



SURFACE VEHICLE STANDARD

J2735®

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V2X Communications Message Set Dictionary

RATIONALE

This limited revision corrects Basic Safety Message extensions added to support SAE J2945/1B.

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1. SCOPE

This SAE Standard specifies a message set, and its data frames and data elements, for use by applications that use vehicle-to-everything (V2X) communications systems.

1.1 Purpose

The purpose of this SAE Standard is to support interoperability among V2X applications through the use of a standardized message set and its data frames and data elements. In some cases, this standard also provides information that is useful in understanding how to apply the message set to V2X applications.

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 +1 724-776-4970 (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 J2945/C Requirements for Probe Data Collection Applications

SAE J2945/1 On-Board System Requirements for V2V Safety Communications

SAE J2945/1B Requirements for Non Light Duty Vehicles and Motorcycles

SAE J2945/3 Requirements for Road Weather Applications

SAE J2945/5 Service Specific Permissions and Security Guidelines for Connected Vehicle Applications

2.1.2 IEEE Publications

Available from IEEE Operations Center, 445 and 501 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

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

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

2.1.3 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ISO/IEC 8824-1 Information Technology - Abstract Syntax Notation One (ASN.1): Specification of Basic Notation

ISO/IEC 8824-2 Information Technology - Abstract Syntax Notation One (ASN.1): Information Object Specification

- ISO/IEC 8824-3 Information Technology - Abstract Syntax Notation One (ASN.1): Constraint Specification
- ISO/IEC 8824-4 Information Technology - Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 Specifications
- ISO/IEC 8825-2 Information Technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)

2.1.4 RTCM Publications

Available from the Radio Technical Commission for Maritime Services, 1800 N Kent St., Suite 1060, Arlington, VA 22209, www.rtcn.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 10403.1 For Differential GNSS (Global Navigation Satellite Systems) Services - Version 3 adopted on October 27, 2006 and its successors, including amendments #1~#5 adopted July 1, 2011, and its successors

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

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

For background material, the following standards or information reports are also of value.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

- SAE J1939 Serial Control and Communications Heavy Duty Vehicle Network - Top Level Document
- SAE J2630 Converting ATIS Message Standards From ASN.1 To XML
- SAE J3067 Candidate Improvements to Dedicated Short Range Communications (DSRC) Message Set Dictionary [SAE J2735] Using Systems Engineering Methods

2.2.2 U.S. Dept. of Transportation, National Transportation Library

Available on-line from the National Transportation Library at <http://ntl.bts.gov>.

Cooperative Intersection Collision Avoidance System Limited to Stop Sign and Traffic Signal Violations (CICAS-V), Task 10 Final Report Dated 09-30-2008 which is available at <https://rosap.ntl.bts.gov/view/dot/4143>.

2.2.3 U.S. Department of Transportation, National ITS Architecture

Available online at <https://www.arc-it.net>.

2.2.4 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

2.2.5 IEEE Publications

Available from IEEE Operations Center, 445 and 501 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

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

IEEE Std 802.11 Standard for LAN/MAN - Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications (and all published Corrigenda for this standard)

IEEE Std 1609.12 Draft IEEE Standard for Wireless Access in Vehicular Environments (WAVE) - Identifiers.

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 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. Approach is also used in certain messages to specify where one or more lanes begin, regardless of whether the lane is ingress or egress.

3.1.3 APPROACHING VEHICLE

An equipped vehicle whose trajectory will or may intersect the HV as the HV maintains its own trajectory.

3.1.4 BACK OFFICE (BO)

A back office infrastructure element that consumes data from, or provides data to, the roadside Infrastructure or other devices capable of V2X communications (e.g., vehicles).

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 CERTIFICATE AUTHORITY (CA)

A back office infrastructure element which interacts with the HV and the RSU to enter into a dialog with the HV and provide certification services. A primary goal of the CA is to manage the collection of certificates for V2X devices.

3.1.7 COMPUTED LANE

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 with the same general path.

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.

