 Data Element: DE_NodeAttribute

Use: The DE_NodeAttribute data concept is an enumerated list of attributes which can pertain to the current node point. The 'scope' of these values is limited to the node itself. That is, unlike other types of attributes which can be switched on or off at any given node (and hence pertains to one or more segments), the DE_NodeAttribute is local to the node in which it is found. These attributes are all binary flags in that they do not need to convey any additional data. Other attributes allow sending short data values to reflect a setting which is set and persists in a similar fashion.

ASN.1 Representation:

```
NodeAttribute ::= ENUMERATED {
    -- Various values which pertain only to the current node point

    -- General Items
    reserved,
    stopLine,              -- point where a mid-path stop line exists
                           -- See also 'do not block' for segments

    -- Path finish details
    roundedCapStyleA,       -- Used to control final path rounded end shape
                            -- with edge of curve at final point in a circle
    roundedCapStyleB,       -- Used to control final path rounded end shape
                            -- with edge of curve extending 50% of width past
                            -- final point in a circle

    -- Topography Points  (items with no concept of a distance along the path)
    mergePoint,            -- Japan merge with 1 or more lanes
    divergePoint,          -- Japan diverge with 1 or more lanes
    downstreamStopLine,    -- Japan style downstream intersection
                                     -- (a 2nd intersection) stop line
    downstreamStartNode,   -- Japan style downstream intersection
                                     -- (a 2nd intersection) start node

    -- Pedestrian Support Attributes
    closedToTraffic,       -- where a pedestrian may NOT go
                           -- to be used during construction events
    safeIsland,            -- a pedestrian safe stopping point
                           -- also called a traffic island
                           -- This usage described a point feature on a path,
                           -- other entries can describe a path
    curbPresentAtStepOff,  -- the sidewalk to street curb is NOT
                           -- angled where it meets the edge of the
                           -- roadway (user must step up/down)

    -- Lane geometry details   (see standard for defined shapes)
    hydrantPresent,        -- Or other services access
    ...
    }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_NodeAttributeList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Refer to the supporting users guide for a description of how to correctly encode and decode the types of the data element as well as examples of use.

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7.100 Data Element: DE_NTCIPVehicleclass,

Use: The DE_NTCIP Vehicle class data element is constructed of two 4-bit nibbles defined by the guidelines of NTCIP 1211 (Object Definitions for Signal Control and Prioritization (SCP)) except that the range is extended to be 0..15 for each.

NTCIP Clause 3.1.1.1.4 defines Priority Request Vehicle Class Type as follows: *This object is the 'PRG requested' class type (relative priority of a request). The order of precedence is by class type with 1 highest and 10* (15 for this system) *lowest. A request with a higher class type will override a lower class type.*

NTCIP Clause 3.1.1.1.5 defines Priority Request Vehicle Class Level as follows: *This object is the 'PRG requested' class level (relative priority of a request within each class of request). The order of precedence is by class type and then class level.*

1 is highest and 10 (15 for this system) *lowest. A request with a higher class level does NOT override a lower class level.*

Note that the value zero is not in fact defined in the NTCIP system.

ASN.1 Representation:

```
NTCIPVehicleclass ::= OCTET STRING (SIZE(1))
   -- With bits set as per NTCIP values
   -- Priority Request Vehicle Class Type
   -- in the upper nibble
   -- Priority Request Vehicle Class Level
   -- in the lower nibble
```

XML Representation:

```
<xs:complexType name="NTCIPVehicleclass" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            With bits set as per NTCIP values
            Priority Request Vehicle Class Type
            in the upper nibble
            Priority Request Vehicle Class Level
            in the lower nibble
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="NTCIPVehicleclass-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="NTCIPVehicleclass-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="2"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_SignalRequest <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that the integer value range of 1..10 has been extended to become 0..15 in a one byte octet in the DSRC use of this item.

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7.101 Data Element: DE_ObjectCount

Use: The DE_ObjectCount provides a count of various types of objects.

ASN.1 Representation:
```
ObjectCount ::= INTEGER (0..6000) -- a count of objects
```

XML Representation:
```
<xs:simpleType name="ObjectCount" >
      <xs:annotation>
         <xs:documentation>
            a count of objects
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="6000"/>
      </xs:restriction>
</xs:simpleType>
```

7.102 Data Element: DE_ObstacleDirection

Use: As a companion data element to Obstacle Distance, this data element draws from the output of a forward sensing system to report the obstacle direction from the vehicle detecting and reporting the obstacle. The data is expressed in degrees as azimuth relative to forward direction of vehicle.

ASN.1 Representation:
```
ObstacleDirection ::= Heading -- Use the header DE for this unless it proves
different.
```

XML Representation:
```
<xs:simpleType name="ObstacleDirection" >
      <xs:annotation>
         <xs:documentation>
            Use the header DE for this unless it proves different.
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base ="Heading"/>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.103 Data Element: DE_ObstacleDistance

Use: This data element draws from the output of a forward sensing system to report the presence of an obstacle and its measured distance from the vehicle detecting and reporting the obstacle. This information can be used by road authorities to investigate and remove the obstacle, as well as by other vehicles in advising drivers or on-board systems of the obstacle location. Distance is expressed in meters.

ASN.1 Representation:
```
ObstacleDistance ::= INTEGER (0..32767) -- LSB units of meters
```

XML Representation:
```
<xs:simpleType name="ObstacleDistance" >
      <xs:annotation>
         <xs:documentation>
            LSB units of meters
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
```

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```
            <xs:maxInclusive value="32767"/>
         </xs:restriction>
   </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.104 Data Element: DE_Offset_B10

Use: A 10-bit delta offset in X, Y or Z direction from the last point. Note that when used for delta Elevation (Z), the units are 10cm, not 1cm. The offset is positive to the East (X) and to the North (Y) directions.

ASN.1 Representation:
```
   Offset-B10 ::= INTEGER (-512..511)
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_Node_XY_20b	<ASN>	<>, and
DF	DF_NodeAttributeSet	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

7.105 Data Element: DE_Offset_B11

Use: An 11-bit delta offset in X or Y direction from the last point. The offset is positive to the East (X) and to the North (Y) directions.

ASN.1 Representation:
```
   Offset-B11 ::= INTEGER (-1024..1023)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Node_XY_22b <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.106 Data Element: DE_Offset_B12

Use: A 12-bit delta offset in X, Y or Z direction from the last point. The offset is positive to the East (X) and to the North (Y) directions.

ASN.1 Representation:
```
   Offset-B12 ::= INTEGER (-2048..2047)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Node_XY_24b <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.107 Data Element: DE_Offset_B13

Use: A 13-bit delta offset in X or Y direction from the last point. The offset is positive to the East (X) and to the North (Y) directions.

ASN.1 Representation:
```
   Offset-B13 ::= INTEGER (-4096..4095)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Node_XY_26b <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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7.108 Data Element: DE_Offset_B14

Use: A 14-bit delta offset in X or Y direction from the last point. The offset is positive to the East (X) and to the North (Y) directions.

ASN.1 Representation:
```
Offset-B14 ::= INTEGER (-8192..8191)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Node_XY_28b <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.109 Data Element: DE_Offset_B16

Use: A 16-bit delta offset in X, Y or Z direction from the last point. The offset is positive to the East (X) and to the North (Y) directions.

ASN.1 Representation:
```
Offset-B16 ::= INTEGER (-32768..32767)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Node_XY_32b <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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7.110 Data Element: DE_PayloadData

Use: A stream of octets to be exchanged.

ASN.1 Representation:
```
PayloadData ::= OCTET STRING (SIZE(1..2048))
```

XML Representation:
```
<xs:complexType name="PayloadData" >
   <xs:simpleContent>
      <xs:extension base="PayloadData-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="PayloadData-string">
   <xs:restriction base="xs:base64Binary">
      <xs:minLength value="2"/>
      <xs:maxLength value="2731"/>
   </xs:restriction>
</xs:simpleType >
```

7.111 Data Element: DE_Payload

Use: A data element to convey bulk information as a stream of bytes.

ASN.1 Representation:
```
Payload ::= OCTET STRING (SIZE(1..64))
```

XML Representation:

```
<xs:complexType name="Payload" >
   <xs:simpleContent>
      <xs:extension base="Payload-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="Payload-string">
   <xs:restriction base="xs:base64Binary">
      <xs:minLength value="2"/>
      <xs:maxLength value="86"/>
   </xs:restriction>
</xs:simpleType >
```

7.112 Data Element: DE_PedestrianBicycleDetect

Use: The PedestrianBicycleDetect data concept is used to provide an indication of detecting Pedestrians and/or Bicyclists in the crossing lane.

ASN.1 Representation:

```
PedestrianBicycleDetect ::= BOOLEAN --
                 -- true if ANY Pedestrians or Bicyclists are
                 -- detected crossing the target lane or lanes
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ConnectionManeuverAssist <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.113 Data Element: DE_PositionConfidence

Use: This DE is used to provide the confidence interval of the 95% confidence level for the currently reported value of entries such as the DE_Position entries, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. It is used in the horizontal plane. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be in accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

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ASN.1 Representation:

```
PositionConfidence ::= ENUMERATED {
   unavailable (0),  -- B'0000  Not Equipped or unavailable
   a500m   (1), -- B'0001  500m  or about 5 * 10 ^ -3 decimal degrees
   a200m   (2), -- B'0010  200m  or about 2 * 10 ^ -3 decimal degrees
   a100m   (3), -- B'0011  100m  or about 1 * 10 ^ -3 decimal degrees
   a50m    (4), -- B'0100  50m   or about 5 * 10 ^ -4 decimal degrees
   a20m    (5), -- B'0101  20m   or about 2 * 10 ^ -4 decimal degrees
   a10m    (6), -- B'0110  10m   or about 1 * 10 ^ -4 decimal degrees
   a5m     (7), -- B'0111  5m    or about 5 * 10 ^ -5 decimal degrees
   a2m     (8), -- B'1000  2m    or about 2 * 10 ^ -5 decimal degrees
   a1m     (9), -- B'1001  1m    or about 1 * 10 ^ -5 decimal degrees
   a50cm  (10), -- B'1010  0.50m or about 5 * 10 ^ -6 decimal degrees
   a20cm  (11), -- B'1011  0.20m or about 2 * 10 ^ -6 decimal degrees
   a10cm  (12), -- B'1100  0.10m or about 1 * 10 ^ -6 decimal degrees
   a5cm   (13), -- B'1101  0.05m or about 5 * 10 ^ -7 decimal degrees
   a2cm   (14), -- B'1110  0.02m or about 2 * 10 ^ -7 decimal degrees
   a1cm   (15)  -- B'1111  0.01m or about 1 * 10 ^ -7 decimal degrees
   }
   -- Encoded as a 4 bit value
```

XML Representation:

```
<xs:simpleType name="PositionConfidence" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- B&apos;0000  Not Equipped or unavailable
            a500m (1) -- B&apos;0001  500m  or about 5 * 10 ^ -3 decimal degrees
            a200m (2) -- B&apos;0010  200m  or about 2 * 10 ^ -3 decimal degrees
            a100m (3) -- B&apos;0011  100m  or about 1 * 10 ^ -3 decimal degrees
            a50m (4) -- B&apos;0100  50m   or about 5 * 10 ^ -4 decimal degrees
            a20m (5) -- B&apos;0101  20m   or about 2 * 10 ^ -4 decimal degrees
            a10m (6) -- B&apos;0110  10m   or about 1 * 10 ^ -4 decimal degrees
            a5m (7) -- B&apos;0111  5m    or about 5 * 10 ^ -5 decimal degrees
            a2m (8) -- B&apos;1000  2m    or about 2 * 10 ^ -5 decimal degrees
            a1m (9) -- B&apos;1001  1m    or about 1 * 10 ^ -5 decimal degrees
            a50cm (10) -- B&apos;1010  0.50m or about 5 * 10 ^ -6 decimal degrees
            a20cm (11) -- B&apos;1011  0.20m or about 2 * 10 ^ -6 decimal degrees
            a10cm (12) -- B&apos;1100  0.10m or about 1 * 10 ^ -6 decimal degrees
            a5cm (13) -- B&apos;1101  0.05m or about 5 * 10 ^ -7 decimal degrees
            a2cm (14) -- B&apos;1110  0.02m or about 2 * 10 ^ -7 decimal degrees
            a1cm (15) -- B&apos;1111  0.01m or about 1 * 10 ^ -7 decimal degrees
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 4 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="15"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="a500m"/>
               <xs:enumeration value="a200m"/>
               <xs:enumeration value="a100m"/>
               <xs:enumeration value="a50m"/>
```

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```
                  <xs:enumeration value="a20m"/>
                  <xs:enumeration value="a10m"/>
                  <xs:enumeration value="a5m"/>
                  <xs:enumeration value="a2m"/>
                  <xs:enumeration value="a1m"/>
                  <xs:enumeration value="a50cm"/>
                  <xs:enumeration value="a20cm"/>
                  <xs:enumeration value="a10cm"/>
                  <xs:enumeration value="a5cm"/>
                  <xs:enumeration value="a2cm"/>
                  <xs:enumeration value="a1cm"/>
               </xs:restriction>
            </xs:simpleType >
         </xs:union>
   </xs:simpleType>
```

Remarks: Observe that the relationships between degrees of latitude or longitude and the distances given are for the general area of North America. These values will, of course, change with the exact position of the user on the face of the earth.

7.114 Data Element: DE_PrioritizationResponseStatus

Use: The PrioritizationResponseStatus data concept is used in the PrioritizationResponse data frame to indicate the general status of a prior prioritization request. The entry needs further review by US experts and coordination with certain areas of NTCIP standards and operational concepts.

ASN.1 Representation:

```
   PrioritizationResponseStatus ::= ENUMERATED {
      unknown      (0),
                   -- unknown state
      requested    (1),
                   -- this prioritization request was detected
                   -- by the traffic controller
      processing   (2),
                   -- checking request
                   -- (request is in queue, others requests are prior)
      watchOtherTraffic (3),
                   -- can not give full permission,
                   -- therefore watch for other traffic
      granted      (4),
                   -- intervention was successful
                   -- and now prioritization is active
      rejected     (5),
                   -- the prioritization or preemption request was
                   -- rejected by the traffic controller
      maxPresence (6)
                   -- request has exceeded maxPresence time
      }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_PrioritizationResponse_EU <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.115 Data Element: DE_Priority

Use: A priority for the alert message, giving urgency of this message. A relative degree of merit compared with other similar messages for this type (not other message being sent by the device, nor a priority of display urgency at the receiver).

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At this time, the lower five bits are reserved and shall be set to zero. This effectively reduces the number of priority levels to eight. The value of all zeros shall be used for "routine" messages such as roadside signage where not displaying the message to the driver is of only modest impact. The value 111xxxxx shall be the highest level of priority and shall be consider the most important level. When choices of display order or transmission order are considered, messages with this level of priority shall be given precedence. The remaining 6 levels shall be used as determined by local conventions.

ASN.1 Representation:

```
Priority ::= OCTET STRING (SIZE(1))
    -- Follow definition notes on setting these bits
```

XML Representation:

```
<xs:complexType name="Priority" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            Follow definition notes on setting these bits
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="Priority-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="Priority-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="2"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_RoadSideAlert (RSA) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that a well chosen roadway with a set of priority schemes chosen to be very well managed can be thrown into chaos when an incident event occurs in it and when emergency response equipment enters the transmission zone during the response to the event. Local agreements on practices, including roadside unit (RSU) placement, will be needed to insure correct operation.

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7.116 Data Element: DE_ProbeSegmentNumber

Use: The PSN enables users to identify vehicle trajectory for a limited amount of time or over a limited distance. It is randomly generated by a vehicle every 120 seconds or 1km, whichever comes last. The interval between PSN changes is a random number of seconds between 0 and 10s or a random distance between 0 and 200m, whichever comes last. When sending messages containing a PSN, each message must contain a single PSN.

For Example when using the PSN in a Probe Data snapshot, all snapshots contained within a single message must contain the same PSN. All remaining Snapshots with a PSN that has already been sent to an RSU will be purged when the RSU communication link is broken. Event based Snapshots will not contain a PSN.

ASN.1 Representation:

```
ProbeSegmentNumber ::= INTEGER (0..32767)
   -- value determined by local device
   -- as per standard
```

XML Representation:

```
<xs:simpleType name="ProbeSegmentNumber" >
      <xs:annotation>
         <xs:documentation>
            value determined by local device
            as per standard
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="32767"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_ProbeVehicleData (PVD) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.117 Data Element: DE_RainSensor

Use: A general sensor of rain intensity which requires further interpretation by the OEM for precise semantic meaning.

The "Rain Sensor" Probe Data Element is intended to inform Probe Data Users as to how hard it was raining/snowing in the area the vehicle was traveling at the time the Probe Data snapshot was taken. The value of the Rain Sensor data element ranges from 0-7, with 0 indicating "No Rain/Snow", 1 indicating "Light Mist", and 7 indicating "Heavy Downpour". This information could be sent to vehicles approaching the area to warn drives of raining/snowing conditions ahead or it could provide Traffic Operation Centers with locations most likely in need of a snowplow.

ASN.1 Representation:

```
RainSensor ::= ENUMERATED {
     none                (0),
     lightMist           (1),
     heavyMist           (2),
     lightRainOrDrizzle  (3),
     rain                (4),
     moderateRain        (5),
     heavyRain           (6),
     heavyDownpour       (7)
     }
```

XML Representation:

```
<xs:simpleType name="RainSensor" >
      <xs:annotation>
         <xs:appinfo>
            none (0)
            lightMist (1)
            heavyMist (2)
            lightRainOrDrizzle (3)
            rain (4)
            moderateRain (5)
            heavyRain (6)
            heavyDownpour (7)
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
```

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```
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="none"/>
               <xs:enumeration value="lightMist"/>
               <xs:enumeration value="heavyMist"/>
               <xs:enumeration value="lightRainOrDrizzle"/>
               <xs:enumeration value="rain"/>
               <xs:enumeration value="moderateRain"/>
               <xs:enumeration value="heavyRain"/>
               <xs:enumeration value="heavyDownpour"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
   </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: It is recommended that Automotive Manufacturers divide the range of their Rain Sensors into 8 resistance ranges corresponding to the above scale. For Example: a sensor that has a resistance range from 12K Ohms (Max Rain Fall) to 250 Ohms (No Rain Fall) will have the following resistance value ranges:

0=250 to 1749 Ohms

1=1750 to 3249 Ohms

2=3250 to 4749 Ohms

3=4750 to 6249 Ohms

4=6250 to 7749 Ohms

5=7750 to 9249 Ohms

6=9250 to 10749 Ohms

7= 10501 to 12000 Ohms

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7.118 Data Element: DE_RequestedItem

Use: The Requested Item data element is used to specify what item (or items) is being requested in a CommonSafetyRequest message sent to other vehicles. The requested item may be broadcast by other vehicles in the Part II content of the BSM or the *a la carte* message that they transmit.

ASN.1 Representation:

```
   RequestedItem ::= ENUMERATED {
      reserved       (0),
      itemA          (1),
           -- consisting of 2 elements:
           -- lights          ExteriorLights
           -- lightBar        LightbarInUse

      itemB          (2),
           -- consisting of:
           -- wipers   a SEQUENCE
```

```
itemC         (3),
     -- consisting of:
     -- brakeStatus  BrakeSystemStatus

itemD         (4),
     -- consisting of 2 elements:
     -- brakePressure   BrakeAppliedPressure
     -- roadFriction    CoefficientOfFriction

itemE         (5),
     -- consisting of 4 elements:
     -- sunData         SunSensor
     -- rainData        RainSensor
     -- airTemp         AmbientAirTemperature
     -- airPres         AmbientAirPressure

itemF         (6),
     -- consisting of:
     -- steering  a SEQUENCE

itemG         (7),
     -- consisting of:
     -- accelSets a SEQUENCE

itemH         (8),
     -- consisting of:
     -- object a SEQUENCE


itemI         (9),
     -- consisting of:
     -- fullPos         FullPositionVector

itemJ         (10),
     -- consisting of:
     -- position2D      Position2D

itemK         (11),
     -- consisting of:
     -- position3D      Position3D

itemL         (12),
     -- consisting of 2 elements:
     -- speedHeadC      SpeedandHeadingConfidence
     -- speedC          SpeedConfidence

itemM         (13),
     -- consisting of:
     -- vehicleData a SEQUENCE

itemN         (14),
     -- consisting of:
     -- vehicleIdent   VehicleIdent

itemO         (15),
     -- consisting of:
     -- weatherReport a SEQUENCE

itemP         (16),
     -- consisting of:
```

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```
          -- breadcrumbs    VehicleMotionTrail

     itemQ         (17),
          -- consisting of:
          -- gpsStatus      GPSstatus

     ... -- # LOCAL_CONTENT OPTIONAL,
     }
     -- values to 127 reserved for std use
     -- values 128 to 255 reserved for local use
```

XML Representation:

```
   <xs:simpleType name="RequestedItem" >
         <xs:annotation>
            <xs:appinfo>
               reserved (0)
               itemA (1) -- consisting of 2 elements:
                -- lights          ExteriorLights
                -- lightBar        LightbarInUse
               itemB (2) -- consisting of:
                -- wipers  a SEQUENCE
               itemC (3) -- consisting of:
                -- brakeStatus  BrakeSystemStatus
               itemD (4) -- consisting of 2 elements:
                -- brakePressure   BrakeAppliedPressure
                -- roadFriction    CoefficientOfFriction
               itemE (5) -- consisting of 4 elements:
                -- sunData         SunSensor
                -- rainData        RainSensor
                -- airTemp         AmbientAirTemperature
                -- airPres         AmbientAirPressure
               itemF (6) -- consisting of:
                -- steering  a SEQUENCE
               itemG (7) -- consisting of:
                -- accelSets a SEQUENCE
               itemH (8) -- consisting of:
                -- object a SEQUENCE
               itemI (9) -- consisting of:
                -- fullPos         FullPositionVector
               itemJ (10) -- consisting of:
                -- position2D      Position2D
               itemK (11) -- consisting of:
                -- position3D      Position3D
               itemL (12) -- consisting of 2 elements:
                -- speedHeadC      SpeedandHeadingConfidence
                -- speedC          SpeedConfidence
               itemM (13) -- consisting of:
                -- vehicleData a SEQUENCE
               itemN (14) -- consisting of:
                -- vehicleIdent   VehicleIdent
               itemO (15) -- consisting of:
                -- weatherReport a SEQUENCE
               itemP (16) -- consisting of:
                -- breadcrumbs    VehicleMotionTrail
               itemQ (17) -- consisting of:
                -- gpsStatus      GPSstatus
            </xs:appinfo>
            <xs:documentation>
               values to 127 reserved for std use
               values 128 to 255 reserved for local use
            </xs:documentation>
```

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```
        </xs:annotation>
        <xs:union>
           <xs:simpleType>
              <xs:restriction base="xs:unsignedInt">
                 <xs:minInclusive value="0"/>
                 <xs:maxInclusive value="17"/>
              </xs:restriction>
           </xs:simpleType>
           <xs:simpleType>
              <xs:restriction base="xs:string">
                 <xs:enumeration value="reserved"/>
                 <xs:enumeration value="itemA"/>
                 <xs:enumeration value="itemB"/>
                 <xs:enumeration value="itemC"/>
                 <xs:enumeration value="itemD"/>
                 <xs:enumeration value="itemE"/>
                 <xs:enumeration value="itemF"/>
                 <xs:enumeration value="itemG"/>
                 <xs:enumeration value="itemH"/>
                 <xs:enumeration value="itemI"/>
                 <xs:enumeration value="itemJ"/>
                 <xs:enumeration value="itemK"/>
                 <xs:enumeration value="itemL"/>
                 <xs:enumeration value="itemM"/>
                 <xs:enumeration value="itemN"/>
                 <xs:enumeration value="itemO"/>
                 <xs:enumeration value="itemP"/>
                 <xs:enumeration value="itemQ"/>
              </xs:restriction>
           </xs:simpleType >
           <xs:simpleType>
              <xs:restriction base="local:RequestedItem" />
           </xs:simpleType>
        </xs:union>
   </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_CommonSafetyRequest (CSR) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.119 Data Element: DE_ResponseType

Use: The response type which this vehicle is engaged in at the time an alerting message is being sent. At this time only emergency and non-emergency are defined; however other types of operational modes are expected to be added.

The type of response which a public safety, or other type of vehicle, is engaged in when transmitting emergency alerts. Intended to be used as part of the DSRC safety message for public safety vehicles operating in the area.

ASN.1 Representation:

```
   ResponseType ::= ENUMERATED {
      notInUseOrNotEquipped      (0),
      emergency                  (1),
      nonEmergency               (2),
      pursuit                    (3)
      -- all others Future Use
      }
      -- values to 127 reserved for std use
      -- values 128 to 255 reserved for local use
```

XML Representation:

```
<xs:simpleType name="ResponseType" >
      <xs:annotation>
         <xs:appinfo>
            notInUseOrNotEquipped (0)
            emergency (1)
            nonEmergency (2)
            pursuit (3) -- all others Future Use
         </xs:appinfo>
         <xs:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notInUseOrNotEquipped"/>
               <xs:enumeration value="emergency"/>
               <xs:enumeration value="nonEmergency"/>
               <xs:enumeration value="pursuit"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_EmergencyVehicleAlert (EVA) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: There are remaining issues with this data element, and changes may occur after serious review by a number of different agency types. For example, codes (such as NEMSIS codes) are not really uniform and understood (even within a single service); the urgency of a "code 3" run is different in different parts of the world. The common element here is what action the receiving driver is supposed to do (nothing, follow flagman, be alert, pull over, etc.). See also some of the "mandatory" ITIS advice codes like this. For some applications, some slow speed maneuvering type codes are likely added in future editions (moving a fire truck or tow truck around an incident scene, for example).

7.120 Data Element: DE_RestrictionAppliesTo

Use: The RestrictionAppliesTo data element provides a short list of common vehicle types which may have one or more special movements at an intersection. In general these movements are not visible to other traffic with signal heads, but the SPAT data reflects the state of the movement. Various restricted movements at an intersection can be expressed using this element to indicate where the movement applies.

ASN.1 Representation:

```
RestrictionAppliesTo ::= ENUMERATED {
    none,               -- applies to nothing
    equippedTransit,    -- buses etc.
    equippedTaxis,
    equippedOther,      -- other vehicle types with
                        -- necessary signal phase state
                        -- reception equipment
    emissionCompliant, -- regional variants with more
                        -- definitive items also exist
    equippedBicycle,
```

```
        weightCompliant,
        heightCompliant,
        -- Items dealing with traveler needs
        -- (presumed to be suitably equipped)
        pedestrians,
        slowMovingPersons,
        wheelchairUsers,
        visualDisabilities,
        audioDisabilities,  -- hearing
        otherUnknownDisabilities,
        ...
        }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RestrictionUserType <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.121 Data Element: DE_RestrictionClassID

Use: The DE_RestrictionClass data concept defines an intersection unique value to convey data about classes of users. The mapping used varies with each intersections and is defined in the map message if needed. The defined mappings found there are used to determine when a given class is meant. The typical use of this element is to map additional movement restrictions or rights (in both the MAP and SPAT messages) to special classes of users (trucks, high sided vehicles, special vehicles etc.). There is the general presumption that in the absence of this data, any allowed movement extends to all users.

ASN.1 Representation:

```
RestrictionClassID ::= INTEGER (0..255)
    -- An index value to identify data about classes of users
    -- the value used varies with each intersection's
    -- needs and is defined in the map to the assigned
    -- classes of supported users.
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_AdvisorySpeed	<ASN>	<>, and
DF	DF_Connection	<ASN>	<>, and
DF	DF_RestrictionClassAssignment	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

7.122 Data Element: DE_RoadRegulatorID

Use: The RoadRegulatorID is a 16-bit globally unique identifier assigned to an entity responsible for assigning Intersection IDs in the region over which it has such authority. The value zero shall be used for testing, and should only be used in the absence of a suitable assignment. A single entity which assigns intersection IDs may be assigned several RoadRegulatorIDs.

ASN.1 Representation:

```
RoadRegulatorID ::= INTEGER (0..65535)
    -- The value zero shall be used for testing only
```

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Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_IntersectionReferenceID_CHANGED <ASN> <>, and

DF DF_RoadSegmentReferenceID <ASN> <>.

In addition, this item may be used by data structures in other ITS standards.

7.123 Data Element: DE_RoadSegmentID

Use: The RoadSegmentID is used to uniquely define an section of roadway within a country or region in a 16-bit field. Assignment rules for this value are established elsewhere and may use regional assignment schemas that vary.

ASN.1 Representation:

```
RoadSegmentID ::= INTEGER (0..65535)
    -- The values zero to 255 shall be used for testing only
    -- Note that the value assign to an RoadSegment will be
    -- unique within a given regional ID only during its use
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RoadSegmentReferenceID <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.124 Data Element: DE_RoadwayCrownAngle

Use: The RoadwayCrownAngle data concept relates the gross tangential angle of the roadway surface with respect to the local vertical axis and is measured at the indicated part of the lane. This measurement is typically made at the crown (centerline) or at an edge of the lane path. Its typical use is to relate data used in speed warning and traction calculations for the lane segment or roadway segment it is found in.

ASN.1 Representation:

```
RoadwayCrownAngle ::= INTEGER (-128..127)
     -- In LSB units of 0.3 degrees of angle
     -- over a range of -38.1 to + 38.1 degrees
     -- The value -128 shall be used for unknown
     -- The value zero shall be used for angles
     -- which are between -0.15 and +0.15
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LaneDataAttribute <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.125 Data Element: DE_RTCM_ID

Use: The RTCM-MsgType provides the 12 bit value defined in the RTCM standards for each message. In this standard this is rounded to 16 bits (2 bytes) and the upper four bits are defined as zero when one of the RTCM messages are used. Any bit being set to one in this range would indicate a locally defined (non national standard) meaning. Note that the RTCM message standard itself defines some private proprietary message types (in the range 4001 to 4095 in the 12 bit system) and these are also supported. Refer to the the RTCM for the latest list of these assignments and uses.

ASN.1 Representation:

```
RTCM-ID ::= INTEGER (0..32767)
```

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XML Representation:
```
<xs:simpleType name="RTCM-ID" >
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="32767"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RTCMmsg <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.126 Data Element: DE_RTCM_Payload

Use: The RTCM_Payload element contains the stream of bytes in the actual RTCM message that is being sent.

ASN.1 Representation:
```
RTCM-Payload ::= OCTET STRING (SIZE(1..1023))
```

XML Representation:
```
<xs:complexType name="RTCM-Payload" >
   <xs:simpleContent>
      <xs:extension base="RTCM-Payload-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="RTCM-Payload-string">
   <xs:restriction base="xs:base64Binary">
      <xs:minLength value="2"/>
      <xs:maxLength value="1364"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RTCMmsg <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.127 Data Element: DE_RTCM_Revision

Use: The specific revision of the RTCM standard which is being used. This is needed to know precisely the mapping of the messages types to their definitions, as well as some minor transport layer ordering details when received in the mobile unit.

ASN.1 Representation:
```
RTCM-Revision ::= ENUMERATED {
     unknown        (0),
     reserved       (1),
     rtcmCMR        (2),
     rtcmCMR-Plus   (3),
     rtcmSAPOS      (4),
     rtcmSAPOS-Adv  (5),
     rtcmRTCA       (6),
     rtcmRAW        (7),
     rtcmRINEX      (8),
     rtcmSP3        (9),
```

```
        rtcmBINEX     (10),
        rtcmRev2-x    (19), -- Used when specific rev is not known
        rtcmRev2-0    (20),
        rtcmRev2-1    (21),
        rtcmRev2-3    (23), -- Std 10402.3
        rtcmRev3-0    (30),
        rtcmRev3-1    (31), -- Std 10403.1
        ... -- # LOCAL_CONTENT
        }
        -- values to 127 reserved for std use
        -- values 128 to 255 reserved for local use
```

XML Representation:

```
   <xs:simpleType name="RTCM-Revision" >
         <xs:annotation>
            <xs:appinfo>
               unknown (0)
               reserved (1)
               rtcmCMR (2)
               rtcmCMR Plus (3)
               rtcmSAPOS (4)
               rtcmSAPOS Adv (5)
               rtcmRTCA (6)
               rtcmRAW (7)
               rtcmRINEX (8)
               rtcmSP3 (9)
               rtcmBINEX (10)
               rtcmRev2 x (19) -- Used when specific rev is not known
               rtcmRev2 0 (20)
               rtcmRev2 1 (21)
               rtcmRev2 3 (23) -- Std 10402.3
               rtcmRev3 0 (30)
               rtcmRev3 1 (31) -- Std 10403.1
            </xs:appinfo>
            <xs:documentation>
               values to 127 reserved for std use
               values 128 to 255 reserved for local use
            </xs:documentation>
         </xs:annotation>
         <xs:union>
            <xs:simpleType>
               <xs:restriction base="xs:unsignedInt">
                  <xs:minInclusive value="0"/>
                  <xs:maxInclusive value="31"/>
               </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
               <xs:restriction base="xs:string">
                  <xs:enumeration value="unknown"/>
                  <xs:enumeration value="reserved"/>
                  <xs:enumeration value="rtcmCMR"/>
                  <xs:enumeration value="rtcmCMR Plus"/>
                  <xs:enumeration value="rtcmSAPOS"/>
                  <xs:enumeration value="rtcmSAPOS Adv"/>
                  <xs:enumeration value="rtcmRTCA"/>
                  <xs:enumeration value="rtcmRAW"/>
                  <xs:enumeration value="rtcmRINEX"/>
                  <xs:enumeration value="rtcmSP3"/>
                  <xs:enumeration value="rtcmBINEX"/>
                  <xs:enumeration value="rtcmRev2 x"/>
                  <xs:enumeration value="rtcmRev2 0"/>
```

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```
                <xs:enumeration value="rtcmRev2 1"/>
                <xs:enumeration value="rtcmRev2 3"/>
                <xs:enumeration value="rtcmRev3 0"/>
                <xs:enumeration value="rtcmRev3 1"/>
             </xs:restriction>
          </xs:simpleType >
          <xs:simpleType>
             <xs:restriction base="local:RTCM-Revision" />
          </xs:simpleType>
       </xs:union>
   </xs:simpleType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_RTCMmsg	<ASN>	<XML>, and
MSG	MSG_RTCM_Corrections (RTCM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: In order to fully support the use of networked transport of RTCM corrections (so-called Ntrip systems), the enumerated list of protocol types provides for all the common types outlined in RTCM Standard 10410.0, Appendix B. It is anticipated that revisions 3.x and 2.3 will predominate in practice.

7.128 Data Element: DE_Scale_B12

Use: A 12-bit signed scaling factor supporting scales from zero (which is not used) to >200%. In this data concept the value zero is taken to represent a value of one (scale 1:1) and values above and below this add or remove exactly 0.05% from the initial value of 100%. Hence, a value of 2047 adds 102.35% to 100% resulting in a scale of 202.35% exactly (the largest valid scale value). Negative values which would result in an effective final value below zero are not supported. Hence the smallest valid value allowed is -2000 and the remaining negative values are reserved for future definition.

ASN.1 Representation:
```
Scale-B12 ::= INTEGER (-2048..2047)  -- in steps of 0.05 percent
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ComputedLane CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.129 Data Element: DE_SegmentAttribute

Use: The DE_Segment Attribute data concept is an enumerated list of attributes about the current lane segment which may be enabled or disabled to indicate the presence or absence of the selected attribute on the segment. A segment is one or more of the straight lines formed between each set of node points. It is common for a segment attributer to persist for more then one set of node points if there is any curvature in the lane itself. The described attributes are all binary flags in that they do not need to convey any additional data. Other attributes allow sending short data values to reflect a setting which is set and persists in a similar fashion.

ASN.1 Representation:
```
SegmentAttribute ::= ENUMERATED {
   -- Various values which can be Enabled and Disabled for a lane segement

   -- General Items
   reserved                    ,
   doNotBlock                  ,  -- segment where a vehicle
                                  -- may not come to a stop
   whiteLine                   ,  -- segment where lane crossing not allowed
                                  -- such as the final few meters of a lane
```

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```
-- Porous Lane states, merging, turn outs, parking etc.

mergingLaneLeft           ,  -- indicates porous lanes
mergingLaneRight          ,

curbOnLeft                ,  -- indicates presence of curbs
curbOnRight               ,

loadingzoneOnLeft         ,  -- loading or drop off zones
loadingzoneOnRight        ,

turnOutPointOnLeft        ,  -- opening to adjacent street/alley/road
turnOutPointOnRight       ,

adjacentParkingOnLeft     , -- side of road parking
adjacentParkingOnRight    ,

-- Bike Lane Needs
adjacentBikeLaneOnLeft    , -- presence of marked bike lanes
adjacentBikeLaneOnRight   ,
sharedBikeLane            , -- right of way is shared with bikes
                            -- who may occupy entire lane width
bikeBoxInFront            ,

-- Transit Needs
transitStopOnLeft         , -- any form of bus/transit loading
                            -- with pull in-out access to lane on left
transitStopOnRight        , -- any form of bus/transit loading
                            -- with pull in-out access to lane on right
transitStopInLane         , -- any form of bus/transit loading
                            -- in mid path of the lane
sharedWithTrackedVehicle  , -- lane is shared with train or trolley
                            -- not used for crossing tracks


-- Pedestrian Support Attributes
safeIsland                , -- begin/end a safety island in path
lowCurbsPresent           , -- for ADA support
rumbleStripPresent        , -- for ADA support
audibleSignalingPresent   , -- for ADA support
adaptiveTimingPresent     , -- for ADA support
rfSignalRequestPresent    , -- Supports RF push to walk technologies
partialCurbIntrusion      , -- path is blocked by a median or curb
                            -- but at least 1 meter remains open for use
                            -- and at-grade passage

-- Lane geometry details  (see standard for defined shapes)
taperToLeft               , -- Used to control final path shape
taperToRight              , -- Used to control final path shape
taperToCenterLine         , -- Used to control final path shape

-- Parking Lane and Curb Attributes
parallelParking           , --
headInParking             , -- Parking at an angle with the street
freeParking               , -- no restriction on use of parking
timeRestrictionsOnParking , -- Parking is not permitted at all times
                            -- typically used when the 'parking' lane
                            -- becomes a driving lane at times
costToPark                , -- Used parking has a cost
midBlockCurbPresent       , -- a protruding curb near lane edge
unEvenPavementPresent     , -- a disjoint height at lane edge
```

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```
    ...
    }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_SegmentAttributeList <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: A description of how to correctly encode and decode the types of this data element as well as examples of use may be developed by SAE in another volume.

7.130 Data Element: DE_SignalControlState

Use: The SignalState data element is used to reflect the current general state of the signal system in question. This is how *preemption* and *priority* states are acknowledged, and in this case a single signal system (and intersection) may have multiple states to relate. This data element is typically used as part of the SPAT message.

ASN.1 Representation:
```
SignalControlState ::= OCTET STRING (SIZE(1))
    -- With bits set as follows:

    -- Bit 7 (MSB) Set if the state is currently active
    -- only one active state can exist at a time, and
    -- this state should be sent first in any sequences

    -- Bits 6~4 The preempt or priority value that is
    -- being described.

    -- Bits 3~0 the state bits, indicating either a
    -- preemption or a priority use as follows:

    -- If a preemption: to follow the
    -- preemptState object of NTCIP 1202 v2.19f
    -- See PreemptState for bit definitions.

    -- If a prioirty to follow the
    -- tspInputStatus object utilized in the
    -- NYC ASTC2 traffic controller
    -- See PriorityState for bit definitions
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_IntersectionState CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that in use this object is enclosed in an outer sequence which identifies if it is describing a preemption or a priority use.

7.131 Data Element: DE_SignalGroupID

Use: The SignalGroupID is an index used to map between the internal state machine of one or more signal controllers (or other types of traffic flow devices) and a common numbering system that can represent all possible combinations of active states (movements and phases in US traffic terminology). All possible movement variations are assigned a unique value within the intersection. Conceptually, the ID represents a means to provide a list of lanes in a set which would otherwise need to be be enumerated in the message. The values zero and 255 are reserved, so there may up to 254 different signal group IDs within one single intersection. The value 255 implies to an permissive green movement state and is used when the "stop line" of a lane object is not signalized.

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ASN.1 Representation:

```
SignalGroupID ::= INTEGER (0..255)
    -- The value 0 shall be used when the ID is
    -- not available or not known
    -- the value 255 is reserved to indicate a
    -- permanent green movement state
    -- therefore a simple 8 phase signal controller
    -- device might use 1..9 as its groupIDs
```

Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_Connection	<ASN>	<>, and
DF	DF_MovementState	<ASN>	<>, and
DF	DF_PrioritizationResponse_EU	<ASN>	<>, and
DF	DF_SignalHeadLocation_EU _NEW	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

7.132 Data Element: DE_SignalReqScheme

Use: The SignalReqScheme data element is used in a *priority* or *preempt* request frame to select which preempt or priority controller sequence is to be activated. The data element has either a priority value or a preemption value, depending on the setting of the MSB and what data frame it is used in.

A value of B'1111' indicates a request for cabinet flash when the data element is used in a preempt. The value B'0111' is reserved when used for a priority request. The value B'000' is reserved.

ASN.1 Representation:

```
SignalReqScheme ::= OCTET STRING (SIZE(1))
    -- Encoded as follows:
   -- upper nibble:  Preempt #:
    -- Bit 7 (MSB) 1 =  Preempt and 0 =  Priority
    -- Remaining 3 bits:
    -- Range of 0..7. The values of 1..6 represent
    -- the respective controller preempt or Priority
    -- to be activated. The value of 7 represents a
    -- request for a cabinet flash prempt,
    -- while the value of 0 is reserved.

   -- lower nibble:  Strategy #:
    -- Range is 0..15 and is used to specify a desired
    -- strategy (if available).
    -- Currently no strategies are defined and this
    -- should be zero.
```

XML Representation:

```
<xs:complexType name="SignalReqScheme" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            Encoded as follows:
            upper nibble:  Preempt #:
            Bit 7  (MSB)  1 =  Preempt and 0 =  Priority
            Remaining 3 bits:
```

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```
            Range of 0..7. The values of 1..6 represent
            the respective controller preempt or Priority
            to be activated. The value of 7 represents a
            request for a cabinet flash prempt,
            while the value of 0 is reserved.
            lower nibble:  Strategy #:
            Range is 0..15 and is used to specify a desired
            strategy  (if available) .
            Currently no strategies are defined and this
            should be zero.
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="SignalReqScheme-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="SignalReqScheme-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="2"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_SignalControlZone	<ASN>	<XML>, and
DF	DF_SignalRequest	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: In use, the the vehicle must determine which preempt number or priority number to request by analyzing its location relative to the map layer information.

7.133 Data Element: DE_SignalState

Use: The SignalState data element is used to reflect the current general state of the signal system in question. This is how *preemption* and *priority* states are acknowledged, and in this case a single signal system (and intersection) may have multiple states to relate. This data element is typically used as part of the SPAT message.

ASN.1 Representation:

```
SignalState ::= OCTET STRING (SIZE(1))
    -- With bits set as follows:

    -- Bit 7 (MSB) Set if the state is currently active
    -- only one active state can exist at a time, and
    -- this state should be sent first in any sequences

    -- Bits 6~4 The preempt or priority value that is
    -- being described.

    -- Bits 3~0 the state bits, indicating either a
    -- preemption or a priority use as follows:
```

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```
-- If a preemption: to follow the
-- preemptState object of NTCIP 1202 v2.19f
-- See PreemptState for bit definitions.

-- If a prioirty to follow the
-- tspInputStatus object utilized in the
-- NYC ASTC2 traffic controller
-- See PriorityState for bit definitions
```

XML Representation:

```
<xs:complexType name="SignalState" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            With bits set as follows:
            Bit 7  (MSB)  Set if the state is currently active
            only one active state can exist at a time,  and
            this state should be sent first in any sequences
            Bits 6~4 The preempt or priority value that is
            being described.
            Bits 3~0 the state bits,  indicating either a
            preemption or a priority use as follows:
            If a preemption: to follow the
            preemptState object of NTCIP 1202 v2.19f
            See PreemptState for bit definitions.
            If a prioirty to follow the
            tspInputStatus object utilized in the
            NYC ASTC2 traffic controller
            See PriorityState for bit definitions
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="SignalState-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="SignalState-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="2"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_SignalStatusMessage (SSM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Note that in use this object is enclosed in an outer sequence which identifies if it is describing a preemption or a priority use.

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7.134 Data Element: DE_SignPrority

Use: The relative importance of the sign, a scale from zero (least important) to seven (most important).

ASN.1 Representation:
```
SignPrority ::= INTEGER (0..7)
   -- 0 as least, 7 as most
```

XML Representation:
```
<xs:simpleType name="SignPrority" >
      <xs:annotation>
         <xs:documentation>
            0 as least,  7 as most
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="7"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_TravelerInformation Message (TIM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.135 Data Element: DE_SirenInUse

Use: A data element which is set if any sort of audible alarm is being emitted from the vehicle. This includes various common sirens as well as backup up beepers and other slow speed maneuvering alerts.

Used to reflect any type or style of audio alerting when a vehicle is progressing and transmitting DSRC messages to others about its path. Intended to be used as part of the DSRC safety message for public safety vehicles operating in the area.

ASN.1 Representation:
```
SirenInUse ::= ENUMERATED {
     unavailable   (0), -- Not Equipped or unavailable
     notInUse      (1),
     inUse         (2),
     reserved      (3)  -- for future use
     }
```

XML Representation:
```
<xs:simpleType name="SirenInUse" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- Not Equipped or unavailable
            notInUse (1)
            inUse (2)
            reserved (3) -- for future use
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
```

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```
                <xs:enumeration value="unavailable"/>
                <xs:enumeration value="notInUse"/>
                <xs:enumeration value="inUse"/>
                <xs:enumeration value="reserved"/>
             </xs:restriction>
          </xs:simpleType >
       </xs:union>
   </xs:simpleType>
```

7.136 Data Element: DE_SpeedAdvice

Use: This data element represents the recomended velocity of an object, typically a vehicle speed along a roadway, expressed in unsigned units of 0.1 meters per second.

ASN.1 Representation:

```
   SpeedAdvice ::= INTEGER (0..500) -- Units of 0.1 m/s
            -- The value 500 indicates that
            -- speed is unavailable
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_AdvisorySpeed <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: When the input speed is provided in miles per hour (MPH), convert the input value to units of 0.1 m/s and round to the nearest integer unit. For example, 30 MPH = ~48.28 KPH = 13.41 m/s = 134.1 units of 0.1 m/s, therefore transmit 134. A similar reverse process is used when the speed is to be displayed to an end user in units of MPH.

7.137 Data Element: DE_SpeedConfidence

Use: This DE is used to provide the confidence interval of the 95% confidence level for the currently reported value of DE_Speed, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

ASN.1 Representation:

```
   SpeedConfidence ::= ENUMERATED {
      unavailable  (0), -- B'000  Not Equipped or unavailable
      prec100ms    (1), -- B'001  100  meters / sec
      prec10ms     (2), -- B'010  10   meters / sec
      prec5ms      (3), -- B'011  5    meters / sec
      prec1ms      (4), -- B'100  1    meters / sec
      prec0-1ms    (5), -- B'101  0.1  meters / sec
      prec0-05ms   (6), -- B'110  0.05 meters / sec
      prec0-01ms   (7)  -- B'111  0.01 meters / sec
      }
      -- Encoded as a 3 bit value
```

XML Representation:

```
   <xs:simpleType name="SpeedConfidence" >
       <xs:annotation>
          <xs:appinfo>
             unavailable (0) -- B&apos;000  Not Equipped or unavailable
             prec100ms (1) -- B&apos;001  100  meters / sec
             prec10ms (2) -- B&apos;010  10   meters / sec
             prec5ms (3) -- B&apos;011  5    meters / sec
```

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```
            prec1ms (4) -- B&apos;100  1    meters / sec
            prec0 1ms (5) -- B&apos;101  0.1  meters / sec
            prec0 05ms (6) -- B&apos;110  0.05 meters / sec
            prec0 01ms (7) -- B&apos;111  0.01 meters / sec
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 3 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="prec100ms"/>
               <xs:enumeration value="prec10ms"/>
               <xs:enumeration value="prec5ms"/>
               <xs:enumeration value="prec1ms"/>
               <xs:enumeration value="prec0 1ms"/>
               <xs:enumeration value="prec0 05ms"/>
               <xs:enumeration value="prec0 01ms"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
   </xs:simpleType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_AdvisorySpeed	<ASN>	<>, and
DF	DF_VehicleStatus	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.138 Data Element: DE_SpeedLimitType

Use: The SpeedLimitType data element relates the type of speed limit to which a given speed refers.

ASN.1 Representation:

```
   SpeedLimitType ::= ENUMERATED {
       unknown,                      -- Speed limit type not available
       maxSpeedInSchoolZone,         -- Only sent when the limit is active
       maxSpeedInSchoolZoneWhenChildrenArePresent, -- Sent at any time
       maxSpeedInConstructionZone, -- Used for work zones, incident zones, etc.
                                     -- where a reduced speed is present
       vehicleMinSpeed,
       vehicleMaxSpeed,              -- Regulatory speed limit for general traffic
       vehicleNightMaxSpeed,

       truckMinSpeed,
       truckMaxSpeed,
       truckNightMaxSpeed,

       vehiclesWithTrailersMinSpeed,
```

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```
    vehiclesWithTrailersMaxSpeed,
    vehiclesWithTrailersNightMaxSpeed,
    ...
    }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RegulatorySpeedLimit <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.139 Data Element: DE_Speed

Use: This data element represents the vehicle speed expressed in unsigned units of 0.02 meters per second. It is typically combined with the transmission state to form a 2 byte value. A value of 8191 shall be used when the speed is unavailable.