3.1.9 CONTROLLER ASSEMBLY

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

3.1.10 CONTROLLER UNIT

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

3.1.11 CROSSING VEHICLE

An equipped vehicle whose trajectory will or may intersect the HV as the HV changes its own trajectory to make a turning maneuver.

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

Dark mode indicates that all signal indications are off. Transmission of dark mode may commonly be associated with signalized intersections, ramp meters, lane control, beacons, and power shutdown. When using a SPAT message to convey a non-signalized all-way stop intersection, the dark mode indicates that the signage is missing for the particular approach(es).

3.1.15 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.

3.1.16 DATA CONSUMER

Any entity in the ITS environment which consumes data.

3.1.17 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.

3.1.18 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.

3.1.19 DATA FRAME

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.

3.1.20 DATA PLANE

The data plane is the component of an abstract telecommunications architecture containing the entities that exchange protocol data units that contain application data units with their peers at the various layers in the protocol stack.

3.1.21 DATA TYPE

Classification of a data element based upon how value contained is to be interpreted in operations defined for the data element.

3.1.22 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) between the parties.

3.1.23 DISABLED VEHICLE

A vehicle that is no longer operating as intended (e.g., the engine stopped working). Such a vehicle may be moving or may be stationary.

3.1.24 DISTINGUISHED ENCODING RULES

A variant of ASN BER encoding used by the 2009 edition of this standard.

3.1.25 DRIVER

The human operating an equipped vehicle used in any role, typically the start or end point of a use case in which the driver is alerted to an event or takes some action. The precise means of delivery for driver alerts within each vehicle's human-machine interface are beyond the scope of this effort. There is only one driver at any time within one vehicle. At this time, only drivers of equipped vehicles are included, as none of the current use cases requires interaction with non-equipped vehicles or their drivers.

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

Egress is the 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 V2X-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 registry but no longer used. There are no entity types defined in this standard.

3.1.31 FLASHING MODE

A mode of operation in which at least one traffic signal indication (but, more typically, all signal indications of the entire signalized intersection) in each vehicular signal face of a highway traffic signal is turned on and off repetitively. Refer to MUTCD 2009 for additional information (<http://mutcd.fhwa.dot.gov/>). 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 or yellow flashing.

3.1.32 FLEET VEHICLE

An equipped vehicle which is part of a collection of vehicles owned or operated by a common entity, public or private.

3.1.33 FULL-ACTUATED OPERATION

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

3.1.34 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 V2X standard is a FADD.

3.1.35 HOST VEHICLE (HV)

The equipped vehicle about which a given use case may be constructed. The host vehicle (HV) can be a transmitting vehicle, or a receiving vehicle, or both; this distinction is made clear in the use case description. There is typically only one host vehicle in any use case.

3.1.36 INFRASTRUCTURE

Any roadside device or back office system that supports V2X communications flows (message exchanges), including, but not limited to, V2X RSU devices.

3.1.37 INGRESS

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

3.1.38 INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

Systems that apply information technology to transportation challenges. ITS will often integrate components and users from many domains, both public and private. ITS improves transportation safety and mobility and enhances productivity through the integration of advanced communications technologies into the transportation infrastructure and in vehicles. Intelligent transportation systems (ITS) encompass a broad range of wireless and wire line communications-based information and electronics technologies. See more at: <https://www.its.dot.gov/index.htm>.

3.1.39 INTEROPERABILITY

The ability to share information among heterogeneous applications and systems.

3.1.40 INTERSECTION

In the context of this standard, an intersection is a nexus where two or more approaches meet, and vehicles and other types of users may travel between the connecting links. If signalized, the modes of allowed travel are reflected in the signal phases, the geometry of the intersection, and local regulatory environment. This standard conveys some of this information in messages: specifically, the MAP message conveys the road geometry, while the SPAT message conveys the current signal indication to control movement in the intersection.

3.1.41 INTERSECTION CONTROL BEACON

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

3.1.42 INTERVAL

In the context of signal timing, 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.