ASN.1 Representation:

```
Speed ::= INTEGER (0..8191) -- Units of 0.02 m/s
          -- The value 8191 indicates that
          -- speed is unavailable
```

XML Representation:

```
<xs:simpleType name="Speed" >
      <xs:annotation>
         <xs:documentation>
            Units of 0.02 m/s
            The value 8191 indicates that
            speed is unavailable
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="8191"/>
      </xs:restriction>
</xs:simpleType>
```

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7.140 Data Element: DE_StabilityControlStatus

Use: This data element reflects the current state of the stability control system status. The "Stability Control Status" data element is intended to inform users whether the vehicle's stability control unit was engaged. A typical stability control unit uses the vehicle's yaw rate to determine how far off-axis a vehicle is while taking a turn. This data is correlated with wheel speed, steering angle and acceleration position. If the vehicle is determined to be too far off-axis, corrective action is taken by automatically applying braking force to separate wheels independent of the driver's actions. The element also informs the user if the vehicle is not equipped with a stability control system. If the vehicle is equipped with a stability control system, the element reports whether the system is Off, or in an Active state.

ASN.1 Representation:

```
StabilityControlStatus ::= ENUMERATED {
   unavailable (0), -- B'00  Not Equipped with SC
                    -- or SC status is unavailable
   off          (1), -- B'01  Off
   on           (2)  -- B'10  On or active (engaged)
   }
   -- Encoded as a 2 bit value
```

XML Representation:

```
<xs:simpleType name="StabilityControlStatus" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- B&apos;00  Not Equipped with SC
             -- or SC status is unavailable
            off (1) -- B&apos;01  Off
            on (2) -- B&apos;10  On or active  (engaged)
```

```
          </xs:appinfo>
          <xs:documentation>
             Encoded as a 2 bit value
          </xs:documentation>
       </xs:annotation>
       <xs:union>
          <xs:simpleType>
             <xs:restriction base="xs:unsignedInt">
                <xs:minInclusive value="0"/>
                <xs:maxInclusive value="2"/>
             </xs:restriction>
          </xs:simpleType>
          <xs:simpleType>
             <xs:restriction base="xs:string">
                <xs:enumeration value="unavailable"/>
                <xs:enumeration value="off"/>
                <xs:enumeration value="on"/>
             </xs:restriction>
          </xs:simpleType >
       </xs:union>
   </xs:simpleType>
```

Remarks: The value for notEquipped shall be used when data is not available.

7.141 Data Element: DE_StationID

Use: The StationID has been included into SAEJ2735 for the optional European data element "PrioritizationResponse".

ASN.1 Representation:

```
StationID ::= INTEGER (0..4294967295)
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_PrioritizationResponse_EU	<ASN>	<>, and
DF	DF_VehicleToLanePosition_EU	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

7.142 Data Element: DE_SteeringWheelAngleConfidence

Use: This DE is used to provide the confidence interval of the 95% confidence level for the currently reported value of DE_SteeringWheelAngle, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

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ASN.1 Representation:

```
SteeringWheelAngleConfidence ::= ENUMERATED {
   unavailable (0), -- B'00  Not Equipped with Wheel angle
                    -- or Wheel angle status is unavailable
   prec2deg    (1), -- B'01  2 degrees
   prec1deg    (2), -- B'10  1 degree
   prec0-02deg (3)  -- B'11  0.02 degrees
   }
   -- Encoded as a 2 bit value
```

XML Representation:

```
<xs:simpleType name="SteeringWheelAngleConfidence" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- B&apos;00  Not Equipped with Wheel angle
             -- or Wheel angle status is unavailable
            prec2deg (1) -- B&apos;01  2 degrees
            prec1deg (2) -- B&apos;10  1 degree
            prec0 02deg (3) -- B&apos;11  0.02 degrees
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 2 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="prec2deg"/>
               <xs:enumeration value="prec1deg"/>
               <xs:enumeration value="prec0 02deg"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

Used By: This entry is directly used by the following 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_AccelSteerYawRateConfidence	<ASN>	<XML>, and
DF	DF_ConfidenceSet	<ASN>	<XML>, and
DF	DF_VehicleStatus	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

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7.143 Data Element: DE_SteeringWheelAngleRateOfChange

Use: The rate of change of the angle of the steering wheel, expressed in signed units of 3 degrees/second over a range of 381degrees in either direction. To the right being positive. Values beyond this range shall use the last value (-127 or +127).

ASN.1 Representation:
```
SteeringWheelAngleRateOfChange ::= INTEGER (-127..127)
   -- LSB is 3 degrees per second
```

XML Representation:
```
<xs:simpleType name="SteeringWheelAngleRateOfChange" >
      <xs:annotation>
         <xs:documentation>
            LSB is 3 degrees per second
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:byte">
         <xs:minInclusive value="-127"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: This element may be used by road maintenance operations to determine presence of an obstruction or pothole in the roadway.

7.144 Data Element: DE_SteeringWheelAngle

Use: The angle of the steering wheel, expressed in a signed (to the right being positive) value with units of 1.5 degrees and occupying one byte.

ASN.1 Representation:
```
SteeringWheelAngle ::= OCTET STRING (SIZE(1))
    -- LSB units of 1.5 degrees.
    -- a range of -189 to +189 degrees
    -- 0x01 = 00 = +1.5 deg
    -- 0x81 = -126 = -189 deg and beyond
    -- 0x7E = +126 = +189 deg and beyond
    -- 0x7F = +127 to be used for unavailable
```

XML Representation:
```
<xs:complexType name="SteeringWheelAngle" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            LSB units of 1.5 degrees.
            a range of -189 to +189 degrees
            0x01 = 00 = +1.5 deg
            0x81 = -126 = -189 deg and beyond
            0x7E = +126 = +189 deg and beyond
            0x7F = +127 to be used for unavailable
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="SteeringWheelAngle-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
```

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```
                    <xs:enumeration value="base64Binary"/>
                 </xs:restriction>
              </xs:simpleType>
            </xs:attribute>
         </xs:extension>
      </xs:simpleContent>
   </xs:complexType>
   <xs:simpleType name="SteeringWheelAngle-string">
      <xs:restriction base="xs:base64Binary">
         <xs:length value="2"/>
      </xs:restriction>
   </xs:simpleType >
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleStatus	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_Verbose_(VBSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.145 Data Element: DE_SunSensor

Use: The "Sun Sensor" Probe Data Element is intended to inform Probe Data Users as to the level of Sun Light in the area the vehicle was traveling at the time the Probe Data snapshot was taken. The value of the Sun Sensor data element ranges from 0-7, with 0 indicating "Complete Darkness", 1 indicating "Minimal Sun Light", and 7 indicating "Maximum Sun Light". This information could be sent to vehicles approaching the area to tell drivers to be prepared for sunny/clouding conditions ahead or a Weather Server for monitoring weather conditions in the area.

ASN.1 Representation:

```
   SunSensor ::= INTEGER (0..1000)
      -- units of watts / m2
```

XML Representation:

```
   <xs:simpleType name="SunSensor" >
         <xs:annotation>
            <xs:documentation>
               units of watts / m2
            </xs:documentation>
         </xs:annotation>
         <xs:restriction base="xs:unsignedShort">
            <xs:maxInclusive value="1000"/>
         </xs:restriction>
   </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: It is recommended that Automotive Manufacturers divide the range of their Sun Sensors into 8 resistance ranges corresponding to the above scale. For Example: a sensor that has a resistance range from 12K Ω (No Light) to 250 Ω (Max Light) will have the following resistance value ranges:

- # 0= 10501 to 12000 Ω
- # 1=9250 to 10749 Ω
- # 2=7750 to 9249 Ω

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- # 3=6250 to 7749 Ω
- # 4=4750 to 6249 Ω
- # 5=3250 to 4749 Ω
- # 6=1750 to 3249 Ω
- # 7=250 to 1749 Ω

7.146 Data Element: DE_TemporaryID

Use: This is the 4 byte random device identifier, called the temporary ID. In essence, this value for a mobile OBU device (unlike a typical wireless or wired 802 device) will periodically change to ensure the overall anonymity of the vehicle. Because this value is used as a means to identify the local vehicles that are interacting during an encounter, it is used in the message set.

ASN.1 Representation:
```
TemporaryID ::= OCTET STRING (SIZE(4)) -- a 4 byte string array
```

XML Representation:
```
<xs:complexType name="TemporaryID" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            a 4 byte string array
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="TemporaryID-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="TemporaryID-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="6"/>
   </xs:restriction>
</xs:simpleType >
```

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Used By: This entry is directly used by the following 5 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleIdent	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_Verbose (VBSM)	<ASN>	<XML>, and
MSG	MSG_CommonSafetyRequest (CSR)	<ASN>	<XML>, and
MSG	MSG_EmergencyVehicleAlert (EVA)	<ASN>	<XML>, and
MSG	MSG_IntersectionCollisionAvoidance (ICA)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.147 Data Element: DE_TerminationDistance

Use: Provides a Distance-to-Live type of time-out. Allows users to provide the distance driven until the probe management process ceases and the default condition is applied.

ASN.1 Representation:

```
TermDistance ::= INTEGER (1..30000)   -- units in meters
```

XML Representation:

```
<xs:simpleType name="TermDistance" >
      <xs:annotation>
         <xs:documentation>
            units in meters
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:minInclusive value="1"/>
         <xs:maxInclusive value="30000"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_ProbeDataManagement (PDM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.148 Data Element: DE_TerminationTime

Use: Provides a Time-to-Live type of time-out. Allows users to provide the number of seconds at which time the probe management process ceases and the default condition is applied.

ASN.1 Representation:

```
TermTime ::= INTEGER (1..1800) -- units of sec
```

XML Representation:

```
<xs:simpleType name="TermTime" >
      <xs:annotation>
         <xs:documentation>
            units of sec
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:minInclusive value="1"/>
         <xs:maxInclusive value="1800"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_ProbeDataManagement (PDM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.149 Data Element: DE_ThrottleConfidence

Use: This DE is used to provide the confidence interval of the 95% confidence level for the currently reported value of DE_Throttle, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly. If a fault that triggers the MIL is of a nature to render throttle performance unreliable, then ThrottleConfidence should be represented as "notEquipped."

ASN.1 Representation:

```
ThrottleConfidence ::= ENUMERATED {
   unavailable      (0), -- B'00  Not Equipped or unavailable
   prec10percent    (1), -- B'01  10  percent Confidence level
   prec1percent     (2), -- B'10  1   percent Confidence level
   prec0-5percent   (3)  -- B'11  0.5 percent Confidence level
   }
   -- Encoded as a 2 bit value
```

XML Representation:

```
<xs:simpleType name="ThrottleConfidence" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- B&apos;00  Not Equipped or unavailable
            prec10percent (1) -- B&apos;01  10  percent Confidence level
            prec1percent (2) -- B&apos;10  1   percent Confidence level
            prec0 5percent (3) -- B&apos;11  0.5 percent Confidence level
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 2 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="prec10percent"/>
               <xs:enumeration value="prec1percent"/>
               <xs:enumeration value="prec0 5percent"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ConfidenceSet <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.150 Data Element: DE_ThrottlePosition

Use: The position of the throttle in the vehicle, expressed in units of 0.5 percent of range of travel, unsigned.

ASN.1 Representation:
```
ThrottlePosition ::= INTEGER (0..200) -- LSB units are 0.5 percent
```

XML Representation:
```
<xs:simpleType name="ThrottlePosition" >
      <xs:annotation>
         <xs:documentation>
            LSB units are 0.5 percent
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="200"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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7.151 Data Element: DE_TimeConfidence

Use: This DE is used to provide the confidence interval of the 95% confidence level for the currently reported value of time, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

ASN.1 Representation:
```
TimeConfidence ::= ENUMERATED {
   unavailable              (0), -- Not Equipped or unavailable
   time-100-000             (1), -- Better then  100 Seconds
   time-050-000             (2), -- Better then  50 Seconds
   time-020-000             (3), -- Better then  20 Seconds
   time-010-000             (4), -- Better then  10 Seconds
   time-002-000             (5), -- Better then  2 Seconds
   time-001-000             (6), -- Better then  1 Second
   time-000-500             (7), -- Better then  0.5 Seconds
   time-000-200             (8), -- Better then  0.2 Seconds
   time-000-100             (9), -- Better then  0.1 Seconds
   time-000-050            (10), -- Better then  0.05 Seconds
   time-000-020            (11), -- Better then  0.02 Seconds
   time-000-010            (12), -- Better then  0.01 Seconds
   time-000-005            (13), -- Better then  0.005 Seconds
   time-000-002            (14), -- Better then  0.002 Seconds
   time-000-001            (15), -- Better then  0.001 Seconds
                                 -- Better then one milisecond
   time-000-000-5          (16), -- Better then  0.000,5 Seconds
   time-000-000-2          (17), -- Better then  0.000,2 Seconds
   time-000-000-1          (18), -- Better then  0.000,1 Seconds
   time-000-000-05         (19), -- Better then  0.000,05 Seconds
   time-000-000-02         (20), -- Better then  0.000,02 Seconds
   time-000-000-01         (21), -- Better then  0.000,01 Seconds
   time-000-000-005        (22), -- Better then  0.000,005 Seconds
   time-000-000-002        (23), -- Better then  0.000,002 Seconds
   time-000-000-001        (24), -- Better then  0.000,001 Seconds
```

```
                                    -- Better then one micro second
     time-000-000-000-5      (25), -- Better then  0.000,000,5 Seconds
     time-000-000-000-2      (26), -- Better then  0.000,000,2 Seconds
     time-000-000-000-1      (27), -- Better then  0.000,000,1 Seconds
     time-000-000-000-05     (28), -- Better then  0.000,000,05 Seconds
     time-000-000-000-02     (29), -- Better then  0.000,000,02 Seconds
     time-000-000-000-01     (30), -- Better then  0.000,000,01 Seconds
     time-000-000-000-005    (31), -- Better then  0.000,000,005 Seconds
     time-000-000-000-002    (32), -- Better then  0.000,000,002 Seconds
     time-000-000-000-001    (33), -- Better then  0.000,000,001 Seconds
                                    -- Better then one nano second
     time-000-000-000-000-5  (34), -- Better then  0.000,000,000,5 Seconds
     time-000-000-000-000-2  (35), -- Better then  0.000,000,000,2 Seconds
     time-000-000-000-000-1  (36), -- Better then  0.000,000,000,1 Seconds
     time-000-000-000-000-05 (37), -- Better then  0.000,000,000,05 Seconds
     time-000-000-000-000-02 (38), -- Better then  0.000,000,000,02 Seconds
     time-000-000-000-000-01 (39)  -- Better then  0.000,000,000,01 Seconds
     }
```

XML Representation:

```
   <xs:simpleType name="TimeConfidence" >
         <xs:annotation>
            <xs:appinfo>
               unavailable (0) -- Not Equipped or unavailable
               time 100 000 (1) -- Better then  100 Seconds
               time 050 000 (2) -- Better then  50 Seconds
               time 020 000 (3) -- Better then  20 Seconds
               time 010 000 (4) -- Better then  10 Seconds
               time 002 000 (5) -- Better then  2 Seconds
               time 001 000 (6) -- Better then  1 Second
               time 000 500 (7) -- Better then  0.5 Seconds
               time 000 200 (8) -- Better then  0.2 Seconds
               time 000 100 (9) -- Better then  0.1 Seconds
               time 000 050 (10) -- Better then  0.05 Seconds
               time 000 020 (11) -- Better then  0.02 Seconds
               time 000 010 (12) -- Better then  0.01 Seconds
               time 000 005 (13) -- Better then  0.005 Seconds
               time 000 002 (14) -- Better then  0.002 Seconds
               time 000 001 (15) -- Better then  0.001 Seconds
                -- Better then one milisecond
               time 000 000 5 (16) -- Better then  0.000 ,
               time 000 000 2 (17) -- Better then  0.000 ,
               time 000 000 1 (18) -- Better then  0.000 ,
               time 000 000 05 (19) -- Better then  0.000 ,
               time 000 000 02 (20) -- Better then  0.000 ,
               time 000 000 01 (21) -- Better then  0.000 ,
               time 000 000 005 (22) -- Better then  0.000 ,
               time 000 000 002 (23) -- Better then  0.000 ,
               time 000 000 001 (24) -- Better then  0.000 ,
                -- Better then one micro second
               time 000 000 000 5 (25) -- Better then  0.000 ,
               time 000 000 000 2 (26) -- Better then  0.000 ,
               time 000 000 000 1 (27) -- Better then  0.000 ,
               time 000 000 000 05 (28) -- Better then  0.000 ,
               time 000 000 000 02 (29) -- Better then  0.000 ,
               time 000 000 000 01 (30) -- Better then  0.000 ,
               time 000 000 000 005 (31) -- Better then  0.000 ,
               time 000 000 000 002 (32) -- Better then  0.000 ,
               time 000 000 000 001 (33) -- Better then  0.000 ,
                -- Better then one nano second
               time 000 000 000 000 5 (34) -- Better then  0.000 ,
```

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```
            time 000 000 000 000 2 (35) -- Better then  0.000 ,
            time 000 000 000 000 1 (36) -- Better then  0.000 ,
            time 000 000 000 000 05 (37) -- Better then  0.000 ,
            time 000 000 000 000 02 (38) -- Better then  0.000 ,
            time 000 000 000 000 01 (39) -- Better then  0.000 , 000 , 000 , 01
Seconds
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="39"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="time 100 000"/>
               <xs:enumeration value="time 050 000"/>
               <xs:enumeration value="time 020 000"/>
               <xs:enumeration value="time 010 000"/>
               <xs:enumeration value="time 002 000"/>
               <xs:enumeration value="time 001 000"/>
               <xs:enumeration value="time 000 500"/>
               <xs:enumeration value="time 000 200"/>
               <xs:enumeration value="time 000 100"/>
               <xs:enumeration value="time 000 050"/>
               <xs:enumeration value="time 000 020"/>
               <xs:enumeration value="time 000 010"/>
               <xs:enumeration value="time 000 005"/>
               <xs:enumeration value="time 000 002"/>
               <xs:enumeration value="time 000 001"/>
               <xs:enumeration value="time 000 000 5"/>
               <xs:enumeration value="time 000 000 2"/>
               <xs:enumeration value="time 000 000 1"/>
               <xs:enumeration value="time 000 000 05"/>
               <xs:enumeration value="time 000 000 02"/>
               <xs:enumeration value="time 000 000 01"/>
               <xs:enumeration value="time 000 000 005"/>
               <xs:enumeration value="time 000 000 002"/>
               <xs:enumeration value="time 000 000 001"/>
               <xs:enumeration value="time 000 000 000 5"/>
               <xs:enumeration value="time 000 000 000 2"/>
               <xs:enumeration value="time 000 000 000 1"/>
               <xs:enumeration value="time 000 000 000 05"/>
               <xs:enumeration value="time 000 000 000 02"/>
               <xs:enumeration value="time 000 000 000 01"/>
               <xs:enumeration value="time 000 000 000 005"/>
               <xs:enumeration value="time 000 000 000 002"/>
               <xs:enumeration value="time 000 000 000 001"/>
               <xs:enumeration value="time 000 000 000 000 5"/>
               <xs:enumeration value="time 000 000 000 000 2"/>
               <xs:enumeration value="time 000 000 000 000 1"/>
               <xs:enumeration value="time 000 000 000 000 05"/>
               <xs:enumeration value="time 000 000 000 000 02"/>
               <xs:enumeration value="time 000 000 000 000 01"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
   </xs:simpleType>
```

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Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_ConfidenceSet	<ASN>	<XML>, and
DF	DF_FullPositionVector	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.152 Data Element: DE_TimeIntervalConfidence

Use: This is the statistical confidence for the predicted signal group state change. For evaluation the formula 10^(x/a)-b with a=82.5 and b=1.3 was used. The values are encoded as probability classes with proposed values listed in the below table in the ASN.1 specification.

ASN.1 Representation:

```
TimeIntervalConfidence ::= INTEGER (0..15)
    -- Value    Probability
    --    0          21%
    --    1          36%
    --    2          47%
    --    3          56%
    --    4          62%
    --    5          68%
    --    6          73%
    --    7          77%
    --    8          81%
    --    9          85%
    --   10          88%
    --   11          91%
    --   12          94%
    --   13          96%
    --   14          98%
    --   15         100%
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_TimeChangeDetails CHANGED	<ASN>	<>, and
DF	DF_REG_MovementEvent_JPN	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

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7.153 Data Element: DE_TimeMark

Use: The TimeMark data element is used to relate a moment in local UTC (Universal Time Coordinated) based time when a signal phase is predicted to change, with a precision of 1/10 of a second. A range of 60 full minutes is supported and it can be presumed that the receiver shares a common sense of time with the sender which is kept aligned to within a fraction of a second or better.

If there is a need to send a value greater than the range allowed by the data element (over one hour in the future), the value 36001 shall be sent and shall be interpreted to indicate an indefinite future time value. When the value to be used in undefined or unknown a value of 36001 shall be sent. Note that leap seconds are supported.

ASN.1 Representation:

```
TimeMark ::= INTEGER (0..36002)
   -- Tenths of a second in the current or next hour
   -- In units of 1/10th second from UTC time
   -- A range of 0~36000 covers one hour
   -- The values 35991..36000 are used when a leap second occurs
   -- The value 36001 is used to indicate time >3600 seconds
   -- 36002 is to be used when value undefined or unknown
   -- Note that this is NOT expressed in GPS time
   -- or in local time
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_TimeChangeDetails CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.154 Data Element: DE_TractionControlState

Use: The DE_TractionControlState data element reflects the status of the vehicle traction system. The element is intended to inform others whether one or more of the vehicle's drive wheels is slipping during an acceleration. The element can also inform others that the vehicle is not equipped with a traction control system. If the vehicle is equipped with a traction control system, the element reports whether the system is in an Off, On or Engaged state.

ASN.1 Representation:

```
TractionControlState ::= ENUMERATED {
   unavailable (0), -- B'00  Not Equipped with tracton control
                    -- or tracton control status is unavailable
   off         (1), -- B'01  tracton control is Off
   on          (2), -- B'10  tracton control is On (but not Engaged)
   engaged     (3)  -- B'11  tracton control is Engaged
   }
   -- Encoded as a 2 bit value
```

XML Representation:

```
<xs:simpleType name="TractionControlState" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- B&apos;00  Not Equipped with tracton control
             -- or tracton control status is unavailable
            off (1) -- B&apos;01  tracton control is Off
            on (2) -- B&apos;10  tracton control is On  (but not Engaged)
            engaged (3) -- B&apos;11  tracton control is Engaged
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 2 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="off"/>
               <xs:enumeration value="on"/>
               <xs:enumeration value="engaged"/>
            </xs:restriction>
```

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```
         </xs:simpleType >
      </xs:union>
   </xs:simpleType>
```

Remarks: The value for notEquipped shall be used when data is not available.

7.155 Data Element: DE_TransitStatus

Use: The TransitStatus data element is used to relate basic information about the transit run in progress. This is typically used in a priority request to a signalized system and becomes part of the input processing for how that system will respond to the request.

ASN.1 Representation:

```
   TransitStatus ::= BIT STRING {
       none         (0), -- nothing is active
       anADAuse     (1), -- an ADA access is in progress (wheelchairs, kneling, etc.)
       aBikeLoad    (2), -- loading of a bicyle is in progress
       doorOpen     (3), -- a vehicle door is open for passenger access
       occM         (4),
       occL         (5)
       -- bits four and five are used to relate the
       -- the relative occupancy of the vehicle, with
       -- 00  as least full and 11 indicating a
       -- close-to or full conditon
       } (SIZE(6))
```

XML Representation:

```
   <xs:simpleType name="TransitStatus-item" >
      <xs:annotation>
         <xs:appinfo>
            none (0) -- nothing is active
            anADAuse (1) -- an ADA access is in progress  (wheelchairs ,
            aBikeLoad (2) -- loading of a bicyle is in progress
            doorOpen (3) -- a vehicle door is open for passenger access
            occM (4)
            occL (5) -- bits four and five are used to relate the
             -- the relative occupancy of the vehicle ,  with
             -- 00  as least full and 11 indicating a
             -- close-to or full conditon
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:int">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="5"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="none"/>
               <xs:enumeration value="anADAuse"/>
               <xs:enumeration value="aBikeLoad"/>
               <xs:enumeration value="doorOpen"/>
               <xs:enumeration value="occM"/>
               <xs:enumeration value="occL"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
   </xs:simpleType>
```

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```
<xs:simpleType name="TransitStatus">
   <xs:list itemType="TransitStatus-item"/>
</xs:simpleType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

MSG MSG_SignalRequestMessage (SRM) <ASN> <XML>, and

MSG MSG_SignalStatusMessage (SSM) <ASN> <XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: Most of these values are used to detect that the transit vehicle in not in a state where movement can occur (and that therefore any priority signal should be ignored until the vehicle is again ready to depart). Two bits (bits 4 and 5) are used to relate the relative occupancy of the vehicle.

7.156 Data Element: DE_TransmissionState

Use: The DE_TransmissionState data element is used to provide the current state of the vehicle transmission. It is typically combined with a speed value to represent the vehicle rate of speed. When used with non-equipped vehicles the value "unavailable" shall be sent.

ASN.1 Representation:

```
TransmissionState ::= ENUMERATED {
   neutral         (0), -- Neutral, speed relative to the vehicle alignment
   park            (1), -- Park, speed relative the to vehicle alignment
   forwardGears    (2), -- Forward gears, speed relative the to vehicle alignment
   reverseGears    (3), -- Reverse gears, speed relative the to vehicle alignment
   reserved1       (4),
   reserved2       (5),
   reserved3       (6),
   unavailable     (7), -- not-equipped or unavailable value,
                        -- speed relative to the vehicle alignment

   ... -- # LOCAL_CONTENT
   }
```

XML Representation:

```
<xs:simpleType name="TransmissionState" >
      <xs:annotation>
         <xs:appinfo>
            neutral (0) -- Neutral ,
            park (1) -- Park ,
            forwardGears (2) -- Forward gears ,
            reverseGears (3) -- Reverse gears ,
            reserved1 (4)
            reserved2 (5)
            reserved3 (6)
            unavailable (7) -- not-equipped or unavailable value ,
             -- speed relative to the vehicle alignment
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
```

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```
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="neutral"/>
               <xs:enumeration value="park"/>
               <xs:enumeration value="forwardGears"/>
               <xs:enumeration value="reverseGears"/>
               <xs:enumeration value="reserved1"/>
               <xs:enumeration value="reserved2"/>
               <xs:enumeration value="reserved3"/>
               <xs:enumeration value="unavailable"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType>
            <xs:restriction base="local:TransmissionState" />
         </xs:simpleType>
      </xs:union>
   </xs:simpleType>
```

7.157 Data Element: DE_TransmitInterval

Use: Defines time interval between actions or events. (defines the interval between transmissions of probe messages.)

ASN.1 Representation:

```
   TxTime ::= INTEGER (1..20)   -- units of seconds
```

XML Representation:

```
   <xs:simpleType name="TxTime" >
         <xs:annotation>
            <xs:documentation>
               units of seconds
            </xs:documentation>
         </xs:annotation>
         <xs:restriction base="xs:unsignedByte">
            <xs:minInclusive value="1"/>
            <xs:maxInclusive value="20"/>
         </xs:restriction>
   </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_ProbeDataManagement (PDM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.158 Data Element: DE_TravelerInfoType

Use: The traveler information DE (the type of message if you prefer) to follow in the rest of the message frame structure, used in the traveler information message, which may contain several such structures.

ASN.1 Representation:

```
   TravelerInfoType ::= ENUMERATED {
        unknown             (0),
        advisory            (1),
        roadSignage         (2),
        commercialSignage   (3),
        ... -- # LOCAL_CONTENT
        }
        -- values to 127 reserved for std use
        -- values 128 to 255 reserved for local use
```

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XML Representation:

```
<xs:simpleType name="TravelerInfoType" >
      <xs:annotation>
         <xs:appinfo>
            unknown (0)
            advisory (1)
            roadSignage (2)
            commercialSignage (3)
         </xs:appinfo>
         <xs:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unknown"/>
               <xs:enumeration value="advisory"/>
               <xs:enumeration value="roadSignage"/>
               <xs:enumeration value="commercialSignage"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType>
            <xs:restriction base="local:TravelerInfoType" />
         </xs:simpleType>
      </xs:union>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_TravelerInformation Message (TIM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.159 Data Element: DE_UniqueMSG_ID

Use: A message link value used to connect to other supporting messages in other formats.

ASN.1 Representation:

```
UniqueMSGID ::= OCTET STRING (SIZE(9))
```

XML Representation:

```
<xs:complexType name="UniqueMSGID" >
   <xs:simpleContent>
      <xs:extension base="UniqueMSGID-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
```

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```
<xs:simpleType name="UniqueMSGID-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="12"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_TravelerInformation Message (TIM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.160 Data Element: DE_UPER_Blob

Use: The UperBlob data concept contains a UPER encoded message expressed as a sequence of bytes (a BLOB) using the normal UPER encoding complete with any trailing filler bits to complete the final byte.

ASN.1 Representation:

```
UPER-Blob ::= OCTET STRING (SIZE(10..2000))
    -- Final size range may be further
    -- limited by the transport layer used
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_UPER_Frame_USA (UPER) CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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7.161 Data Element: DE_URL_Base

Use: A valid internet style URI / URL in the form of a text string which will form the base of a compound string which, when combined with the URL-Short data element, will link to the designated resource. The string is to be interpreted as case-insensitive . Lower case is recommended. The protocol to be used (such as http) should be given in the string, The very last letter of the string may be used to differentiate multiple URL-Base values in a single system. This allows for a total of up to 26+10= 36 such base addresses to exist. This last letter is then used to differentiate which base a given short value is to be used with (a matching first letter in the URL-Short value is also used). These letters are stripped from both the base and short data elements before combining to create the final URL/URI value.

ASN.1 Representation:

```
URL-Base ::= IA5String (SIZE(1..45))
```

XML Representation:

```
<xs:simpleType name="URL-Base" >
      <xs:restriction base="xs:string">
         <xs:minLength value="1"/>
         <xs:maxLength value="45"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_TravelerInformation Message (TIM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: It is the responsibility of the local deployment to ensure that all parties can reach the URL given over their own networks, and that the protocols used are acceptable to all. In other words, do not use URLs which depend on private network access to work.

7.162 Data Element: DE_URL_Link

Use: A valid internet style URI / URL in the form of a text string which will link to the designated resource.

ASN.1 Representation:

```
URL-Link ::= IA5String (SIZE(1..255))
```

XML Representation:
```
<xs:simpleType name="URL-Link" >
      <xs:restriction base="xs:anyURI">
         <xs:minLength value="1"/>
         <xs:maxLength value="255"/>
      </xs:restriction>
</xs:simpleType>
```

Remarks: It is the responsibility of the local deployment to ensure that all parties can reach the URL given over their own networks, and that the protocols used are acceptable to all.

7.163 Data Element: DE_URL_Short

Use: A valid internet style URI / URL in the form of a text string which will be used as the final portion of a compound string which, when combined with the URL-Base data element, will link to the designated resource. The string is to be interpreted as case-insensitive . Lower case is recommended. The very first letter of the string shall be used to differentiate which one of multiple URL-Base values in a single system is to b used. This allows for a total of up to 26+10= 36 such base addresses to exist. This initial letter is then stripped off and used to differentiate which base a given short value is to be used with.

ASN.1 Representation:
```
URL-Short ::= IA5String (SIZE(1..15))
```

XML Representation:
```
<xs:simpleType name="URL-Short" >
      <xs:restriction base="xs:string">
         <xs:minLength value="1"/>
         <xs:maxLength value="15"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_TravelerInformation Message (TIM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: It is the responsibility of the local deployment to ensure that all parties can reach the URL given over their own networks, and that the protocols used are acceptable to all.

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7.164 Data Element: DE_VehicleHeight

Use: The height of the vehicle, measured from the ground to the highest surface, excluding any antenna(s), and expressed in units of 5 cm. In cases of vehicles with adjustable ride heights, camper shells, and other devices which may cause the overall height to vary, the largest possible height will be used.

ASN.1 Representation:
```
VehicleHeight ::= INTEGER (0..127)
    -- the height of the vehicle
    -- LSB units of 5 cm, range to 6.35 meters
```

XML Representation:
```
<xs:simpleType name="VehicleHeight" >
      <xs:annotation>
         <xs:documentation>
            the height of the vehicle
            LSB units of 5 cm,  range to 6.35 meters
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="127"/>
      </xs:restriction>
```

```
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.165 Data Element: DE_VehicleLength

Use: The length of the vehicle measured from the edge of the front bumper to the edge of rear bumper expressed in centimeters, unsigned. Note that this is a 14 bit value and it is combined with a 10 bit value (DE_VehicleWidth) to form a 3 byte data frame. When sent alone it shall occupy 2 bytes. The value zero shall be sent when data is unavailable.

ASN.1 Representation:
```
VehicleLength ::= INTEGER (0..16383) -- LSB units are 1 cm
```

XML Representation:
```
<xs:simpleType name="VehicleLength" >
      <xs:annotation>
         <xs:documentation>
            LSB units are 1 cm
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="16383"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleSize <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.166 Data Element: DE_VehicleMass

Use: The mass of the vehicle. With an LSB of 50 kg, this produces a max range of 6350kg (about 14,000 lbs). Mass should reflect current gross mass of vehicle and contents if known, otherwise an average laden value should be established. In cases where the mass is greater then 6350 Kg then the value of 127 shall be used.

ASN.1 Representation:
```
VehicleMass ::= INTEGER (1..127) -- mass with an LSB of 50 Kg
```

XML Representation:
```
<xs:simpleType name="VehicleMass" >
      <xs:annotation>
         <xs:documentation>
            mass with an LSB of 50 Kg
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:minInclusive value="1"/>
         <xs:maxInclusive value="127"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleStatus	<ASN>	<XML>, and
MSG	MSG_EmergencyVehicleAlert (EVA)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

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7.167 Data Element: DE_VehicleRequestStatus

Use: The VehicleRequestStatus data element is used to relate status information about a vehicle when requesting service from a signalized intersection. It relates some basic information about the requester which can be used by the signal systems in its response with changes to the timing plan in use. Note that this status is used in both *priority* and *preemption* use cases but that the information mapped into the lower 4 bits varies with each.

ASN.1 Representation:

```
VehicleRequestStatus ::= OCTET STRING (SIZE(1))
  -- With bits set as follows:
  -- Bit 7 (MSB)  Brakes-on, see notes for use
  -- Bit 6 Emergency Use or operation
  -- Bit 5 Lights in use (see also the light bar element)
  -- Bits 5~0
  -- when a priority, map the values of
  -- LightbarInUse to the lower 4 bits
  -- and set the 5th bit to zero
  -- when a preemption, map the values of
  -- TransistStatus to the lower 5 bits
```

XML Representation:

```
<xs:complexType name="VehicleRequestStatus" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            With bits set as follows:
            Bit 7  (MSB)   Brakes-on,  see notes for use
            Bit 6 Emergency Use or operation
            Bit 5 Lights in use  (see also the light bar element)
            Bits 5~0
            when a priority,  map the values of
            LightbarInUse to the lower 4 bits
            and set the 5th bit to zero
            when a preemption,  map the values of
            TransistStatus to the lower 5 bits
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="VehicleRequestStatus-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="VehicleRequestStatus-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="2"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_SignalRequestMessage (SRM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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Remarks: The MSB bit (the brakes-on bit) is used in the general sense of a vehicle which is not moving or proceeding towards the light. Examples of use would be a response vehicle that has stopped short of the light, but more typically a transit vehicle making a stop to load/unload before reaching the light. This bit can be used by the signal system to disregard a request.

7.168 Data Element: DE_VehicleStatusDeviceTypeTag

Use: The VehicleStatusDeviceTypeTag element is an enumeration of every possible value which can be found in the VehicleStatusDeviceType data frame. It is used to denote that value (and hence also the length) of the data which follows it.

ASN.1 Representation:
```
VehicleStatusDeviceTypeTag ::= ENUMERATED {
   unknown            (0),
   lights             (1),  -- Exterior Lights
   wipers             (2),  -- Wipers
   brakes             (3),  -- Brake Applied
   stab               (4),  -- Stability Control
   trac               (5),  -- Traction Control
   abs                (6),  -- Anti-Lock Brakes
   sunS               (7),  -- Sun Sensor
   rainS              (8),  -- Rain Sensor
   airTemp            (9),  -- Air Temperature
   steering           (10),
   vertAccelThres     (11), -- Wheel that Exceeded the
   vertAccel          (12), -- Vertical g Force Value
   hozAccelLong       (13), -- Longitudinal Acceleration
   hozAccelLat        (14), -- Lateral Acceleration
   hozAccelCon        (15), -- Acceleration Confidence
   accel4way          (16),
   confidenceSet      (17),
   obDist             (18), -- Obstacle Distance
   obDirect           (19), -- Obstacle Direction
   yaw                (20), -- Yaw Rate
   yawRateCon         (21), -- Yaw Rate Confidence
   dateTime           (22), -- complete time
   fullPos            (23), -- complete set of time and
                            -- position, speed, heading
   position2D         (24), -- lat, long
   position3D         (25), -- lat, long, elevation
   vehicle            (26), -- height, mass, type
   speedHeadC         (27),
   speedC             (28),

   ... -- # LOCAL_CONTENT
   }
   -- values to 127 reserved for std use
   -- values 128 to 255 reserved for local use
```

XML Representation:
```
<xs:simpleType name="VehicleStatusDeviceTypeTag" >
      <xs:annotation>
         <xs:appinfo>
            unknown (0)
            lights (1) -- Exterior Lights
            wipers (2) -- Wipers
            brakes (3) -- Brake Applied
            stab (4) -- Stability Control
            trac (5) -- Traction Control
```

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```
         abs (6) -- Anti-Lock Brakes
         sunS (7) -- Sun Sensor
         rainS (8) -- Rain Sensor
         airTemp (9) -- Air Temperature
         steering (10)
         vertAccelThres (11) -- Wheel that Exceeded the
         vertAccel (12) -- Vertical g Force Value
         hozAccelLong (13) -- Longitudinal Acceleration
         hozAccelLat (14) -- Lateral Acceleration
         hozAccelCon (15) -- Acceleration Confidence
         accel4way (16)
         confidenceSet (17)
         obDist (18) -- Obstacle Distance
         obDirect (19) -- Obstacle Direction
         yaw (20) -- Yaw Rate
         yawRateCon (21) -- Yaw Rate Confidence
         dateTime (22) -- complete time
         fullPos (23) -- complete set of time and
          -- position ,  speed ,  heading
         position2D (24) -- lat ,
         position3D (25) -- lat ,
         vehicle (26) -- height ,
         speedHeadC (27)
         speedC (28)
      </xs:appinfo>
      <xs:documentation>
         values to 127 reserved for std use
         values 128 to 255 reserved for local use
      </xs:documentation>
   </xs:annotation>
   <xs:union>
      <xs:simpleType>
         <xs:restriction base="xs:unsignedInt">
            <xs:minInclusive value="0"/>
            <xs:maxInclusive value="28"/>
         </xs:restriction>
      </xs:simpleType>
      <xs:simpleType>
         <xs:restriction base="xs:string">
            <xs:enumeration value="unknown"/>
            <xs:enumeration value="lights"/>
            <xs:enumeration value="wipers"/>
            <xs:enumeration value="brakes"/>
            <xs:enumeration value="stab"/>
            <xs:enumeration value="trac"/>
            <xs:enumeration value="abs"/>
            <xs:enumeration value="sunS"/>
            <xs:enumeration value="rainS"/>
            <xs:enumeration value="airTemp"/>
            <xs:enumeration value="steering"/>
            <xs:enumeration value="vertAccelThres"/>
            <xs:enumeration value="vertAccel"/>
            <xs:enumeration value="hozAccelLong"/>
            <xs:enumeration value="hozAccelLat"/>
            <xs:enumeration value="hozAccelCon"/>
            <xs:enumeration value="accel4way"/>
            <xs:enumeration value="confidenceSet"/>
            <xs:enumeration value="obDist"/>
            <xs:enumeration value="obDirect"/>
            <xs:enumeration value="yaw"/>
            <xs:enumeration value="yawRateCon"/>
```

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```
                <xs:enumeration value="dateTime"/>
                <xs:enumeration value="fullPos"/>
                <xs:enumeration value="position2D"/>
                <xs:enumeration value="position3D"/>
                <xs:enumeration value="vehicle"/>
                <xs:enumeration value="speedHeadC"/>
                <xs:enumeration value="speedC"/>
             </xs:restriction>
          </xs:simpleType >
          <xs:simpleType>
             <xs:restriction base="local:VehicleStatusDeviceTypeTag" />
          </xs:simpleType>
       </xs:union>
 </xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatusRequest <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.169 Data Element: DE_VehicleType

Use: The type (classification) of the vehicle in DSRC terms of overall size.

ASN.1 Representation:

```
VehicleType ::= ENUMERATED {
   none                  (0),   -- Not Equipped, Not known or unavailable
   unknown               (1),   -- Does not fit any other category
   special               (2),   -- Special use
   moto                  (3),   -- Motorcycle
   car                   (4),   -- Passenger car
   carOther              (5),   -- Four tire single units
   bus                   (6),   -- Buses
   axleCnt2              (7),   -- Two axle, six tire single units
   axleCnt3              (8),   -- Three axle, single units
   axleCnt4              (9),   -- Four or more axle, single unit
   axleCnt4Trailer       (10),  -- Four or less axle, single trailer
   axleCnt5Trailer       (11),  -- Five or less axle, single trailer
   axleCnt6Trailer       (12),  -- Six or more axle, single trailer
   axleCnt5MultiTrailer  (13),  -- Five or less axle, multi-trailer
   axleCnt6MultiTrailer  (14),  -- Six axle, multi-trailer
   axleCnt7MultiTrailer  (15),   -- Seven or more axle, multi-trailer
   ... -- # LOCAL_CONTENT
   }
   -- values to 127 reserved for std use
   -- values 128 to 255 reserved for local use
```

XML Representation:

```
<xs:simpleType name="VehicleType" >
      <xs:annotation>
         <xs:appinfo>
            none (0) -- Not Equipped, Not known or unavailable
            unknown (1) -- Does not fit any other category
            special (2) -- Special use
            moto (3) -- Motorcycle
            car (4) -- Passenger car
            carOther (5) -- Four tire single units
            bus (6) -- Buses
            axleCnt2 (7) -- Two axle, six tire single units
            axleCnt3 (8) -- Three axle, single units
            axleCnt4 (9) -- Four or more axle , single unit
            axleCnt4Trailer (10) -- Four or less axle, single trailer
```

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```
            axleCnt5Trailer (11) -- Five or less axle, single trailer
            axleCnt6Trailer (12) -- Six or more axle, single trailer
            axleCnt5MultiTrailer (13) -- Five or less axle, multi-trailer
            axleCnt6MultiTrailer (14) -- Six axle, multi-trailer
            axleCnt7MultiTrailer (15) -- Seven or more axle,  multi-traile
         </xs:appinfo>
         <xs:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="15"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="none"/>
               <xs:enumeration value="unknown"/>
               <xs:enumeration value="special"/>
               <xs:enumeration value="moto"/>
               <xs:enumeration value="car"/>
               <xs:enumeration value="carOther"/>
               <xs:enumeration value="bus"/>
               <xs:enumeration value="axleCnt2"/>
               <xs:enumeration value="axleCnt3"/>
               <xs:enumeration value="axleCnt4"/>
               <xs:enumeration value="axleCnt4Trailer"/>
               <xs:enumeration value="axleCnt5Trailer"/>
               <xs:enumeration value="axleCnt6Trailer"/>
               <xs:enumeration value="axleCnt5MultiTrailer"/>
               <xs:enumeration value="axleCnt6MultiTrailer"/>
               <xs:enumeration value="axleCnt7MultiTrailer"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType>
            <xs:restriction base="local:VehicleType" />
         </xs:simpleType>
      </xs:union>
   </xs:simpleType>
```

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Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleIdent	<ASN>	<XML>, and
DF	DF_VehicleStatus	<ASN>	<XML>, and
MSG	MSG_EmergencyVehicleAlert (EVA)	<ASN>	<XML>, and
MSG	MSG_ProbeVehicleData (PVD)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.170 Data Element: DE_VehicleWidth

Use: The width of the vehicle expressed in centimeters, unsigned. Note that this is a 10 bit value and it is combined with a 14 bit value to form a 3 byte data frame. When sent alone it shall occupy 2 bytes with the upper six bits being set to zero. The width shall be the widest point of the vehicle with all factory installed equipment. The value zero shall be sent when data is unavailable.

ASN.1 Representation:
```
VehicleWidth ::= INTEGER (0..1023) -- LSB units are 1 cm
```

XML Representation:
```
<xs:simpleType name="VehicleWidth" >
      <xs:annotation>
         <xs:documentation>
            LSB units are 1 cm
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="1023"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleSize <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Observe that this data element is often combined with DE_VehicleLength when used.

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7.171 Data Element: DE_Velocity

Use: This data element represents the velocity of an object, typically a vehicle speed or the recommended speed of along a roadway, expressed in unsigned units of 0.02 meters per second. It is typically combined with the transmission state to form a 2 byte value when encoded in the Basic Safety Message. A value of 8191 shall be used when the speed is unavailable.

ASN.1 Representation:
```
Velocity ::= INTEGER (0..8191) -- Units of 0.02 m/s
          -- The value 8191 indicates that
          -- velocity is unavailable
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_RegulatorySpeedLimit <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: When the input speed is provided in miles per hour (MPH), convert the input value to units of 0.1 m/s and round to the nearest integer unit. For example, 30 MPH = ~48.28 KPH = 13.41 m/s = 134.1 units of 0.1 m/s, therefore transmit 134. A similar reverse process is used when the speed is to be displayed to an end user in units of MPH.

7.172 Data Element: DE_VerticalAccelerationThreshold

Use: A bit string enumerating when a preset threshold for vertical acceleration is exceeded at each wheel.

The "Wheel that exceeded Vertical G Threshold" Probe Data Element is intended to inform Probe Data Users which vehicle wheel has exceeded a pre-determined threshold of a percent change in vertical G acceleration per second at the time a Probe Data snapshot was taken. This element is primarily intended to be used in the detection of potholes and similar road abnormalities. This element only provides information for four wheeled vehicles. The element informs the user if the vehicle is NOT equipped with accelerometers on its wheels or that the system is off. When a wheel does exceed the threshold, the element provides details on the particular wheel by specifying Left Front, Left Rear, Right Front and Right Rear.

ASN.1 Representation:

```
VerticalAccelerationThreshold ::= BIT STRING {
   allOff      (0), -- B'0000  The condition All Off or not equipped
   leftFront   (1), -- B'0001  Left Front Event
   leftRear    (2), -- B'0010  Left Rear Event
   rightFront  (4), -- B'0100  Right Front Event
   rightRear   (8)  -- B'1000  Right Rear Event
   } -- to fit in 4 bits
```

XML Representation:

```
<xs:simpleType name="VerticalAccelerationThreshold-item" >
      <xs:annotation>
         <xs:appinfo>
            allOff (0) -- B&apos;0000  The condition All Off or not equipped
            leftFront (1) -- B&apos;0001  Left Front Event
            leftRear (2) -- B&apos;0010  Left Rear Event
            rightFront (4) -- B&apos;0100  Right Front Event
            rightRear (8) -- B&apos;1000  Right Rear Event
         </xs:appinfo>
         <xs:documentation>
            to fit in 4 bits
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:int">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="8"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="allOff"/>
               <xs:enumeration value="leftFront"/>
               <xs:enumeration value="leftRear"/>
               <xs:enumeration value="rightFront"/>
               <xs:enumeration value="rightRear"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
<xs:simpleType name="VerticalAccelerationThreshold">
   <xs:list itemType="VerticalAccelerationThreshold-item"/>
</xs:simpleType>
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.173 Data Element: DE_VerticalAcceleration

Use: A data element representing the signed vertical acceleration of the vehicle along the vertical axis in units of 0.02 G (where 9.80665 meters per second squared is one G, i.e 0.02 G = 0.1962 meters per second squared). This provides an uneven range of over +1.5 to -3.4G in each direction with some negative values for greater negative ranges as denoted. A one byte payload.

ASN.1 Representation:

```
VerticalAcceleration ::= INTEGER (-127..127)
    -- LSB units of 0.02 G steps over
    -- a range +1.54 to -3.4G
    -- and offset by 50  Value 50 = 0g, Value 0 = -1G
    -- value +127 = 1.54G,
    -- value -120 = -3.4G
    -- value -121 for ranges -3.4 to -4.4G
    -- value -122 for ranges -4.4 to -5.4G
    -- value -123 for ranges -5.4 to -6.4G
    -- value -124 for ranges -6.4 to -7.4G
    -- value -125 for ranges -7.4 to -8.4G
    -- value -126 for ranges larger than -8.4G
    -- value -127 for unavailable data
```

XML Representation:

```
<xs:simpleType name="VerticalAcceleration" >
      <xs:annotation>
         <xs:documentation>
            LSB units of 0.02 G steps over
            a range +1.54 to -3.4G
            and offset by 50  Value 50 = 0g,  Value 0 = -1G
            value +127 = 1.54G,
            value -120 = -3.4G
            value -121 for ranges -3.4 to -4.4G
            value -122 for ranges -4.4 to -5.4G
            value -123 for ranges -5.4 to -6.4G
            value -124 for ranges -6.4 to -7.4G
            value -125 for ranges -7.4 to -8.4G
            value -126 for ranges larger than -8.4G
            value -127 for unavailable data
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:byte">
         <xs:minInclusive value="-127"/>
      </xs:restriction>
</xs:simpleType>
```

Remarks: The association of a received value, e.g. -122, with a particular vertical acceleration in the indicated range is left to the discretion of the receiving system.

7.174 Data Element: DE_VINstring,

Use: The VINstring, data element is used to convey a unique identifying string about the vehicle. This may be the vehicle's VIN value assignment, or it may be another string selected by the owner-operator for fleet needs. A shorter value is in general preferred to save bandwidth.

ASN.1 Representation:

```
VINstring ::= OCTET STRING (SIZE(1..17))
    -- A legal VIN or a shorter value
    -- to provide an ident of the vehicle
    -- If a VIN is sent, then IA5 encoding
    -- shall be used
```

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XML Representation:

```
<xs:complexType name="VINstring" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            A legal VIN or a shorter value
            to provide an ident of the vehicle
            If a VIN is sent,  then IA5 encoding
            shall be used
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="VINstring-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="VINstring-string">
   <xs:restriction base="xs:base64Binary">
      <xs:minLength value="2"/>
      <xs:maxLength value="23"/>
   </xs:restriction>
</xs:simpleType >
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleIdent <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

7.175 Data Element: DE_WaitOnStopline

Use: The WaitOnStopline data concept is used to indicate to the vehicle it must stop at the stop line and not move past.