3.1.43 INTERVAL SEQUENCE

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

3.1.44 INTERNATIONAL TRAVELER INFORMATION SYSTEMS (ITIS)

The term commonly associated with the SAE J2540-2 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 (i.e., a traffic accident) and is 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. ITIS phrases can also be freely mixed with text and used to describe incidents, accidents, weather reports, roadway signage, and other content types.

3.1.45 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 in terms of its centerline path and various attributes. In the V2X message set, the lane object is used to represent lanes. Lanes consist not only of sections of "drivable" roadway traversed by motor vehicles, but other types of lanes, including pedestrian and bicycle walkways, train tracks, transit lanes, and certain types of dividers and barriers. When used in describing an intersection, a lane is often defined for each possible path into and out of the intersection (e.g., within the MAP message). In use, the current signal phase (and therefore the allowed movements) that is applicable to that lane or its approach at a given point in time is provided in the SPAT message.

3.1.46 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.

3.1.47 LINK (RF)

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

3.1.48 LINK (TRAFFIC)

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

3.1.49 LOCAL DEPLOYMENT

A local deployment is an embodiment of the V2X message set within a region that implements one or more V2X applications. Such deployments use the messages of the standard in conformant ways to exchange data. Such deployments may have additional information content defined in the regional extensions of the messages to handle needs which are unique.

3.1.50 MANAGEMENT PLANE

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

3.1.51 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 in the context of pre-defined applications. Within Section 5 of this standard, each sub-section (e.g., 5.1) defines one message. The casual term "message type" often has the same meaning as "message" in this standard.

3.1.52 MESSAGE SET

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

3.1.53 NETWORKING SERVICES

The collection of management plane and data plane functions at the network layer and transport layer.

3.1.54 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 currently underway): "The time relationship between coordinated phases [and a] 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 a green can be coordinated along a roadway to speed motorists along at a designed speed.

3.1.55 ON-BOARD UNIT

An on-board unit (OBU) is a vehicle mounted V2X device used to transmit and receive a variety of message traffic to and from other V2X devices (other OBUs and RSUs). Among the message types and applications supported by this process are vehicle safety messages used to exchange information on each vehicle's dynamic movements for coordination and safety, a primary subject of this standard.

3.1.56 OPERATOR

The human user of infrastructure or a back office, typically the start or end point of a flow or an event in which the operator is informed of some condition. Similar to the vehicle's human-machine interface, the interface of the human operator with the physical equipment is beyond the scope of this effort. It is presumed that there will be multiple operators interfacing to the physical equipment. In most of the current use cases, the operator is passive in the flow of events; however, the use cases and flows support any business use case logic for the operator. Qualifiers such as road/roadway/infrastructure may be added.

3.1.57 PARKED VEHICLE

An equipped vehicle which is stationary, with a transmission state indicating that it will not move.

3.1.58 PEDESTRIAN CHANGE INTERVAL

An interval during which the flashing upraised hand (symbolizing DON'T WALK) signal indication is displayed, often also called the pedestrian clearance time. During this interval, the SPAT message indicates a DON'T WALK state for that pedestrian lane (along with an optional period of time remaining for this state).

3.1.59 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 message 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 m/s.

3.1.60 PEDESTRIAN PHASE

The time during which a walking figure or word WALK is presented, and the flashing DON'T WALK is presented. The pedestrian phase is the time interval of the pedestrian walk interval and the pedestrian change interval combined.

3.1.61 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 indicate a WALK state for that pedestrian lane (along with an optional period of time remaining for this state and the subsequent pedestrian clearance state).

3.1.62 PERMISSIVE MODE

A mode 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.

3.1.63 PREEMPTION CONTROL

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

3.1.64 PRE-TIMED 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. Pre-timed operation may be fixed or based on time of day schedules.

3.1.65 PROTECTED MODE

A mode 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.

3.1.66 PROVIDER SERVICE IDENTIFIER (PSID)

A number that identifies a service provided by an application. PSID is defined in IEEE Std 1609.12.

3.1.67 PUBLIC SAFETY VEHICLE

An equipped vehicle actively engaged in public safety operations and announcing so to others. When not engaged in public safety operations, this role reverts to the behaviors associated with its basic vehicle class and type (typically a passenger vehicle). This type of vehicle is presumed to be equipped with an on-board unit specialized for public safety ("PSOBU") device.

3.1.68 RED CLEARANCE INTERVAL

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

3.1.69 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 reused 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.

3.1.70 REFERENCE POINT

A reference point is a complete set of values for latitude - longitude - and height above the reference ellipsoid 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 are encoded in this standard use a system of local reference points to index and offset the data that follows. Also called an anchor point.

3.1.71 REPORTING VEHICLE

An equipped vehicle which is providing some form of additional data to other vehicles or to the roadside Infrastructure.

3.1.72 REVERSING VEHICLE

An equipped vehicle in which the transmission is engaged to propel the vehicle backwards.

3.1.73 ROADSIDE UNIT

A roadside unit (RSU) is a V2X device used to transmit to, and receive from, V2X-equipped moving vehicles (OBUs). The RSU transmits from a fixed position on the roadside (which may be either a permanent installation or "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.

3.1.74 ROLES

These are the parts "played" by each actor in a given UML use case scenario, e.g., primary vehicle, nearby vehicle, approaching vehicles.

3.1.75 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.

3.1.76 SIGNAL HEAD

An assembly of one or more traffic 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.

3.1.77 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 is 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).

3.1.78 SIGNAL SECTION

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

3.1.79 SIGNAL TIMING

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

3.1.80 SPAT

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 describe an intersection and its current and future control states.

3.1.81 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.

3.1.82 SPLIT (SIGNAL)

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

3.1.83 STABILITY CONTROL

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

3.1.84 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, often found at the lane's edge leading to the center 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.

3.1.85 STOPPED VEHICLE

An equipped vehicle which is stationary but which remains in gear and able to move at any time.

3.1.86 SYNTAX

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

3.1.87 TOWING VEHICLE

An equipped light passenger vehicle which is towing a trailer.

3.1.88 TRANSACTIONS

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

3.1.89 TRANSIT VEHICLE

An equipped vehicle engaged in Transit operations, e.g., a bus.

3.1.90 UNALIGNED PACKED ENCODING RULES

The variant of ASN PER encoding which is the default encoding for this standard.

3.1.91 UNAVAILABLE

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

3.1.92 UN-EQUIPPED VEHICLE

A vehicle which is not equipped with an OBU device.

3.1.93 VEHICLE

In the context of this standard, all types of motor vehicles, including light passenger vehicles, heavy and freight vehicles, buses, special services vehicles (street sweepers, tow trucks, etc.), those vehicles used in public safety and response roles, and various “alternative” vehicles which may use public roadways, such as motorcycles, off-road heavy equipment, etc. For certain basic use cases in the current scope of work, non-motorized vehicle roles and pedestrian roles are also modeled as vehicles. It is expected that a more detailed breakdown will be required in time.

3.1.94 VEHICLE TYPE

In the context of 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.

3.1.95 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.”

3.1.96 WARNING BEACON

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

3.1.97 WAVE DEVICE

A device which is conformant to wireless access for vehicular environment communication protocol.

3.1.98 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.

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 |
| 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 |
| CAM | Cooperative Awareness Message |
| CAN | Controller Area Network |
| CCC | Cooperative Cruise Control |
| 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 |
| DGPS | Differential GPS (or GNSS) |
| 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 Estimates System |
| GID | Geographic Information Description |
| GMT | Greenwich Mean Time |
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System |
| HMI | Human Machine Interface |
| 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 |
| JER | JSON Encoding Rules |
| JSON | JavaScript Object Notation |
| LCW | Lane Change Warning |
| LLC | Logical Link Control |
| LLH | Latitude, Longitude, Height, and Above the Ellipsoid |
| 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 |
| NHSTA | National Highway Traffic Safety Administration |
| NMEA | National Marine Electronics Association |
| NTCIP | National Transportation Communications for ITS Protocols |
| NTRIP | Networked Transport of RTCM via Internet Protocol |
| OER | Octet Encoding Rules |
| 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 |
| PSID | Provider Service Identifier |
| PSN | Probe Segment Number |
| PVD | Probe Vehicle Data Message |
| RSA | Roadside Alert Message |
| RSU | Roadside Unit |
| RTCM | Radio Technical Commission for Maritime Services or RTCM Corrections Message |