ASN.1 Representation:

```
WaitOnStopline ::= BOOLEAN --
         -- True or False
         -- If "true", the vehicles on this specific connecting
         -- maneuver have to stop on the stop-line
         -- and not to enter the collision area
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ConnectionManeuverAssist <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

7.176 Data Element: DE_WiperRate

Use: The current rate at which wiper sweeps are taking place on the subject vehicle. In units of sweeps per minute. Use a value of 1 for any sweep rate with a period greater than 60 seconds.

ASN.1 Representation:

```
WiperRate ::= INTEGER (0..127) -- units of sweeps per minute
```

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XML Representation:

```
<xs:simpleType name="WiperRate" >
      <xs:annotation>
         <xs:documentation>
            units of sweeps per minute
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="127"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleStatus	<ASN>	<XML>, and
DF	DF_WiperStatus	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

7.177 Data Element: DE_WiperStatusFront

Use: The current status of the wiper system on the front of the subject vehicle.

The "Wiper Status" Probe Data Element is intended to inform Probe Data Users whether or not it was raining/snowing at the vehicles location at the time the Probe Data snapshot was taken. The element also provides an indication as to how hard it was raining/snowing by including the "Swipes Per Minute" of the wiper blades across the windshield. The higher the "Swipes Per Minute", the harder it was raining/snowing. The element also includes whether the wipers were turned on manually (driver activated) or automatically (rain sensor activated) to provide additional information as to driving conditions in the area of the vehicle.

ASN.1 Representation:

```
WiperStatusFront ::= ENUMERATED {
     unavailable         (0), -- Not Equipped with wiper status
                              -- or wiper status is unavailable
     off                 (1),
     intermittent        (2),
     low                 (3),
     high                (4),
     washerInUse       (126), -- washing solution being used
     automaticPresent  (127), -- Auto wiper equipped
     ... -- # LOCAL_CONTENT
     }
```

XML Representation:

```
<xs:simpleType name="WiperStatusFront" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- Not Equipped with wiper status
             -- or wiper status is unavailable
            off (1)
            intermittent (2)
            low (3)
            high (4)
            washerInUse (126) -- washing solution being used
            automaticPresent (127) -- Auto wiper equipped
         </xs:appinfo>
      </xs:annotation>
```

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```
        <xs:union>
           <xs:simpleType>
              <xs:restriction base="xs:unsignedInt">
                 <xs:minInclusive value="0"/>
                 <xs:maxInclusive value="127"/>
              </xs:restriction>
           </xs:simpleType>
           <xs:simpleType>
              <xs:restriction base="xs:string">
                 <xs:enumeration value="unavailable"/>
                 <xs:enumeration value="off"/>
                 <xs:enumeration value="intermittent"/>
                 <xs:enumeration value="low"/>
                 <xs:enumeration value="high"/>
                 <xs:enumeration value="washerInUse"/>
                 <xs:enumeration value="automaticPresent"/>
              </xs:restriction>
           </xs:simpleType >
           <xs:simpleType>
              <xs:restriction base="local:WiperStatusFront" />
           </xs:simpleType>
        </xs:union>
     </xs:simpleType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleStatus	<ASN>	<XML>, and
DF	DF_WiperStatus	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: See also the data element WiperRate which conveys the current sweep rate of wiper strokes.

7.178 Data Element: DE_WiperStatusRear

Use: The current status of the wiper system on the rear of the subject vehicle.

The "Wiper Status" Probe Data Element is intended to inform Probe Data Users whether or not it was raining/snowing at the vehicles location at the time the Probe Data snapshot was taken. The element also provides an indication as to how hard it was raining/snowing by including the "Swipes Per Minute" of the wiper blades across the windshield. The higher the "Swipes Per Minute", the harder it was raining/snowing. The element also includes whether the wipers were turned on manually (driver activated) or automatically (rain sensor activated) to provide additional information as to driving conditions in the area of the vehicle.

ASN.1 Representation:

```
   WiperStatusRear ::= ENUMERATED {
        unavailable          (0), -- Not Equipped with wiper status
                                  -- or wiper status is unavailable
        off                  (1),
        intermittent         (2),
        low                  (3),
        high                 (4),
        washerInUse        (126), -- washing solution being used
        automaticPresent   (127), -- Auto wipper equipped
        ... -- # LOCAL_CONTENT
        }
```

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XML Representation:

```
<xs:simpleType name="WiperStatusRear" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- Not Equipped with wiper status
             -- or wiper status is unavailable
            off (1)
            intermittent (2)
            low (3)
            high (4)
            washerInUse (126) -- washing solution being used
            automaticPresent (127) -- Auto wipper equipped
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="127"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="off"/>
               <xs:enumeration value="intermittent"/>
               <xs:enumeration value="low"/>
               <xs:enumeration value="high"/>
               <xs:enumeration value="washerInUse"/>
               <xs:enumeration value="automaticPresent"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType>
            <xs:restriction base="local:WiperStatusRear" />
         </xs:simpleType>
      </xs:union>
</xs:simpleType>
```

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Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleStatus	<ASN>	<XML>, and
DF	DF_WiperStatus	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: See also the data element WiperRate which conveys the current sweep rate of wiper strokes.

7.179 Data Element: DE_YawRateConfidence

Use: This DE is used to provide the confidence interval of the 95% confidence level for the currently reported value of DE_YAWRate, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate yaw rate. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

ASN.1 Representation:

```
YawRateConfidence ::= ENUMERATED {
   unavailable    (0), -- B'000  Not Equipped with yaw rate status
                       -- or yaw rate status is unavailable
   degSec-100-00  (1), -- B'001  100  deg/sec
   degSec-010-00  (2), -- B'010  10   deg/sec
   degSec-005-00  (3), -- B'011  5    deg/sec
   degSec-001-00  (4), -- B'100  1    deg/sec
   degSec-000-10  (5), -- B'101  0.1  deg/sec
   degSec-000-05  (6), -- B'110  0.05 deg/sec
   degSec-000-01  (7)  -- B'111  0.01 deg/sec
   }
   -- Encoded as a 3 bit value
```

XML Representation:

```
<xs:simpleType name="YawRateConfidence" >
      <xs:annotation>
         <xs:appinfo>
            unavailable (0) -- B&apos;000  Not Equipped with yaw rate status
             -- or yaw rate status is unavailable
            degSec 100 00 (1) -- B&apos;001  100  deg/sec
            degSec 010 00 (2) -- B&apos;010  10   deg/sec
            degSec 005 00 (3) -- B&apos;011  5    deg/sec
            degSec 001 00 (4) -- B&apos;100  1    deg/sec
            degSec 000 10 (5) -- B&apos;101  0.1  deg/sec
            degSec 000 05 (6) -- B&apos;110  0.05 deg/sec
            degSec 000 01 (7) -- B&apos;111  0.01 deg/sec
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 3 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="unavailable"/>
               <xs:enumeration value="degSec 100 00"/>
               <xs:enumeration value="degSec 010 00"/>
               <xs:enumeration value="degSec 005 00"/>
               <xs:enumeration value="degSec 001 00"/>
               <xs:enumeration value="degSec 000 10"/>
               <xs:enumeration value="degSec 000 05"/>
               <xs:enumeration value="degSec 000 01"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_AccelSteerYawRateConfidence <ASN> <XML>, and

DF DF_VehicleStatus <ASN> <XML>.

In addition, this item may be used by data structures in other ITS standards.

7.180 Data Element: DE_YawRate

Use: The Yaw Rate of the vehicle, a signed value (to the right being positive) and expressed in 0.01 degrees per second. The "Yaw Rate" Probe Data Element is used in conjunction with the "Yaw Rate Confidence" Data Element to inform others on the amount of a vehicle's rotation about it's longitudinal axis within a certain time period, often at the time a Probe Data snapshot was taken. The Yaw Rate Element reports the vehicle's rotation in degrees per second with the Yaw Rate Confidence Element providing additional information on the coarseness of the Yaw Rate element also in degrees per second.

ASN.1 Representation:

```
YawRate ::= INTEGER (-32767..32767)
    -- LSB units of 0.01 degrees per second (signed)
```

XML Representation:

```
<xs:simpleType name="YawRate" >
      <xs:annotation>
         <xs:documentation>
            LSB units of 0.01 degrees per second  (signed)
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:short">
         <xs:minInclusive value="-32767"/>
      </xs:restriction>
</xs:simpleType>
```

7.181 Data Element: DE_ZoneLength

Use: The ZoneLength data concept is used to provide an estimated distance from the stop bar, along the lane centerline back in the lane to which it pertains. It is used in various way to related this distance value. For use with clearance zones it represents the point where the driver can successfully execute the connection maneuver. It is used in the Clearance Maneuver Assist data frame to relate dynamic data about the lane. It is also used to relate the distance from the stop bar to the rear edge of any queue. It is further used within the context of a vehicles traveling speed to advise on preferred dynamic approach speeds.

ASN.1 Representation:

```
ZoneLength ::= INTEGER (0..10000)
    -- Unit = 1 meter, 0 = unknown,
    -- The value 10000 to be used for Distances >=10000 m
    -- (e.g. from known point to another point along a
    -- known path, often against traffic flow direction
    -- when used for measuring queues)
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_AdvisorySpeed <ASN> <>, and

DF DF_ConnectionManeuverAssist <ASN> <>.

In addition, this item may be used by data structures in other ITS standards

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8. EXTERNAL DATA ENTRIES

This section defines the precise structure of the regional data concepts defined in this standard for a generic region. In the absence of any specification adopted by the region in question, these definitions are normative for that region.

The DSRC message content defined by this standard is further divided into specific messages, data frames, and elements as defined in this clause and in others of this standard. Typically, these messages are made up of content further defined in this document (i.e. made up of entries that are either atomic or complex but which are also defined in this document) and message content defined externally to this document. Such external content is reused from other functional areas and standards developed by other groups and SDOs. The contents of this standard (both at the complete message level and its component parts) may be reused by other efforts elsewhere.

All text in this clause is considered normative unless expressly marked otherwise. Definitions for this message set are presented in the following subclauses. The ASN.1 is presented in a section titled ASN.1 Representation. The equivalent XML expression is presented in a section titled XML Representation which follows the translation rule set cited in Clause Two (SAE Standard J2630). Should the two sections conflict in some way, the ASN.1 expression shall take precedence.

The productions of ASN.1 which follow shall be considered normative in nature. While the majority of the normative content is reflected in the actual syntax of the ASN.1, some entries also have additional statements in the ASN.1 comments which shall be considered normative as well. In addition, the textual commentary provided with each entry (in sections marked "use" and "remarks") may also provide additional normative restrictions on the proper use of the entry being described. The XML productions follow directly from the ASN.1 specifications and the same rules shall be applied. Users of this standard seeking to be in conformance with it shall follow the normative text outlined here.

8.1 Data Element: DE_AltitudeConfidence_EU [EU]

Use: The DE_AltitudeConfidence data element provides the confidence of an altitude value in a 4 bit value.

ASN.1 Representation:
```
AltitudeConfidence ::= ENUMERATED {
   alt-000-01,  -- accuracy within    0.01 meter
   alt-000-02,  -- accuracy within    0.02 meter
   alt-000-05,  -- accuracy within    0.05 meter
   alt-000-10,  -- accuracy within    0.10 meter
   alt-000-20,  -- accuracy within    0.20 meter
   alt-000-50,  -- accuracy within    0.50 meter
   alt-001-00,  -- accuracy within    1.00 meter
   alt-002-00,  -- accuracy within    2.00 meter
   alt-005-00,  -- accuracy within    5.00 meter
   alt-010-00,  -- accuracy within   10.00 meter
   alt-020-00,  -- accuracy within   20.00 meter
   alt-050-00,  -- accuracy within   50.00 meter
   alt-100-00,  -- accuracy within  100.00 meter
   alt-200-00,  -- accuracy within  200.00 meter
   outOfRange,  -- accuracy exceeds 200.00 meters
   unavailable  -- unavailable
}
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Altitude_EU <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.2 Data Element: DE_AltitudeValue_EU [EU]

Use: The AltitudeValue data value is as defined in TS102894-2 data dictionary.

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ASN.1 Representation:
```
AltitudeValue ::= INTEGER (-100000..800001)  -- units of  0.01 meter
   -- Where:
   -- seaLevel(0),
   -- oneCentimeter(1),
   -- unavailable(800001)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Altitude_EU <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.3 Data Element: DE_Angle_JPN [JPN]

Use: The Angle data element is used to describe the angle with which another lane path meets the current lanes at the node point, or to describe the angle information related to how each approach intersects with each other at one intersection, or to describe the headway angle of ingress at the node point. The true north is zero degree. The value increases in 1.5 degree steps in a clockwise fashion.

ASN.1 Representation:
```
Angle ::= INTEGER (0..239)
   -- Unsigned units of 1.5 degree, in 1 byte
   -- the true north is 0, positive is clockwise
   -- the values 240 to 254 shall not be sent
   -- the value 255 (0xFF) indicates an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ComputedLane CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.4 Data Element: DE_Day_JPN [JPN]

Use: The DayJpn data element is used to describe the day of the month using a 1 byte BCD coding format

ASN.1 Representation:
```
Day ::= INTEGER (0..255)
   -- BCD coding of Day of Month, in 1 byte
   -- values with nibble values between 1010 and 1111 shall not be sent
   -- except that the value xxx (0xFF shall indicate an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_TimeMark_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.5 Data Element: DE_DayOfWeek_JPN [JPN]

Use: The DayOfWeekJpn data element is used to describe the day of the week using regional numbering conventions.

ASN.1 Representation:
```
DayOfWeek ::= ENUMERATED {
    unknown   (0),
    monday    (1),
    tuesday   (2),
    wednesday (3),
    thursday  (4),
    friday    (5),
    saturday  (6),
    sunday    (7)
    }
   -- Encoding as per above, in 3 bits
   -- the value 0x00 shall indicate an invalid value
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_TimeMark_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The value which is assigned to each enumerated state is normative. Those transport layers that may reassign these values over the air for effective bandwidth reduction (such as UPER) may need to restore these values when the message value is exchanged with others in the higher layers (the application layers).

8.6 Data Element: DE_DegreesLat_JPN [JPN]

Use: The DegreesJpn data element is used to describe signed units of degrees of lat.

ASN.1 Representation:

```
DegreesLat ::= INTEGER (-90..90)
   -- Signed units of degrees, in 1 byte
   -- the values  +91 to +126 shall not be sent
   -- the values -128 to  -91 shall not be sent
   -- the value 127 (0x7F) shall indicate an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LatitudeDMS2 <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.7 Data Element: DE_DegreesLong_JPN [JPN]

Use: The DegreesJpn data element is used to describe signed units of degrees of long.

ASN.1 Representation:

```
DegreesLong ::= INTEGER (-180..180)
   -- Signed units of degrees, in 2 bytes
   -- the values +181 to +32766 shall not be sent
   -- the values -181 to -32768 shall not be sent
   -- the value 32767 (0x7FFF shall indicate an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_LongitudeDMS2 <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.8 Data Element: DE_Elevation_JPN [JPN]

Use: The Elevation_JPN data element represents the geographic position above or below the reference ellipsoid (typically WGS-84). It has a resolution of 1 decimeter and represents a symmetric range of positive and negative values.

ASN.1 Representation:

```
Elevation ::= INTEGER (-32768..32767)
  -- Signed units of 0.1m (10cm), in 2 bytes
  -- the value 32767 (0x7FFF) shall indicate an invalid value
```

Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_FullPositionVector	<ASN>	<XML>, and
DF	DF_Position3D	<ASN>	<XML>, and
MSG	MSG_BasicSafetyMessage_Verbose_(VBSM)	<ASN>	<XML>, and
DF	DF_REG_Position3D_JPN	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

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8.9 Data Element: DE_EmissionType_EU [EU]

Use: The DE_EmissionType_EU data element allows selecting an emission type (typically for a road segment use restriction) as per regional value conventions of the EU region.

ASN.1 Representation:
```
EmissionType ::= ENUMERATED {
     typeA,  -- check for proper restrictions
     typeB,  --
     typeC,  --
     typeD,  --
     typeE,  --
     ... -- # LOCAL_CONTENT
     }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_REG_RestrictionUserType_EU <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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8.10 Data Element: DE_Holiday_JPN [JPN]

Use: The HolidayJpn data element is used to describe the state of the week according to regional needs.

ASN.1 Representation:
```
Holiday ::= ENUMERATED {
    weekday  (0),
    holiday  (1)
    }
   -- Encoding as per above, in 1 bit
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_TimeMark_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The value which is assigned to each enumerated state is normative. Those transport layers that may reassign these values over the air for effective bandwidth reduction (such as UPER) may need to restore these values when the message value is exchanged with others in the higher layers (the application layers).

8.11 Data Element: DE_Hour_JPN [JPN]

Use: The HourJpn data element is used to describe the hour using a 1 byte BCD coding format

ASN.1 Representation:
```
Hour ::= INTEGER (0..255)
   -- BCD coding of Hour of a Day, in 1 byte
   -- values above upper nibble 0010 and lower nibble 0100 shall not be sent
   -- values with lower nibble values between 1010 and 1111 shall not be sent
   -- except that the value 255 (0xFF) shall indicate an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_TimeMark_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.12 Data Element: DE_Incident Response Equipment [ITIS]

Use: The ITIS enumeration list commonly refered to as "Incident Response Equipment," is assigned the upper byte value of [39] (which provides for value ranges from 9984 to 10239, inclusive). This list is formally called "IncidentResponseEquipment" in the ASN.1 and XML productions. The items in this enumeration list are not allowed to be used as an event category classification. This list contains a total of 72 different phrases. The remaining 55 values up to the lower byte value of [127] are reserved for additional "national" phrases in this byte range. Local phrases may be added to the list starting with the lower byte value of 128 and proceeding upward from there (in other words, the first value assigned for any local additions to this list would be given the value 10112).

ASN.1 Representation:

```
IncidentResponseEquipment ::= ENUMERATED {
   ground-fire-suppression          (9985),
   heavy-ground-equipment           (9986),
   aircraft                         (9988),
   marine-equipment                 (9989),
   support-equipment                (9990),
   medical-rescue-unit              (9991),
   other                            (9993),   -- Depreciated by fire standards, do not
                                              -- use
   ground-fire-suppression-other    (9994),
   engine                           (9995),
   truck-or-aerial                  (9996),
   quint                            (9997),   -- A five-function type of fire apparatus.
                                              -- The units in the movie Backdraft were
                                              -- quints
   tanker-pumper-combination        (9998),
   brush-truck                      (10000),
   aircraft-rescue-firefighting     (10001),
   heavy-ground-equipment-other     (10004),
   dozer-or-plow                    (10005),
   tractor                          (10006),
   tanker-or-tender                 (10008),
   aircraft-other                   (10024),
   aircraft-fixed-wing-tanker       (10025),
   helitanker                       (10026),
   helicopter                       (10027),
   marine-equipment-other           (10034),
   fire-boat-with-pump              (10035),
   boat-no-pump                     (10036),
   support-apparatus-other          (10044),
   breathing-apparatus-support      (10045),
   light-and-air-unit               (10046),
   medical-rescue-unit-other        (10054),
   rescue-unit                      (10055),
   urban-search-rescue-unit         (10056),
   high-angle-rescue                (10057),
   crash-fire-rescue                (10058),
   bLS-unit                         (10059),
   aLS-unit                         (10060),
   mobile-command-post              (10075),  -- Depreciated, do not use
   chief-officer-car                (10076),
   hAZMAT-unit                      (10077),
   type-i-hand-crew                 (10078),
   type-ii-hand-crew                (10079),
   privately-owned-vehicle          (10083),  -- (Often found in volunteer fire teams)
   other-apparatus-resource         (10084),  -- (Remapped from fire code zero)
   ambulance                        (10085),
   bomb-squad-van                   (10086),
```

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```
   combine-harvester               (10087),
   construction-vehicle            (10088),
   farm-tractor                    (10089),
   grass-cutting-machines          (10090),
   hAZMAT-containment-tow          (10091),
   heavy-tow                       (10092),
   light-tow                       (10094),
   flatbed-tow                     (10114),
   hedge-cutting-machines          (10093),
   mobile-crane                    (10095),
   refuse-collection-vehicle       (10096),
   resurfacing-vehicle             (10097),
   road-sweeper                    (10098),
   roadside-litter-collection-crews (10099),
   salvage-vehicle                 (10100),
   sand-truck                      (10101),
   snowplow                        (10102),
   steam-roller                    (10103),
   swat-team-van                   (10104),
   track-laying-vehicle            (10105),
   unknown-vehicle                 (10106),
   white-lining-vehicle            (10107),  -- Consider using Roadwork "road marking
                                             -- operations" unless the objective is to
                                             -- refer to the specific vehicle of this
                                             -- type. Alternative Rendering: line
                                             -- painting vehicle
   dump-truck                      (10108),
   supervisor-vehicle              (10109),
   snow-blower                     (10110),
   rotary-snow-blower              (10111),
   road-grader                     (10112),  -- Alternative term: motor grader
   steam-truck                     (10113),  -- A special truck that thaws culverts and
                                             -- storm drains
   ... -- # LOCAL_CONTENT_ITIS
   }
```

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XML Representation:

```
<xs:simpleType name="IncidentResponseEquipment" >
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="9984"/>
               <xs:maxInclusive value="10239"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="ground fire suppression" id="_9985"/>
               <xs:enumeration value="heavy ground equipment" id="_9986"/>
               <xs:enumeration value="aircraft" id="_9988"/>
               <xs:enumeration value="marine equipment" id="_9989"/>
               <xs:enumeration value="support equipment" id="_9990"/>
               <xs:enumeration value="medical rescue unit" id="_9991"/>
               <xs:enumeration value="other" id="_9993"/>
               <xs:enumeration value="ground fire suppression other" id="_9994"/>
               <xs:enumeration value="engine" id="_9995"/>
               <xs:enumeration value="truck or aerial" id="_9996"/>
               <xs:enumeration value="quint" id="_9997"/>
               <xs:enumeration value="tanker pumper combination" id="_9998"/>
               <xs:enumeration value="brush truck" id="_10000"/>
               <xs:enumeration value="aircraft rescue firefighting" id="_10001"/>
```

```
            <xs:enumeration value="heavy ground equipment other" id="_10004"/>
            <xs:enumeration value="dozer or plow" id="_10005"/>
            <xs:enumeration value="tractor" id="_10006"/>
            <xs:enumeration value="tanker or tender" id="_10008"/>
            <xs:enumeration value="aircraft other" id="_10024"/>
            <xs:enumeration value="aircraft fixed wing tanker" id="_10025"/>
            <xs:enumeration value="helitanker" id="_10026"/>
            <xs:enumeration value="helicopter" id="_10027"/>
            <xs:enumeration value="marine equipment other" id="_10034"/>
            <xs:enumeration value="fire boat with pump" id="_10035"/>
            <xs:enumeration value="boat no pump" id="_10036"/>
            <xs:enumeration value="support apparatus other" id="_10044"/>
            <xs:enumeration value="breathing apparatus support" id="_10045"/>
            <xs:enumeration value="light and air unit" id="_10046"/>
            <xs:enumeration value="medical rescue unit other" id="_10054"/>
            <xs:enumeration value="rescue unit" id="_10055"/>
            <xs:enumeration value="urban search rescue unit" id="_10056"/>
            <xs:enumeration value="high angle rescue" id="_10057"/>
            <xs:enumeration value="crash fire rescue" id="_10058"/>
            <xs:enumeration value="bLS unit" id="_10059"/>
            <xs:enumeration value="aLS unit" id="_10060"/>
            <xs:enumeration value="mobile command post" id="_10075"/>
            <xs:enumeration value="chief officer car" id="_10076"/>
            <xs:enumeration value="hAZMAT unit" id="_10077"/>
            <xs:enumeration value="type i hand crew" id="_10078"/>
            <xs:enumeration value="type ii hand crew" id="_10079"/>
            <xs:enumeration value="privately owned vehicle" id="_10083"/>
            <xs:enumeration value="other apparatus resource" id="_10084"/>
            <xs:enumeration value="ambulance" id="_10085"/>
            <xs:enumeration value="bomb squad van" id="_10086"/>
            <xs:enumeration value="combine harvester" id="_10087"/>
            <xs:enumeration value="construction vehicle" id="_10088"/>
            <xs:enumeration value="farm tractor" id="_10089"/>
            <xs:enumeration value="grass cutting machines" id="_10090"/>
            <xs:enumeration value="hAZMAT containment tow" id="_10091"/>
            <xs:enumeration value="heavy tow" id="_10092"/>
            <xs:enumeration value="light tow" id="_10094"/>
            <xs:enumeration value="flatbed tow" id="_10114"/>
            <xs:enumeration value="hedge cutting machines" id="_10093"/>
            <xs:enumeration value="mobile crane" id="_10095"/>
            <xs:enumeration value="refuse collection vehicle" id="_10096"/>
            <xs:enumeration value="resurfacing vehicle" id="_10097"/>
            <xs:enumeration value="road sweeper" id="_10098"/>
            <xs:enumeration value="roadside litter collection crews" id="_10099"/>
            <xs:enumeration value="salvage vehicle" id="_10100"/>
            <xs:enumeration value="sand truck" id="_10101"/>
            <xs:enumeration value="snowplow" id="_10102"/>
            <xs:enumeration value="steam roller" id="_10103"/>
            <xs:enumeration value="swat team van" id="_10104"/>
            <xs:enumeration value="track laying vehicle" id="_10105"/>
            <xs:enumeration value="unknown vehicle" id="_10106"/>
            <xs:enumeration value="white lining vehicle" id="_10107"/>
            <xs:enumeration value="dump truck" id="_10108"/>
            <xs:enumeration value="supervisor vehicle" id="_10109"/>
            <xs:enumeration value="snow blower" id="_10110"/>
            <xs:enumeration value="rotary snow blower" id="_10111"/>
            <xs:enumeration value="road grader" id="_10112"/>
            <xs:enumeration value="steam truck" id="_10113"/>
         </xs:restriction>
      </xs:simpleType >
      <xs:simpleType>
```

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```
            <xs:restriction base="xs:string">
               <xs:pattern value="\[.+\].*"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="local:IncidentResponseEquipment" />
         </xs:simpleType>
      </xs:union>
</xs:simpleType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleIdent	<ASN>	<XML>, and
MSG	MSG_EmergencyVehicleAlert (EVA)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

8.13 Data Element: DE_ITIS_Text [ITIS]

Use: Simple text used with ITIS codes.

ASN.1 Representation:
```
ITIStext ::= IA5String (SIZE(1..500))
```

XML Representation:
```
<xs:simpleType name="ITIStext" >
      <xs:restriction base="xs:string">
         <xs:minLength value="1"/>
         <xs:maxLength value="500"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_ITIS-Codes_And_Text <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

8.14 Data Element: DE_LatitudeDMS [JPN]

Use: The geographic latitude of an object, expressed in 1/100th of an integer second, where 60 seconds comprise one minute, and 60 minutes comprise a degree of latitude (often referred to as a DDMMSS.sss format). This format is used only in Japanese deployments. The finer precision offered by units in 1/10th integer microdegrees is used elsewhere (about ~28X more precise). In both cases the data is with reference to the horizontal datum then in use. The value 32,400,001 shall be used when unavailable.

ASN.1 Representation:
```
LatitudeDMS ::= INTEGER (-32400000.. 32400000)
   -- Signed units of 0.01 seconds of a minute of a degree of Latitude
   -- Providing a range of plus-minus 90 degrees
   -- in a 4 byte value when implicit or in BER forms
   -- the value 0x7FFF FFFF shall indicate an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Node_LLdms_48b <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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8.15 Data Element: DE_LongitudeDMS [JPN]

Use: The geographic longitude of an object, expressed in 1/100th of an integer second, where 60 seconds comprise one minute, and 60 minutes comprise a degree of longitude (often referred to as a DDMMSS.sss format). This format is used only in Japanese deployments. The finer precision offered by units in 1/10th integer microdegrees is used elsewhere (about ~28X more precise). In both cases the data is with reference to the horizontal datum then in use. The value 64,800,001 shall be used when unavailable.

ASN.1 Representation:
```
LongitudeDMS ::= INTEGER (-64800000.. 64800000)
    -- Signed units of 0.01 seconds of a minute of a degree of Longitude
    -- Providing a range of plus-minus 180 degrees
    -- in a 4 byte value when implicit or in BER forms
    -- the value 0x7FFF FFFF shall indicate an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Node_LLdms_48b <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.16 Data Element: DE_MaxTimetoChange [JPN]

Use: The MaxTimetoChange data element provides the maximum time to change to the next state.

ASN.1 Representation:
```
MaxTimetoChange ::= INTEGER (0..2402)
    -- Unsigned units of 0.1 seconds, in 2 bytes
    -- the value 2401 shall indicate 'forever'
    -- the values 2402 to 65534 shall not be sent
    -- the value 65535 (0xFFFF) shall indicate an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_REG_MovementEvent_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.17 Data Element: DE_MinTimetoChange [JPN]

Use: The MinTimetoChangedata element provides the minimum time to change to the next state.

ASN.1 Representation:
```
MinTimetoChange ::= INTEGER (0..2402)
    -- Unsigned units of 0.1 seconds, in 2 bytes
    -- the value 2401 shall indicate 'forever'
    -- the values 2402 to 32766 shall not be sent
    -- the value 32767(0x7FFF) shall indicate an invalid value
    -- Note that:
    -- The MSB is used as a flag and set to one to
    -- indicate that the value does not count down.
    -- Under this condition the movement phase may end
    -- immediately if certain condition are meet.
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_REG_MovementEvent_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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8.18 Data Element: DE_Minute_JPN [JPN]

Use: The MinuteJpn data element is used to describe a minute (of time) using a 1 byte BCD coding format

ASN.1 Representation:
```
Minute ::= INTEGER (0..255)
    -- BCD coding of Minute of an Hour, in 1 byte
    -- values above a combined BCD value of 59 (>59)
    -- (i.e. 0110 0000) shall not be sent
    -- except that value 255 (0xFF) shall indicate an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_TimeMark_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.19 Data Element: DE_MinutesAngle_JPN [JPN]

Use: The MinutesJpn data element is used to describe units of a unsigned minute of angle.

ASN.1 Representation:
```
MinutesAngle ::= INTEGER (0..59)
    -- Unsigned units of minutes of an angle, in 1 byte
    -- values above 59 shall not be sent
    -- except that value 255 (0xFF) shall indicate an invalid value
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_LatitudeDMS2	<ASN>	<>, and
DF	DF_LongitudeDMS2	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

8.20 Data Element: DE_Month_JPN [JPN]

Use: The MonthJpn data element is used to describe the month using a 1 byte BCD coding format

ASN.1 Representation:
```
Month ::= INTEGER (1..255)
    -- BCD coding of Month of a year, in 1 byte
    -- values above a combined BCD value of 12 (>12)
    -- (i.e. 0001 0011) shall not be sent
    -- except that value 255 (0xFF) shall indicate an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_TimeMark_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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8.21 Data Element: DE_MsgCount_JPN [JPN]

Use: The MsgCount_JPN data element is used to provide a sequence number within a stream of messages from the same sender.

ASN.1 Representation:

```
MsgCount ::= INTEGER (0..255)
   -- a count value which is incremented with each use
   -- the next value after 255 shall be one
   -- value 0 (0x00) shall indicate that MsgCount is not available
```

Used By: This entry is directly used by the following 11 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_IntersectionGeometry CHANGED	<ASN>	<>, and
DF	DF_IntersectionState CHANGED	<ASN>	<>, and
DF	DF_RoadSegment CHANGED	<ASN>	<>, and
MSG	MSG_BasicSafetyMessage_Verbose (VBSM)	<ASN>	<XML>, and
MSG	MSG_CommonSafetyRequest (CSR)	<ASN>	<XML>, and
MSG	MSG_IntersectionCollisionAvoidance (ICA)	<ASN>	<XML>, and
MSG	MSG_MapData (MAP)	<ASN>	<>, and
MSG	MSG_RoadSideAlert (RSA)	<ASN>	<XML>, and
MSG	MSG_RTCM_Corrections (RTCM)	<ASN>	<XML>, and
MSG	MSG_SignalRequestMessage (SRM)	<ASN>	<XML>, and
MSG	MSG_SignalStatusMessage (SSM)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

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8.22 Data Element: DE_Responder Group Affected [ITIS]

Use: The ITIS enumeration list commonly refered to as "Responder Group Affected," is assigned the upper byte value of [38] (which provides for value ranges from 9728 to 9983, inclusive). This list is formally called "ResponderGroupAffected" in the ASN.1 and XML productions. Items from this enumeration list can be used as an event category classification. This list contains a total of 14 different phrases. The remaining 113 values up to the lower byte value of [127] are reserved for additional "national" phrases in this byte range. Local phrases may be added to the list starting with the lower byte value of 128 and proceeding upward from there (in other words, the first value assigned for any local additions to this list would be given the value 9856).

ASN.1 Representation:

```
ResponderGroupAffected ::= ENUMERATED  {
   emergency-vehicle-units           (9729),  -- Default phrase, to be used when one of
                                              -- the below does not fit better
   federal-law-enforcement-units     (9730),
   state-police-units                (9731),
   county-police-units               (9732),  -- Hint: also sheriff response units
   local-police-units                (9733),
   ambulance-units                   (9734),
```

```
   rescue-units                      (9735),
   fire-units                        (9736),
   hAZMAT-units                      (9737),
   light-tow-unit                    (9738),
   heavy-tow-unit                    (9739),
   freeway-service-patrols           (9740),
   transportation-response-units     (9741),
   private-contractor-response-units (9742),
   ... -- # LOCAL_CONTENT_ITIS
   }
   -- These groups are used in coordinated response and staging area information
   -- (rather than typically consumer related)
```

XML Representation:

```
<xs:simpleType name="ResponderGroupAffected" >
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="9728"/>
               <xs:maxInclusive value="9983"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="emergency vehicle units" id="_9729"/>
               <xs:enumeration value="federal law enforcement units" id="_9730"/>
               <xs:enumeration value="state police units" id="_9731"/>
               <xs:enumeration value="county police units" id="_9732"/>
               <xs:enumeration value="local police units" id="_9733"/>
               <xs:enumeration value="ambulance units" id="_9734"/>
               <xs:enumeration value="rescue units" id="_9735"/>
               <xs:enumeration value="fire units" id="_9736"/>
               <xs:enumeration value="hAZMAT units" id="_9737"/>
               <xs:enumeration value="light tow unit" id="_9738"/>
               <xs:enumeration value="heavy tow unit" id="_9739"/>
               <xs:enumeration value="freeway service patrols" id="_9740"/>
               <xs:enumeration value="transportation response units" id="_9741"/>
               <xs:enumeration value="private contractor response units" id="_9742"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:pattern value="\[.+\].*"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="local:ResponderGroupAffected" />
         </xs:simpleType>
      </xs:union>
</xs:simpleType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleIdent	<ASN>	<XML>, and
MSG	MSG_EmergencyVehicleAlert (EVA)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

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8.23 Data Element: DE_Second_JPN [JPN]

Use: The SecondJpn data element is used to describe a second (of time) using a 1 byte BCD coding format

ASN.1 Representation:
```
Second ::= INTEGER (0..60)
   -- BCD coding of a second of time, in 1 byte
   -- values above a combined BCD value of 60
   -- (i.e. 0110 0000) shall not be sent
   -- except that value 255 (0xFF) shall indicate an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_TimeMark_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.24 Data Element: DE_SecondsAngle_JPN [JPN]

Use: The Angle_JPN data element is used to describe the unsigned seconds of an angle in steps of 1/10oth of a second.

ASN.1 Representation:
```
SecondsAngle ::= INTEGER (0..5999)
   -- Unsigned units of 1/100th seconds of angle, in 2 bytes
   -- values from 6000 to 65534 shall not be sent
   -- the value 65535 (0xFFFF) shall indicate an invalid value
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_LatitudeDMS2	<ASN>	<>, and
DF	DF_LongitudeDMS2	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

8.25 Data Element: DE_SummerTime_JPN [JPN]

Use: The SummerTimedata element is used to describe if summer time is locally active.

ASN.1 Representation:
```
SummerTime ::= ENUMERATED {
    notInSummerTime    (0),
    inSummerTime       (1)
    }
   -- Encoding as per above, in 1 bit
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_TimeMark_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The value which is assigned to each enumerated state is normative. Those transport layers that may reassign these values over the air for effective bandwidth reduction (such as UPER) may need to restore these values when the message value is exchanged with others in the higher layers (the application layers).

8.26 Data Element: DE_TenthSecond_JPN [JPN]

Use: The TenthSecond data element is used to describe a tenth of a second (of time) using a 1 byte BCD coding format

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ASN.1 Representation:

```
TenthSecond ::= INTEGER (0..9)
   -- Unsigned units of 100 milliseconds, in 1 byte
   -- values from 10 to 254 shall not be sent
   -- the value 255 (0xFF) shall indicate an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_TimeMark_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.27 Data Element: DE_TimeRemaining_JPN [JPN]

Use: The TimeRemaining data element is used to express the time (in units of 0.1 seconds) remaining for a signal phase value. This is used as the regional way to express the various UTC based time found in the data frame TimeChangeDetails. This is a count-down type of value in that every second the remaining value reduces by 10.

ASN.1 Representation:

```
TimeRemaining ::= INTEGER (0..9001)
    -- Unsigned units of 0.1 seconds, spanning 15 minutes, in 2 bytes
    -- the value 9001 shall indicate 'forever'
    -- values from 9002 to 65534 shall not be sent
    -- the value 65535 (0xFFFF) shall indicate an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_REG_MovementEvent_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.28 Data Element: DE_Vehicle Groups Affected [ITIS]

Use: The ITIS enumeration list commonly refered to as "Vehicle Groups Affected," is assigned the upper byte value of [36] (which provides for value ranges from 9216 to 9471, inclusive). This list is formally called "VehicleGroupAffected" in the ASN.1 and XML productions. Items from this enumeration list can be used as an event category classification. This list contains a total of 35 different phrases. The remaining 92 values up to the lower byte value of [127] are reserved for additional "national" phrases in this byte range. Local phrases may be added to the list starting with the lower byte value of 128 and proceeding upward from there (in other words, the first value assigned for any local additions to this list would be given the value 9344).

ASN.1 Representation:

```
VehicleGroupAffected ::= ENUMERATED  {
   all-vehicles                               (9217),
   bicycles                                   (9218),
   motorcycles                                (9219),  -- to include mopeds as well
   cars                                       (9220),  -- (remapped from ERM value of
                                                       -- zero)
   light-vehicles                             (9221),
   cars-and-light-vehicles                    (9222),
   cars-with-trailers                         (9223),
   cars-with-recreational-trailers            (9224),
   vehicles-with-trailers                     (9225),
   heavy-vehicles                             (9226),
   trucks                                     (9227),
   buses                                      (9228),
   articulated-buses                          (9229),
   school-buses                               (9230),
   vehicles-with-semi-trailers                (9231),
   vehicles-with-double-trailers              (9232),  -- Alternative Rendering:  western
                                                       -- doubles
   high-profile-vehicles                      (9233),
   wide-vehicles                              (9234),
   long-vehicles                              (9235),
```

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```
   hazardous-loads                            (9236),
   exceptional-loads                          (9237),
   abnormal-loads                             (9238),
   convoys                                    (9239),
   maintenance-vehicles                       (9240),
   delivery-vehicles                          (9241),
   vehicles-with-even-numbered-license-plates (9242),
   vehicles-with-odd-numbered-license-plates  (9243),
   vehicles-with-parking-permits              (9244),
   vehicles-with-catalytic-converters         (9245),
   vehicles-without-catalytic-converters      (9246),
   gas-powered-vehicles                       (9247),
   diesel-powered-vehicles                    (9248),
   lPG-vehicles                               (9249),
   military-convoys                           (9250),
   military-vehicles                          (9251),
   ... -- # LOCAL_CONTENT_ITIS
   }
   -- Classification of vehicles and types of transport
```

XML Representation:

```
<xs:simpleType name="VehicleGroupAffected" >
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="9216"/>
               <xs:maxInclusive value="9471"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="all vehicles" id="_9217"/>
               <xs:enumeration value="bicycles" id="_9218"/>
               <xs:enumeration value="motorcycles" id="_9219"/>
               <xs:enumeration value="cars" id="_9220"/>
               <xs:enumeration value="light vehicles" id="_9221"/>
               <xs:enumeration value="cars and light vehicles" id="_9222"/>
               <xs:enumeration value="cars with trailers" id="_9223"/>
               <xs:enumeration value="cars with recreational trailers" id="_9224"/>
               <xs:enumeration value="vehicles with trailers" id="_9225"/>
               <xs:enumeration value="heavy vehicles" id="_9226"/>
               <xs:enumeration value="trucks" id="_9227"/>
               <xs:enumeration value="buses" id="_9228"/>
               <xs:enumeration value="articulated buses" id="_9229"/>
               <xs:enumeration value="school buses" id="_9230"/>
               <xs:enumeration value="vehicles with semi trailers" id="_9231"/>
               <xs:enumeration value="vehicles with double trailers" id="_9232"/>
               <xs:enumeration value="high profile vehicles" id="_9233"/>
               <xs:enumeration value="wide vehicles" id="_9234"/>
               <xs:enumeration value="long vehicles" id="_9235"/>
               <xs:enumeration value="hazardous loads" id="_9236"/>
               <xs:enumeration value="exceptional loads" id="_9237"/>
               <xs:enumeration value="abnormal loads" id="_9238"/>
               <xs:enumeration value="convoys" id="_9239"/>
               <xs:enumeration value="maintenance vehicles" id="_9240"/>
               <xs:enumeration value="delivery vehicles" id="_9241"/>
               <xs:enumeration value="vehicles with even numbered license plates"
id="_9242"/>
               <xs:enumeration value="vehicles with odd numbered license plates"
id="_9243"/>
```

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```
            <xs:enumeration value="vehicles with parking permits" id="_9244"/>
            <xs:enumeration value="vehicles with catalytic converters" id="_9245"/>
            <xs:enumeration value="vehicles without catalytic converters" id="_9246"/>
            <xs:enumeration value="gas powered vehicles" id="_9247"/>
            <xs:enumeration value="diesel powered vehicles" id="_9248"/>
            <xs:enumeration value="lPG vehicles" id="_9249"/>
            <xs:enumeration value="military convoys" id="_9250"/>
            <xs:enumeration value="military vehicles" id="_9251"/>
         </xs:restriction>
      </xs:simpleType >
      <xs:simpleType>
         <xs:restriction base="xs:string">
            <xs:pattern value="\[.+\].*"/>
         </xs:restriction>
      </xs:simpleType>
      <xs:simpleType>
         <xs:restriction base="local:VehicleGroupAffected" />
      </xs:simpleType>
   </xs:union>
</xs:simpleType>
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleIdent	<ASN>	<XML>, and
MSG	MSG_EmergencyVehicleAlert (EVA)	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

8.29 Data Element: DE_Year_JPN [JPN]

Use: The YearJpn data element is used to describe the year (of time) using a 2 byte BCD coding format

ASN.1 Representation:

```
Year ::= INTEGER (1..65535)
   -- BCD coding of four digits of the year A.D. in 2 bytes
   -- values with nibble values between 1010 and 1111 shall not be sent
   -- except that the value 65535 (0xFFFF) shall indicate an invalid value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_TimeMark_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.30 Data Frame: DF_Altitude_EU [EU]

Use: The DF_Altitude data frame provides the altitude and confidence of the accuracy of that altitude from the reference ellipsoid, typically in the WGS84 coordinate system.

ASN.1 Representation:

```
Altitude ::= SEQUENCE {
   value        AltitudeValue,
   confidence   AltitudeConfidence
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_REG_Position3D_EU <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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8.31 Data Frame: DF_ITIS-Codes_And_Text [ITIS]

Use: The use of ITIS codes interspersed with free text. The complete set of ITIS codes can be found in Volume Two of the J2540 Standard. This is a set of nealry 1,500 items which are used to encode common events and list items in ITS.

ASN.1 Representation:
```
ITIScodesAndText ::= SEQUENCE (SIZE(1..100)) OF SEQUENCE {
  item CHOICE    {
       itis ITIScodes,
       text ITIStext
       } -- # UNTAGGED
  }
```

XML Representation:
```
<xs:complexType name="ITIScodesAndText" >
   <xs:sequence minOccurs="1" maxOccurs="100">
      <xs:choice >
         <xs:element name="itis" type="ITIScodes" />
         <xs:element name="text" type="ITIStext" />
      </xs:choice>
   </xs:sequence>
</xs:complexType>
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called MSG_TravelerInformation Message (TIM) <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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Remarks: Refer to the SAE ITIS entry ITIScodes for the complete (and lengthy) listing of these codes and for an XML rendering.

8.32 Data Frame: DF_LatitudeDMS2 [JPN]

Use: The geographic latitude of an object, expressed in 1/100th of an integer second, where 60 seconds comprise one minute, and 60 minutes comprise a degree of latitude (often referred to as a DDMMSS.sss format). This format is used only in Japanese deployments. The finer precision offered by units in 1/10th integer microdegrees is used elsewhere (about ~28X more precise). In both cases the data is expressed with reference to the horizontal datum then in use. The value 32,400,001 shall be used when unavailable.

ASN.1 Representation:
```
LatitudeDMS2 ::= SEQUENCE {
   d  DegreesLat,     -- units of degrees
   m  MinutesAngle,   -- units of minutes
   s  SecondsAngle    -- units of 1/100th seconds
   } -- total size of 4 bytes (32 bits) when implicit encoding is used
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_Node_LLdms_80b	<ASN>	<>, and
DF	DF_REG_Position3D_JPN	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

8.33 Data Frame: DF_LongitudeDMS2 [JPN]

Use: The geographic longitude of an object, expressed in 1/100th of an integer second, where 60 seconds comprise one minute, and 60 minutes comprise a degree of latitude (often referred to as a DDMMSS.sss format). This format is used only in Japanese deployments. The finer precision offered by units in 1/10th integer microdegrees is used elsewhere (about ~28X more precise). In both cases the data is expressed with reference to the horizontal datum then in use. The value 64,800,001 shall be used when unavailable.

ASN.1 Representation:
```
LongitudeDMS2 ::= SEQUENCE {
   d  DegreesLong,    -- units of degrees
   m  MinutesAngle,   -- units of minutes
   s  SecondsAngle    -- units of 1/100th seconds
   } -- total size of 5 bytes (40 bits) when implicit encoding is used
```

Used By: This entry is directly used by the following 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_Node_LLdms_80b	<ASN>	<>, and
DF	DF_REG_Position3D_JPN	<ASN>	<>.

In addition, this item may be used by data structures in other ITS standards.

8.34 Data Frame: DF_Node_LLdms_48b [JPN]

Use: A 48-bit node type with lat-long values expressed in Japanese 0.001 second units.

ASN.1 Representation:
```
Node-LLdms-48b ::= SEQUENCE {
   lon  LongitudeDMS,
   lat  LatitudeDMS
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_REG_NodeOffsetPoint_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.35 Data Frame: DF_Node_LLdms_80b [JPN]

Use: An 80-bit node type with lat-long values expressed in Japanese 0.001 second units.

ASN.1 Representation:
```
Node-LLdms-80b ::= SEQUENCE {
   lon  LongitudeDMS2,
   lat  LatitudeDMS2
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_REG_NodeOffsetPoint_JPN <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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8.36 Data Frame: DF_PrioritizationResponse_EU [EU]

Use: The PrioritizationResponse data frame is used to provide the prior response state and the signal group ID for a vehicle (or other object).

ASN.1 Representation:
```
PrioritizationResponse ::= SEQUENCE {
   stationID      DSRC.StationID,
                  -- Id of requesting vehicle
                  -- Note that the stationID has to remain unchanged
                  -- during the whole prioritisation process
   priorState     DSRC.PrioritizationResponseStatus,
                  -- State of prioritization request
```

```
   signalGroup     DSRC.SignalGroupID,
                   -- id of prioritized LaneSet, which will
                   -- be given free way
   ... -- # LOCAL_CONTENT
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_PrioritizationResponseList_EU <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.37 Data Frame: DF_PrioritizationResponseList_EU [EU]

Use: The PrioritizationResponseList data frame is a list of PrioritizationResponse entries.

ASN.1 Representation:
```
PrioritizationResponseList ::= SEQUENCE SIZE(1..10) OF PrioritizationResponse
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_REG_IntersectionState_EU <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.38 Data Frame: DF_REG_AdvisorySpeed_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-AdvisorySpeed ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_AdvisorySpeed <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.39 Data Frame: DF_REG_ComputedLane_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-ComputedLane ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_ComputedLane <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.40 Data Frame: DF_REG_ConnectionManeuverAssist_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-ConnectionManeuverAssist ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_ConnectionManeuverAssist <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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8.41 Data Frame: DF_REG_GenericLane_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-GenericLane ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_GenericLane <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.42 Data Frame: DF_REG_Intersection_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-Intersection ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_Intersection <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.43 Data Frame: DF_REG_IntersectionState_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-IntersectionState ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_IntersectionState <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.44 Data Frame: DF_REG_IntersectionState_EU [EU]

Use: The regional definition of extensions to this data frame, for the EU region.

ASN.1 Representation:
```
Reg-IntersectionState ::= SEQUENCE {
   activePrioritizations PrioritizationResponseList OPTIONAL,
   ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_IntersectionState <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.45 Data Frame: DF_REG_LaneAttributes_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-LaneAttributes ::= SEQUENCE { ... }
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_RegionalLaneAttributes <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.46 Data Frame: DF_REG_LaneDataAttribute_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-LaneDataAttribute ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_LaneDataAttribute <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.47 Data Frame: DF_REG_LaneDataAttribute_JPN [JPN]

Use: The regional definition of extensions to this data frame, for the Japan region.

ASN.1 Representation:
```
Reg-LaneDataAttribute ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_LaneDataAttribute <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.48 Data Frame: DF_REG_MapData_Base_EU NEW [EU]

Use: The regional definition of extensions to this data frame, for the EU region.

ASN.1 Representation:
```
Reg-MapData ::= SEQUENCE {
   signalHeadLocations   SignalHeadLocationList OPTIONAL,
   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_MapData <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.49 Data Frame: DF_REG_MapData_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-MapData ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_MapData <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.50 Data Frame: DF_REG_MovementEvent_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

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ASN.1 Representation:
```
Reg-MovementEvent ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_MovementEvent <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.51 Data Frame: DF_REG_MovementEvent_JPN [JPN]

Use: The regional definition of extensions to this data frame, for the Japan region.

ASN.1 Representation:
```
Reg-MovementEvent ::= SEQUENCE {
   -- A set of countdown style time-to-change values
   -- all in units of 0.1 seconds and following
   -- the naming of the base DSRC standard

   startTime    TimeRemaining   OPTIONAL,
                -- When this phase 1st started
   minEndTime   MinTimetoChange,
                -- Expected shortest end time
   maxEndTime   MaxTimetoChange OPTIONAL,
                -- Expected longer end time
   likelyTime   TimeRemaining   OPTIONAL,
                -- Best predicted value based on other data
   confidence   DSRC.TimeIntervalConfidence   OPTIONAL,
                -- Applies to above time element only
   nextTime     TimeRemaining   OPTIONAL,
   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_MovementEvent <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.52 Data Frame: DF_REG_MovementState_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-MovementState ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_MovementState <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.53 Data Frame: DF_REG_NodeAttribute_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-NodeAttribute ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_RegionalNodeAttribute <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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8.54 Data Frame: DF_REG_NodeOffsetPoint_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-NodeOffsetPoint ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_NodeOffsetPoint <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.55 Data Frame: DF_REG_NodeOffsetPoint_JPN [JPN]

Use: The regional definition of extensions to this data frame, for the Japan region.

ASN.1 Representation:
```
Reg-NodeOffsetPoint ::= CHOICE {
   -- Full position expressed in units of 0.01 seconds
   posA     Node-LLdms-48b,

   -- Full position expressed in multiple elements in
   -- an DD.MM.SS.sss style format
   posB     Node-LLdms-80b,

   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_NodeOffsetPoint <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.56 Data Frame: DF_REG_Position3D_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-Position3D ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_Position3D <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.57 Data Frame: DF_REG_Position3D_EU [EU]

Use: The regional definition of extensions to this data frame, for the EU region.

ASN.1 Representation:
```
Reg-Position3D ::= SEQUENCE {
   altitude    Altitude,
   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_Position3D <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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8.58 Data Frame: DF_REG_Position3D_JPN [JPN]

Use: A data concept which provides a definitive and precise location in the WGS-84 coordinate system from which short offsets may then be used to create additional data using a flat earth projection centered from this point. The REG_Position3D_JPN data frame contains the latitude, the longitude, and the elevation information.

ASN.1 Representation:
```
Reg-Position3D ::= SEQUENCE {
   latitude     LatitudeDMS2,
   longitude    LongitudeDMS2,
   elevation    Elevation,
   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_Position3D <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.59 Data Frame: DF_REG_RestrictionUserType_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-RestrictionUserType ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_RestrictionUserType <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.60 Data Frame: DF_REG_RestrictionUserType_EU [EU]

Use: The regional definition of extensions to this data frame, for the EU region.

ASN.1 Representation:
```
Reg-RestrictionUserType ::= SEQUENCE {
   emission   EmissionType OPTIONAL,
   ...
   }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_RestrictionUserType <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.61 Data Frame: DF_REG_RoadSegment_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-RoadSegment ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_RoadSegment <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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8.62 Data Frame: DF_REG_SignalControlZone_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-SignalControlZone ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_SignalControlZone <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.63 Data Frame: DF_REG_SPAT_Base [REGION]

Use: The regional definition of any extensions to this data frame, if required. Used to allow each region to add additional content to a given data frame to suit regional needs. In such use, the required elements are defined below to augment the base standard. Each region will define this data concept, and the containing namespace, as it requires.

ASN.1 Representation:
```
Reg-SPAT ::= SEQUENCE { ... }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_SPAT <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.64 Data Frame: DF_Reg-ConnectionManeuverAssist_EU [EU]

Use: The regional definition of extensions to this data frame, for the EU region.

ASN.1 Representation:
```
Reg-ConnectionManeuverAssist ::= SEQUENCE {
    vehicleToLanePositions  VehicleToLanePositionList,
    rsuDistanceFromAnchor   DSRC.NodeOffsetPoint OPTIONAL
}
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Regional_ConnectionManeuverAssist <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.65 Data Frame: DF_SignalHeadLocation_EU NEW [EU]

Use: The HeadOfLightPosition data frame provides the location of a signal head with respect to the intersection in which is located.

ASN.1 Representation:
```
SignalHeadLocation ::= SEQUENCE {
   node             DSRC.NodeOffsetPoint, -- the location
   elevation        DSRC.Offset-B11,      -- elevation up to 10 meters
   signalGroupID    DSRC.SignalGroupID,
   ...
}
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_SignalHeadLocationList_EU NEW <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

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8.66 Data Frame: DF_SignalHeadLocationList_EU NEW [EU]

Use: The SignalHeadLocationList data frame consists of a list of SignalHeadLocations.

ASN.1 Representation:

```
SignalHeadLocationList ::= SEQUENCE (SIZE(1..20)) OF  SignalHeadLocation
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_REG_MapData_Base_EU_NEW <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.67 Data Frame: DF_TimeMark_JPN [JPN]

Use: The TimeMark_JPN data element is used to describe the information about when the message is generated. It contains the information of the year, the month, the day, summer time or not, holiday or not, day of the week, the hour, the minute, the second and the millisecond.

ASN.1 Representation:

```
TimeMark ::= SEQUENCE {
    year        Year,           -- BCD coding of A.D. 2 bytes
    month       Month,          -- BCD coding of Month, 1 byte
    day         Day,            -- BCD coding of Day, 1 byte
    summerTime  SummerTime,
    holiday     Holiday,
    dayofWeek   DayOfWeek,
    hour        Hour,           -- BCD coding of Hour, 1 byte
    minute      Minute,         -- BCD coding of Minute, 1 byte
    second      Second,         -- BCD coding of Second, 1 byte
    tenthSecond TenthSecond     -- units of 100 millisecond, 1 byte
}
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_TimeChangeDetails_CHANGED <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.68 Data Frame: DF_VehicleToLanePosition_EU [EU]

Use: The VehicleToLanePosition data frame is used to provide information regarding what lane a subject vehicle (or other object) is in.

ASN.1 Representation:

```
VehicleToLanePosition ::= SEQUENCE {
    stationID   DSRC.StationID,
    laneID      DSRC.LaneID,
    ... -- # LOCAL_CONTENT
    }
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleToLanePositionList_EU <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.69 Data Frame: DF_VehicleToLanePositionList_EU [EU]

Use: The VehicleToLanePositionList data frame is a list of VehicleToLanePosition entries

ASN.1 Representation:

```
VehicleToLanePositionList ::= SEQUENCE SIZE(1..5) OF VehicleToLanePosition
```

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Used By: This entry is used directly by one other data structure in this standard, a DF called DF_Reg-ConnectionManeuverAssist_EU <ASN> <>. In addition, this item may be used by data structures in other ITS standards.

8.70 Data Element: ESS_EssMobileFriction [NTCIP]

Use: Indicates measured coefficient of friction in percent. The value 101 shall indicate an error condition or missing value.

ASN.1 Representation:
```
EssMobileFriction ::= INTEGER (0..101)
```

XML Representation:
```
<xs:simpleType name="EssMobileFriction" >
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="101"/>
      </xs:restriction>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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8.71 Data Element: ESS_EssPrecipRate_quantity [NTCIP]

Use: The rainfall, or water equivalent of snow, rate in tenths of grams per square meter per second (for rain, this is approximately to 0.36 mm/hr). A value of 65535 shall indicate an error condition or missing value.

ASN.1 Representation:
```
EssPrecipRate ::= INTEGER (0..65535)
```

XML Representation:
```
<xs:simpleType name="EssPrecipRate" >
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

8.72 Data Element: ESS_EssPrecipSituation_code [NTCIP]

Use: Describes the weather situation in terms of precipitation.

ASN.1 Representation:
```
EssPrecipSituation ::= ENUMERATED {
   other (1),
   unknown (2),
   noPrecipitation (3),
   unidentifiedSlight (4),
   unidentifiedModerate (5),
   unidentifiedHeavy (6),
   snowSlight (7),
   snowModerate (8),
   snowHeavy (9),
   rainSlight (10),
   rainModerate (11),
```

```
   rainHeavy (12),
   frozenPrecipitationSlight (13),
   frozenPrecipitationModerate (14),
   frozenPrecipitationHeavy (15)
   }
```

XML Representation:

```
<xs:simpleType name="EssPrecipSituation" >
      <xs:annotation>
         <xs:appinfo>
            other (1)
            unknown (2)
            noPrecipitation (3)
            unidentifiedSlight (4)
            unidentifiedModerate (5)
            unidentifiedHeavy (6)
            snowSlight (7)
            snowModerate (8)
            snowHeavy (9)
            rainSlight (10)
            rainModerate (11)
            rainHeavy (12)
            frozenPrecipitationSlight (13)
            frozenPrecipitationModerate (14)
            frozenPrecipitationHeavy (15)
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="1"/>
               <xs:maxInclusive value="15"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="other"/>
               <xs:enumeration value="unknown"/>
               <xs:enumeration value="noPrecipitation"/>
               <xs:enumeration value="unidentifiedSlight"/>
               <xs:enumeration value="unidentifiedModerate"/>
               <xs:enumeration value="unidentifiedHeavy"/>
               <xs:enumeration value="snowSlight"/>
               <xs:enumeration value="snowModerate"/>
               <xs:enumeration value="snowHeavy"/>
               <xs:enumeration value="rainSlight"/>
               <xs:enumeration value="rainModerate"/>
               <xs:enumeration value="rainHeavy"/>
               <xs:enumeration value="frozenPrecipitationSlight"/>
               <xs:enumeration value="frozenPrecipitationModerate"/>
               <xs:enumeration value="frozenPrecipitationHeavy"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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8.73 Data Element: ESS_EssPrecipYesNo_code [NTCIP]

Use: Indicates whether or not moisture is detected by the sensor.

ASN.1 Representation:
```
EssPrecipYesNo ::= ENUMERATED {precip (1), noPrecip (2), error (3)}
```

XML Representation:
```
<xs:simpleType name="EssPrecipYesNo" >
      <xs:annotation>
         <xs:appinfo>
            precip (1)
            noPrecip (2)
            error (3)
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="1"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="precip"/>
               <xs:enumeration value="noPrecip"/>
               <xs:enumeration value="error"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

Remarks: Used in ATIS to gross coverage area reports, not just point sensor measurements.

8.74 Data Element: ESS_EssSolarRadiation_quantity [NTCIP]

Use: The direct solar radiation integrated over the 24 hours preceding the observation in Joules, per square meter. A value of 65535 shall indicate a missing value.

ASN.1 Representation:
```
EssSolarRadiation ::= INTEGER (0..65535)
```

XML Representation:
```
<xs:simpleType name="EssSolarRadiation" >
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

Used By: This entry is used directly by one other data structure in this standard, a DF called DF_VehicleStatus <ASN> <XML>. In addition, this item may be used by data structures in other ITS standards.

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8.75 Data Element: EXT_ITIS_Codes [ITIS]

Use: The complete set of ITIS codes can be found in Volume Two of the J2540 Standard. This is a set of over 1,000 items which are used to encode common events and list items in ITS.

ASN.1 Representation:
```
ITIScodes ::= INTEGER (0..65565)
-- The defined list of ITIS codes is too long to list here
-- Many smaller lists use a sub-set of these codes as defined elements
-- Also enumerated values expressed as text constant are very common,
-- and in many deployments the list codes are used as a shorthand for
-- this text.  Also the XML expressions commonly use a union of the
-- code values and the textual expressions.
-- Consult SAE J2540 for further details.
```

Used By: This entry is directly used by the following 6 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_ITIS_Phrase_ExitService	<ASN>	<XML>, and
DF	DF_ITIS_Phrase_GenericSignage	<ASN>	<XML>, and
DF	DF_ITIS_Phrase_SpeedLimit	<ASN>	<XML>, and
DF	DF_ITIS_Phrase_WorkZone	<ASN>	<XML>, and
MSG	MSG_RoadSideAlert_(RSA)	<ASN>	<XML>, and
DF	DF_ITIS-Codes_And_Text	<ASN>	<XML>.

In addition, this item may be used by data structures in other ITS standards.

Remarks: Refer to the SAE ITIS documents for the complete (and lengthy) listing of these codes and for an XML rendering. An XML schema is also available in the "itis" namespace for this element. Note the "over the wire" format of items in these lists is a 16-bit value in some systems, hence, the use of INTEGER above, however, it is a numbered union of values and phrases in other systems such as XML.

9. DATA CONCEPTS UNDER DEVELOPMENT

The following data frames and data elements are still in development in this edition of the standard. They are not recommended for use in new systems and are presented here for reference because there may be deployed systems which make use on of them or which depend on them (both in deployments of DSRC and in other ITS standards). These entries may in turn use definitions taken from other standards that were taken from the then current adopted standards of these organizations. The referenced standards shall be consulted for further information regarding their proper use. Unless otherwise noted in each entry, the below ASN.1 and XML definitions shall be taken as the governing definition when used in this standard, even when a more current revision of the standard is adopted by the issuing organization. In subsequent editions of this standard, these entries may no longer be present.

At this time there are no messages in this category.

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10. CONFORMANCE

Since this SAE Standard specifies standard message set, data frames and data elements for use by applications intended to utilize the DSRC communications systems, an application will be judged to be in conformance with this Standard by demonstrating functional interoperability with other conformant applications. The level of interoperability possible will initially be limited to applications that can effectively use the initial representative message set, data frames and data elements specified in this Standard. Applications in conformance with this Standard shall be able to receive or to send at least one of the messages defined in this standard.

In addition, an implementation is considered compliant with this standard if all messages, data frames, and data elements that it sends conform to the format and encoding rules specified herein. Conformance to a format requires that:

- required data fields are present,
- no data field is included that is not either required, explicitly optional, or classified as local content,
- data fields appear in the indicated order, and
- numerical values are within specified ranges.

11. OTHER APPLICATION NOTES (INFORMATIVE)

11.1 On the use of TIME

The representation of time in the DSRC Standard follows the methodology defined in the ISO 8601 standards for representing time. Unless specifically indicated in the definition of a data element, data frame, or message, the time reference shall be Coordinated Universal Time (UTC) with the time zone of Greenwich Mean Time (GMT). In this regard it follows the conventions of other ITS standards; however there are some minor unique points that should be pointed out. First, the resolution of time in DSRC is universally kept and expressed with a precision of one millisecond. This value (and its modulo derivatives) is commonly used in many DSRC applications and forms the basis of many “short” forms of time. Time within the current UTC minute is therefore expressed in a 2 bytes value (range 0 to 60,000 milliseconds) in many messages. The rest of the elements of time (minutes, hours, days, month years etc..) are expressed in the normative definition provided by ISO 8601 including a local time zone, although the time zones is not used in most DSRC messages. Leap-seconds and other periodic approbations are handled in the normal ISO 8601 way. In many DSRC messages there is only a need to send relative time (such as the current minute or second) and the full (absolute) moment of time is only sent once or periodically when actually needed. It should also be pointed out that component elements of the time in DSRC are sent as integer values (i.e. Jan is sent as Hex 0x01) and not as ASCII strings as is found in some representations (for example, ISO 8601 expressed as XML where Jan is represented as the ASCII pattern for “01” or Hex 0x3031). In addition, some unknown values have been mapped to the last value in the range. This is at odds with some other standards that use zero for both a legal value of time and as an unknown value.

11.2 Persistence of the temporary MAC ID field

The MAC address used by OBUs is randomly generated at various times according to a timer, or vehicle start-up, or possibly other events. This random MAC address is called the Temporary ID in DSRC messages. The reason for having a non-permanent MAC address, and avoiding any other long-term identification that is publicly available, is to preserve privacy through anonymity. The MAC value for a mobile OBU device (unlike a typical wireless or wired 802 device) will therefore periodically change to a new random value to ensure the overall anonymity of the vehicle. Because this value is used as a means to identify the local vehicles that are interacting during an encounter, it is used in the message set.

11.3 URLs used in the Standard

The Standard makes use of URL strings in various places to link to other information. At times the data elements used to convey the full URL break the string up into component parts. This is done to save payload bytes in the transmitted message. The data element *URL-Short* must be combined with the contents of the data element *URL-Base* to create a valid URL string in such cases.

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11.4 Forward Compatibility in the Standard

The ASN and XML defined by the standard is designed to allow the addition of new messages and content descriptions while preserving the backward compatibility with content described in this edition. Tagging values have been chosen such that both new standardized content as well as any locally developed and deployed content can be added. Locally defined content shall use the ITS convention of tag numbering ranges from 128 to 255 for any content which is added.

For further information and examples of how new message content is added to the ASN or XML defined here, refer to the Implementation Guide for additional details and examples.

11.5 Requirements placed on the ASN encoding used by this standard

The general approach to compatibility used is that every compliant ASN parser must be able to handle well structured ASN messages, both those found in the standard today and those with several types of content that may be added to messages and found in the deployment environment in the future. By *handle*, it is meant that such a message can be parsed, and the currently defined content can be recovered. There are no requirements to use the resulting new content in any way, as it is not defined in this edition of the standard.

There are three types of additional tags (beyond those defined in the standard) that can be found in valid DSRC messages. These are:

- New application Tags
- New *local* application Tags
- Basic Universal Tags

New application tag content (numbered from zero and following after the last tag defined in the previous version of the standard). This is expected to be developed in the succeeding editions of the standard. New *local* application tag content (numbered from 128 to 255 to indicate that the content is locally defined). This type of tag is found when a deployment decides to add new (typically experimental) content to an existing message type in places where the symbol "..." is found. New tag content can also be composed of the basic universal tags used by ASN for basic types (integers, etc.). New messages may also come to exist, but as these will be encoded as different message types then those now defined, they should not be a problem to any compliant parser.

12. COMMENTS ON 2014 REVISION OF SAE J2735 [INFORMATIVE]

The 2014 revision of this standard changes the specification of the MAP and SPAT message types, and of their constituent data frames and elements. These changes are intended to reflect worldwide requirements for these messages, many of which were derived from field trials. These new message definitions include an optional concept called "regional extensions," which is intended to allow the inclusion of content satisfying region-specific needs. Regional extensions for Europe, Japan, and USA are defined in the 2014 revision of the standard. Additional regions can be defined in future revisions. An implementation of this standard is configured to belong to no more than one region.

The SRS and SSR messages in the standard have not been updated in the 2014 revision, and are not consistent with the indexing system utilized in the MAP and SPAT messages.

The MAP and SPAT messages are encoded with Unaligned Packed Encoding Rules (UPER), while the other messages in the standard are encoded with Distinguished Encoding Rules (DER). A DER-encoded Framework Message is also defined, which can encapsulate a UPER-encoded MAP or SPAT message for transmission in an environment where DER encoding is expected. No XML scheme definitions are given for the content added or changed in the 2014 revision.

The remainder of this section provides more detailed information about the revised MAP and SPAT messages. The details about the MAP message in Section 12 assume it describes an intersection, although this is not the only use for a MAP message.

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12.1 The Lane presumptions used in the MAP and SPAT messages [Informative]

The MAP and SPAT messages in this standard use a common format for all lane object types to improve code reuse. Each lane is defined to be one of these basic types, and each type has certain somewhat obvious assumptions made about it which reflect real world operational needs that this standard supports. This section describes the eight basic types of lane objects found in the standard. It serves to document the basic assumptions and properties which each type of lane has in the MAP message. This in turn describes how different modes of travel use and interact with the lanes and with other travelers in a coordinated way to safely traverse the intersection based on the active movements in the SPAT. This information is necessary to understanding the intended data model, which the lanes then describe and which can be conveyed in the resulting message. A data model, in this context, refers to the internal representation of the MAP information content in a form suitable for use by an application.

Motor Vehicle Lanes Motor vehicle traffic is presumed to occupy and follow a motor vehicle lane along the described lane path (in the allowed directions of travel) and can be present at ANY time (except that vehicles may not come to rest at those segments which are marked as *do not block*). Motor vehicle lane paths cross over other lane type paths and can be alongside other lanes types, and merging across such lanes occurs. In general, motor vehicle traffic proceeds from the edge of the described lane in the intersection map to the lane's stop line, stopping as near to the line as conditions allow (other vehicles ahead of the subject vehicle will cause queuing). In the absence of an active movement, the stop line of an ingress lane in a signalized intersection is presumed to be in the "red" state. Outbound lanes (egress lanes), having no stop line, allow motor vehicle traffic to simply proceed off the edge of the map. When an active movement allows it, vehicles proceed to the end of the lane, passing the stop line, and crossing to another lane as indicated by the (optional) *ConnectsTo* data for this lane by means of the given maneuver, and proceed. Further details of the outbound (egress) lane(s) may or may not be described according to the design in the intersection in the MAP message, which is driven by the use cases to be supported. For example, minimalistic intersection designs may not contain either egress lanes or crosswalk lanes.

Pedestrian Crosswalk Lanes Crosswalk traffic is presumed to occupy and use a crosswalk lane along the described lane path (in the allowed directions of travel) and to enter the crosswalk and be present ONLY when there is an active movement for the lane (except that pedestrians or any other allowed users may safely come to rest at those intermediate segments which are marked as *safe islands* or *refuge* points along the path). In this respect they operate as the opposite of a motor vehicle lane and it must be kept in mind that crosswalks type lanes are not the same as sidewalk type lanes. Crosswalk lane paths cross over other lanes paths and can be alongside other lane types. As a rule, merging[2] of crosswalk lanes across other crosswalk lanes does not occur. That is, unlike motor vehicle lanes, the traveler does not merge from one parallel lane to another Crosswalks connect at their end points. In general, crosswalk traffic proceeds from the start of the edge of the described lane to the end of the described lane without stopping. Other lanes, typically sidewalks or different crosswalks, may or may not be present at the terminus of a given crosswalk path depending on what content the map contains. By definition, a stop line exists at both ends of the crosswalk lane path and serves to prevent entry into the lane and the intersection conflict area. In the absence of an active movement, the stop line at the terminus of each crosswalk path is presumed to be in the "red" (no walk) state, and to be empty (or clearing). When an active movement allows, users enter the lane passing the initial stop line, and proceed to the end of the lane, passing beyond the final stop line. Observe that lane attributes allow for multiple signal group assignment in each direction when different timing plans are required based on the direction of travel. In some use cases where routing directions need to be conveyed for travelers, the *ConnectsTo* data for this lane is used in the normal way to connect the lane to another crosswalk or to a sidewalk lane. Further details of these lanes may or may not be described according to the design in the intersection in the MAP message. For example, an intersection designed to support pedestrians would include crosswalk lanes, while one designed for motor vehicle use only would not.

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[2] In cases where multiple crosswalk movements with independent timing is used to cross a set of motor vehicle lanes, it is common to describe each movement as referring to a lane which represents a part of the overall path. A safety island would typically be found between each lane.

An alternative mechanism to relate the lane connectively and signal group used between sidewalks without using the crosswalk lane is also allowed, and may be deployed in European areas. In this embodiment two sidewalk lanes types are connected using the *ConnectsTo* data in the normal way. In this method the resulting conflict area is not defined (no lane path information or lane width is present) in a manner that is similar to the “no man’s land” in the center of the intersection. This approach has the benefit of not describing lane paths which cross over other paths. If a safe island is required, that would be represented as a small additional sidewalk lane with suitable *ConnectsTo* data at each end. This alternative methodology can be used for representing some signalized bicycle lanes as well. **Sidewalk Lanes** Pedestrian traffic (and bicycle traffic if indicated as allowed) is presumed to occupy and follow a sidewalk lane along the described lane path (in the allowed directions of travel) and can be present at ANY time and flow at any rate (i.e. long stationary periods are expected). Sidewalk lane paths do not as a rule cross over other lane paths[3] and can be alongside other lane types. Like motor vehicle lanes, there may be “keep out” segments along the path when required. In general, traffic in this lane type proceeds without restrictions or concerns for (awareness of) the current intersection movement state. When a traveler on this lane type must cross a motorized lane type, it connects to the crosswalk lane type at which point further movement is controlled in the normal way using the movement state of the SPAT message. Outbound lanes (egress lanes), allow traffic to simply proceed off the edge of the map. Details of sidewalk lanes may or may not be described according to the design in the intersection in the MAP message. They are typically added to the MAP message when there is a need to support non-motorized vehicle modes of use.

Bicycle Lanes Bicycle traffic is presumed to occupy and follow a bicycle lane along the described lane path (in the allowed directions of travel) and can in general be present at ANY time. Bicycles may not come to rest at those segments which are marked as *do not block* and bicycle traffic may safely come to rest at those intermediate segments which are marked as *safe* islands or *refuge* points along the path. In some respects bicycle lanes share attributes of both motor vehicle and crosswalk lane types. Bicycle lane paths cross over other lane paths and can be alongside other lane types, and merging across such lanes occurs. In general, bicycle traffic proceeds from the edge of the described lane to the lane stop line, stopping as near to the line as conditions allow (other users can cause queuing). In the absence of an active movement, the stop line of an ingress lane in a signalized intersection is presumed to be in the “red” state. Outbound lanes (egress lanes), having no stop line, allow bicycle traffic to simply proceed off the edge of the map. When an active movement allows, bicycles proceed to to the end of the lane, passing the stop line, and crossing to another lane as indicated by the *ConnectsTo* data for this lane and the movements, and proceed. .

Median Lanes In general no type of traffic is presumed to occupy and follow a median lane along the described lane path. Median lanes are often crossed by crosswalk lanes, but do not as a rule cross other lane types. Median lanes serve the need to describe the general layout of the intersection and have value in improving the algorithmic ability to project a vehicle’s BSM message with positional measurement biases into the correct lane for traffic control and safety uses. This lane type does not have a movement state associated with it. Information about curb height and other barrier details can be of value to emergency responders in traversing the intersection.

Striping Lanes No type of traffic is presumed to occupy and follow a striping lane along its path; rather this type of lane is used to provide a visual indication of the edge of the travel path between lanes across unusually long intersections. So the actual vehicle traffic path occurs alongside of it. In the rare case that path information is required along with a ConnectsTo structure, the ingress lane connects to the stripe lane which in turn connects to the egress lane. The maneuver used refers to that from the ingress lane to the egress lane. Striping lane paths cross over other lane paths and can be alongside other lanes types, and merging across such lanes occurs. The stripe lane type does not have a stop line and vehicle movement is prevented from “entering” it by the stop line of the lane which connects to it. Stripe lanes are typically described and used in the intersection in the MAP message when the intersection geometry is better described by their presence. The most common use case would be to delineate the paths of multiple left-hand turn lanes.

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[3] Railroad tracks and bike lanes are the most notable exceptions.

Tracked Vehicle Lanes Tracked vehicle traffic (rail, trolley, and tram type vehicles) is presumed to occupy and follow a tracked vehicle lane along the described lane path (in the allowed directions of travel) and can be present at ANY time (and such vehicles may come to rest along the path, and this may effectively block other traffic flow). Tracked vehicle lane paths cross over other lane paths and can be alongside other lanes types. A train crossing near or inside of the intersection would be typical of this. Tracked vehicle lanes do not merge with other lanes as such, but can be co-located with them (such as a rail transit stop that shares its lane's width and path with a motor vehicle lane).). In general, tracked vehicle traffic proceeds from the edge of the described lane in the intersection map to the lane's stop line (if one is in fact present[4] at all), stopping as near to the stop line as conditions allow (other vehicles ahead of the subject vehicle can cause queuing). More typically, when there is a tracked vehicle present in the tracked vehicle lane, other traffic flow is restricted and the signal controller device will only activate those movements which can occur at the same time.

Parking Lanes Stationary and slow moving vehicle traffic is presumed to occupy the parking lane type along the described lane path (in the allowed directions of travel) and can be present at ANY time. Parking lane paths are typically found alongside other lane types, can be found on either side of the roadway, and merging into and out of such lanes occurs when vehicles pull into or out of adjoining traffic. In a general safety sense, the presence of stationary motor vehicle traffic sending BSMs from this lane type provides the opportunity to detect a potential risk by other approaching vehicles in the adjoining lanes when they merge into flowing traffic. In some intersections the same physical lane can be used for parking during selected hours of operation and as a moving motor vehicle lane at other times, or both. Such a use case is handled in the MAP message by simply describing both lanes and then invoking the active one for the current time of day within the SPAT message (recall that by design the SPAT message deals with all *time of day* regulatory matters). The parking lane type does not have stop lines and is not associated with a movement event.

12.2 The Indexing system used in the MAP and SPAT messages [Informative]

The MAP and SPAT messages in this standard use a number of indexing values to link between data objects found in the messages, which in turn describe the overall data model supported by the messages. This section of the standard addresses how these indices are intended to work. The proper ASN type name for each index data element is shown in **bold** when it is first used in this section. Recall that the standard is intended as a means to exchange required data effectively (both uniformly and compactly) and to do this it must cover a broad range of identified use case needs with various (optionally present) content. It is anticipated that any deployment application using these messages will in fact develop a different *internal data model* optimized to the user needs which it is serving (it might, as an example, discard certain lane types not of interest to it). Said another way, the MAP and SPAT messages are not intended to be used "as transmitted" but to be translated into whatever local data model the end device application requires. Along this same line of reasoning, it should be kept in mind that the path and distance describing the geometry for each lane may vary from one user community to another, and this in turn can result in smaller or larger maps offering differing content as suits each need.

A brief summary of the indexing process used from the top to the bottom is as follows. All lane objects are identified within the context of an intersection by a **LaneID**. A lane object can also be identified in a globally unique manner by concatenating its **IntersectionReferenceID** and its LaneID. This is unchanged from the previous adopted standard, but a UPER type definition is now provided. Note that while there is a concept of "regions" added to the standard as part of the amendment effort to support global use, the local region concept for adding additional ASN content is not the same as the regional areas over which a set of intersections enjoy a unique index assignment (the two separate systems coexist but have similar names). While this clause covers indexing methods and systems used throughout the MAP and SPAT messages, most of the practical indexing occurs using only the **LaneID** values. The LaneID is used to express relationships between different lanes within a single intersection, the most typical use case. But when combined with an optional IntersectionReferenceID, this index can be used in places such as the **ConnectsTo** data structure to express lane relationships which span multiple intersections (and multiple regions) when required. This use case occurs at the edge of regions, typically at State and other Government boundaries in the US.

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[4] Unless a vehicle is routinely unloading passengers at a point near the intersection (and hence may need a stop line to be described to other users of the MAP-SPAT messages) the more typical use case would be a train that simply passes through the intersection.

IntersectionReferenceID At the highest level, all intersections have a globally unique ID which will require a registration process to manage. This process is outside the scope of this standard. It is expected that the assignment of this value is permanent in nature. Every **region** is assigned a range of **IntersectionID** values which it may manage and assign as it sees fit. The RegionalID value of zero is assigned, by definition, for testing use. Both of these values are in fact defined as INTEGER (0..65535). Every "intersection" in a given region is assigned such a unique IntersectionID value. The lane collection within an intersection is arbitrary by design. A key design goal of the MAP/SPAT process has been to allow assigning collections of roadways to intersections in arbitrary ways. That is, the number and kind of signal controllers involved in what is defined as one single intersection is entirely arbitrary. This supports the need to arbitrarily bundle controllers in areas of tight intersection spacing without any regards to the level of coordination between them. This also supports the need to abstract (hide) the internal working of the intersection from the allowed movements of the intersection published in the SPAT messages to others.

These two-byte fields (again, each an integer ranging from 0 to 65536) were allocated for this ID process with the design presumption that the upper two bytes will often not need to be sent due to local environmental conditions. As an example, presuming an assignment of an intersection region to a US State, an intersection located in Ann Arbor, Michigan may be able to avoid sending the field RegionalID indicating the broader geographical concept of Michigan in the USA. In practical terms, an intersection may be referred to by its IntersectionID over broad operational coverage areas, sending the RegionalID only when required. The value range of IntersectionID for 0x0001 to 0x00FF is specifically allocated in each region for deployment testing, and it is recommended that early adopters should select from that range for testing use. Note further that the data element *revision* in the *IntersectionGeometry* data frame is incremented every time the intersection geometry contents are modified, as a means to alert users to data changes.

LaneID All lane objects are assigned a unique value within the intersection. The values zero and 255 are reserved, so there may be 254 different lane objects within one single intersection. In practice an intersection with 4 multiple lane approaches, complete with various medians, bike lanes, crosswalks and sidewalks all modeled would require about 50 such indices. The **LaneID** is used to link to other lanes. All information about any lane object is contained in the "generic lane" data concept. The "connects to" as well as what approach indices which apply to the lanes, are found within that structure. When a LaneID is referred to within a generic lane description to express a relationship to another lane the referring lane is spoken of as the *owning* lane. The ConnectsTo data frames within a lane are an example of this. Within an intersection, the LaneID uniquely describes that lane, and therefore its stop line (stop bar) as well (when the lane object type in question in fact has a stop line; not all lane objects do).

Therefore the SPAT message can be used to express "*the yellow protected turn light in the left turn lane #123 leading to outbound lane #124 will change to the color red (the current movement state of stop and do not proceed) at time 34 minutes and 56.2 seconds after the hour*" by the value #123 and the associated time mark values. In this example the information that lane #123 is in fact a "left turn lane" and that making the left turn maneuver is allowed and that it leads to the outbound lane #124 is all contained in the generic lane data structure for the lane. To recap, each lane object is assigned a unique lane ID, and this is how other lanes refer to it.

ApproachID A GenericLane data frame optionally includes an ApproachGroup data frame that includes two ApproachIDs, one for an ingress approach and one for an egress approach. When the ApproachGroup is included in the GenericLane, if the lane belongs to only an ingress approach, the egress ApproachID is indicated as zero, and vice versa for a lane that belongs to only an egress approach. A bidirectional lane might belong to both an ingress and an egress approach, and have two non-zero ApproachIDs in an ApproachGroup. The approach concept is sometimes of use when the precise lane of a moving vehicle cannot be determined.

LaneConnectionID The **LaneConnectionID** index is used to provide dynamic movement assist details for *connecting* to one or more outbound lanes. This index is (optionally) assigned to a lane in the Connection data structure of the map message. This allows an owning lane to learn what values would pertain to it. The index is then used within the SPAT message in the **IntersectionState** data frame in the **ConnectionManeuverAssist** data frame where it is expressed. The ConnectionManeuverAssist data frame contains dynamic information for the traveler/vehicle in the link it is connected to relating to queue clearance along the path of the maneuver. The values zero and 255 are not used, so an effective range of 254 values can be used.

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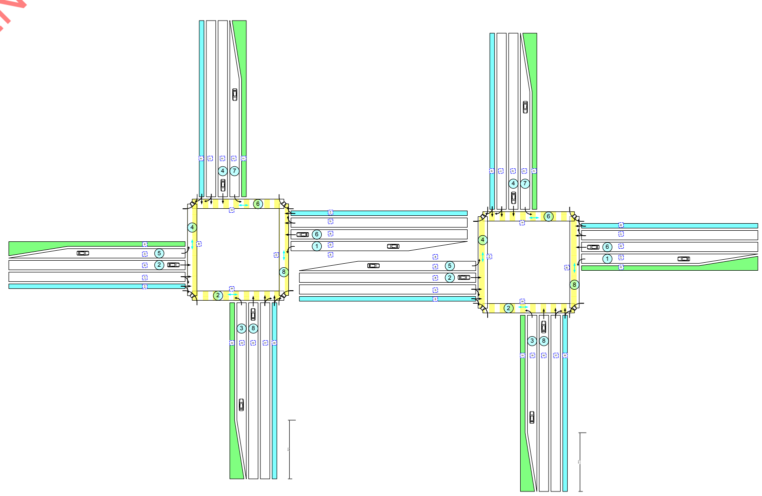
SignalGroupID The **SignalGroupID** in an index used to map between the internal state machine of one or more signal controllers (or other types of traffic flow devices) and a common numbering system that can represent all possible combinations of active states (movements and phases in US traffic terminology). All possible movement variations are assigned a unique value within the intersection. The values zero and 255 are reserved (with special meanings), so there may be up to 254 different signal group IDs within one single intersection. In practice, an intersection with one common eight phase signal control would have eight signal group IDs, likely numbered from hex 0x01 to 0x09. Note that the state of the movements for this is given in the **MovementState** data structures (which contains the SignalGroupID) and list of **MovementEvent** entries where the **SignalPhaseState** (i.e. Red, Yellow, Green, etc. in the US) and the **TimeChangeDetails** (i.e. the time at which the state will change) are found. Note also that the MovementEvent is presented as a list of such events, allowing the ability to express the times of multiple future state changes for eco driving and other needs.

ConnectsTo and LaneIDs, SignalGroupIDs, and LaneConnectionIDs While the ConnectsTo data concept is not an index itself, it contains three index types of interest in this discussion. The ConnectsTo data concept is comprised of a list of one or more **Connection** data structures. Each Connection data frame contains information about one and only one other lane (hence a list is used to provide multiple connections). A key design rule of the ConnectsTo data frame is that it serves to connect ONE lane (the owning lane index) to ONE other lane (the connecting lane index) with ONE maneuver. Signal phase and timing data for this connection is reflected in ONE SignalGroupID index, and any (optional) dynamic clearance advice data to make this maneuver is reflected in ONE LaneConnectionID index.

Lane connectivity (the allowed maneuvers from the end of the owning lane) is provided by the connected LaneID. The SPAT timing information is provided by the SignalGroupID. Dynamic clearance advice is provided by the LaneConnectionID. In the not uncommon event that a lane to lane connection is serviced by various movements or phases (US terminology), or that there are multiple connecting lanes with the same maneuvers, additional entries in the ConnectsTo list are simply added to reflect each unique combination.

Other Intersections and Lane IDs The IntersectionReferenceID is (optionally) found in the Connection data frame (found in ConnectsTo) when the lane index (laneID) being described belongs to another intersection. This construct supports the need to describe multiple complex intersections in close space (i.e. dense urban land use) effectively. Recall that each map message can contain more than one intersection, supporting various map queuing strategies. In dense urban deployments this supports an intersection geometry plan where the lane segments for only inbound lanes are described in each intersection, and where all outbound lanes are linked to using the IntersectionID and LaneID assigned by the adjacent intersection (note that this allows crossing both to another intersection and another intersection located in another region when required). In a more typical deployment the lane path description sent to mobile users would be truncated several hundred meters back from each lanes stop line. In this use case, the resulting intersections can be combined in a mosaic fashion as conceptually shown below. Note also that unlike connected lanes within the intersection which connect to the *first* geometrically described node point ("the front"), connections to lanes in other intersections, by definition, connect to the *last* node point ("the back") of the lane. Note finally that these two example intersections could also be expressed as a single intersection as well, and unless a grid of such intersections is to be deployed, that would likely be a more effective design solution from an overall message size perspective.



Example of Two Intersections reusing each other's lanes

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13. NOTES

13.1 Marginal Indicia

A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY THE SAE DSRC (DEDICATED SHORT RANGE COMMUNICATION) TECHNICAL COMMITTEE

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APPENDIX A - MESSAGE FRAMEWORK

A.1 INTRODUCTION

This annex is intended as a guide for message framework issues.

A.2 MESSAGE ID

J2735 messages have no need for a common header and none is defined. A message common header would be data that is common to all messages. It would be part of the transmitted message, unchanged by any lower levels and required and used by a receiving application or applications. The only datum that fits this definition is the DSRCmsgID. The DSRCmsgID is a mandatory element in every J2735 message, and it is required to be the first element.

A.3 FREQUENTLY USED ELEMENTS

For any generic message, the frequently used elements are defined as shown below.

```
-- Generic Message Structure
AnExampleMessage::= SEQUENCE {
   -- DSRCmsgID and Frequently Used Elements
   msgID        DSRCmsgID,
   msgCnt       MsgCount,
   id           TemporaryID,

   -- Message Content itself is defined here
   -- Message Content itself is defined here
   -- Message Content itself is defined here

   ... -- # LOCAL_CONTENT

   -- Final header item
   crc          Msg_CRC OPTIONAL
   }
```

The MsgCount element is defined as either required or optional in several of the messages. When it is present, it should be placed in the order shown in the specific message set definition of Section 5. See the entry in the preceding section for its definition and usage notes.

The TemporaryID element is defined as either required or optional in several messages. When it is present, it should be placed in the order shown in the specific message set definition of Section 5. See the entry in the preceding section for its definition and usage notes.

The CRC element (of type CRCvalue) element is defined as either required or optional in several of the messages and the value should always occupy the last two bytes of the message payload.[5] This element is transmitted when the underlying protocols will not expressly provide a suitable CRC value for each recovered (received) message. The purpose of this data element is not to ensure message reception correctness (which the lower layers are presumed to handle) but rather as a message level hash value of the preceding payload content.

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[5] In fact the T-L-V of this data element occupies the last 4 bytes of the message payload, but only the last two bytes contain the actual crc value itself.

A.4 APPLICATION PROGRAMMING INTERFACE

An Application Programming Interface (API) is required to process common management information not included in a message (Application Protocol Data Unit). This message related information is not transmitted as part of the message set. An API for J2735 purposes is either information provided by an application which is required by the application's lower layers or is information required by an application and provided by the application's lower layers. The mechanism of communication is not considered in scope for J2735 and may or may not be provided by other standards. Any J2735 API should include the transmitted power level and the message priority.

A.5 PSC/PSID

The PSC/PSID is an example of information shared by application and its lower layers. It is considered out of scope for the J2735 standard.

A.6 MESSAGE PRIORITY

When a message is passed to lower layers for transmission its Message Priority should be made available as well so that the lower layers can properly account for the message's urgency and importance when scheduling its transmission. This is the only common management information defined in J2735.

A.6.1 Priority Related Terms

It is important for this discussion to note the meanings and differences between some priority-related terms used in various standards:

User Priority: As described in IEEE WAVE Standards (IEEE Std 1609.3™ and IEEE Std 1609.4™), aAs three bit field represents User Priority which determines how a given Medium Access Control (MAC) sub layer frame competes with other MAC frames for access to the wireless medium. The priorities range from zero to seven (0-7) where 7 is highest. Transmission priority 0 is higher than transmission priorities 2 and 1 due to historical IEEE development evolution as a way to add a 'new' lowest priority. Note that the default transmission priority is 0. Please note that J2735 priorities are not limited to the case where messages are carried in IEEE 1609 packets.

Access Category: As defined in the IEEE 802.11 standard, an access category is related to the user priority and ranges from 0 to 3 where 3 is highest. Access Category is related to transmission priority as follows:

- Transmission Priorities 7 and 6 are Access Category 3.
- Transmission Priorities 5 and 4 are Access Category 2.
- Transmission Priorities 3 and 0 are Access Category 1.
- Transmission Priorities 2 and 1 are Access Category 0.

The following table lists all Transmission Priorities from highest to lowest as well as their corresponding Access Category:

Priority		Access Category
7	Highest	AC3
6		
5		AC2
4		
3		AC1
0		
2		AC0
1	Lowest	

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Message Priority (as considered in this annex): The Message Priority is a function only of the message type and the message contents. It represents the combination of message urgency and importance. It is independent of lower layer protocols. Recommended Message Priorities are shown below, using a scale of 1 to 7, with 7 representing the highest priority. Compliance to this standard does not require that an implementation support Message Priority, or that it use the specific values in this annex. Message Priority is not defined as a data element or conveyed within any of the messages of this standard.

The main purpose of the Message Priority is to serve as input to the protocol at the next lower layer in a transmitting device. If the lower layer protocol supports a prioritization behavior, it might use the Message Priority in determining how to treat a given message. This standard recommends that the interface between the message layer and the lower layer allow the Message Priority to be passed down along with a message. Note that the criteria used in determining Message Priority may not match the service objectives of a lower layer priority mechanism, so caution should be observed in using the Message Priority. In particular, the similarity between the Message Priority scale (1 to 7) and the IEEE 1609 User Priority scale (0 to 7) does not imply that a simple mapping is appropriate.

Message Priority is a relative metric. The comparison of the Message Priorities of two messages is only appropriate if they contend for access on the same channel. If messages composed according to this standard are transmitted over IEEE 1609 lower layers that recognize the Control Channel (CCH) and Service Channel (SCH) designations, there is no relevance to the comparison of the Message Priority of a message sent on the CCH (e.g. a Basic Safety Message) to the Message Priority of a message sent on one of the SCHs (e.g. electronic toll collection).

Provider Service Identifier (PSID): As described within IEEE Std 1609.3, the PSID is a number that identifies a service provided by an application. A PSID has no relevance for the J2735 defined message priority because it identifies the type of service being offered for the network stack and is considered out of scope here.

Display Priority: A receiver may define a priority associated with displaying messages. This would likely be proprietary to the OEM deploying the receiver and is out of scope for this discussion.

DE_Priority: The Priority data frame is used in a DSRC message set to establish the relative importance of certain messages with respect to other similar messages of the same type. It is not a display priority (although it may factor into display ordering algorithms), nor is it a transmission priority for lower layers.

Other Priorities: This section is limited to those priority concepts that are contained in this standard or may directly interface with it. Other priority concepts exist that are relevant to somebody using this standard, such as may appear in applications or lower layers, but these are not defined here.

A.6.2 Message Priority Enforcement

This annex is intended only to provide guidance for recommended priority assignments to messages and message sets. It is informative only.

Neither the Technical Committee nor its associated subcommittees are chartered to police or enforce the J2735 defined application layer priorities detailed here; such enforcement will be, in all likelihood, the responsibility of an empowered governmental agency. This annex and its associated table are simply a tool to promote harmony and communication within a DSRC community.

A.6.3 Message Priority Table

J2735 Message Priority is based upon a balance between the importance and urgency of a message to be transmitted; the interpretation of the terms being as follows:

- **IMPORTANCE:** The first level of priority is associated with societal and/or safety impact, and prioritizes safety above all other applications and/or communications. The greater the potential for saving life or preventing injury, the higher the importance the message and message sets receive. Though this is as per the USA Federal Communications Commission, there is no intent to limit this guideline to any single country.

- **URGENCY:** Many applications are predicated upon allowable communications latency. The range of that latency defines the urgency of the message; if the message requires quick transfer from sender to listener, it has a higher associated urgency.

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