| | |
|--------|--|
| RTK | Real Time Kinematics |
| SC-104 | Sub-Committee 104 of the RTCM |
| 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 or Supplemental Restraint System |
| SSM | Signal Status Message |
| SSP | Service-Specific Permissions |
| 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 |
| UPER | Unaligned Packed Encoding Rules |
| USDOT | United States Department of Transportation |
| UTC | Universal Coordinated Time |
| V2I | Vehicle-to-Infrastructure |
| V2P | Vehicle-to-Pedestrian |
| V2V | Vehicle-to-Vehicle |
| V2X | Vehicle-to-Everything |
| VIN | Vehicle Identification Number |
| VSC | Vehicle Safety Communications |
| VSC-2 | Vehicle Safety Communications 2 |

| | |
|------|---|
| WAVE | Wireless Access in Vehicular Environments |
| WSM | WAVE Short Message |
| WSMP | WAVE Short Message Protocol |
| XER | XML Encoding Rules |
| XML | Extensible Markup Language |

4. THE USE OF V2X MESSAGES IN APPLICATIONS

This section contains introductory material about this edition of SAE J2735, and background information on the rationale for the standard and the user needs which it was developed to meet. The general design approach used in the standard and a selection of topics which provide both informative and normative information about its use can be found in Section 11.

4.1 Introduction to V2X 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. These requirements for interoperability are also relevant to contemplated mobility applications. This SAE Standard specifies messages, data frames and data elements to facilitate interoperability at the application layer.

The message set specified in this SAE Standard can be used by an application to send information using V2X communications to peer instances of that application (for example, in a vehicle) to the other end (for example, in another vehicle). These lower layers of the protocol stack are defined and specified in standards developed by other Standards Development Organizations (SDOs). 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 as 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 V2X communications. The messages themselves 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. These techniques are also intended to expedite the development of messages to be defined in the future. The 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 or developed in support of regional needs are presented in Section 8. Data concepts which allow regional deployment to extend the standard in various ways are found in Section 9.

NOTE: Use of regional extensions is discouraged for security reasons (refer to SAE J2945/5, 2.7.5).

4.2 V2X Communications Overview (Informative)

While the data dictionary was originally developed for use over DSRC, other interfaces such as cellular-V2X using V2X sidelink as defined in 3GPP may be used, as well as traditional cellular networks, Wi-Fi, and any other communications media that meet the requirements of the applications using the data dictionary.

4.2.1 WAVE Communications Overview

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 or 3GPP standards (V2X sidelink), depending on which communications interface is being used. The system generally supports a MAC and PHY for each channel on which it operates. The range of this system is generally considered to be distances of less than 1000 meters.

The IEEE 1609 family of standards is used along with the MAC and PHY layer standards to enable safety, mobility, and other applications, including many that use the data dictionary in this SAE Standard. IEEE 1609 supports a multi-channel system that includes specifications for network and transport layers (1609.3), as well as corresponding security services (1609.2).

Two data exchange options (network and transport layer protocols) are identified in IEEE 1609.3: the WAVE short message protocol (WSMP) and IPv6 (with various transport layer protocols). IEEE 1609.3 also specifies services for applications and upper layers that use one or both of these two protocol stacks. WSMP is uniquely specified by IEEE 1609.3, and it supports both broadcast and unicast addressing.

4.2.2 Security

IEEE 1609.2 specifies cryptographic data security services. These services include data signing and verification for authentication and integrity, as well as encryption and decryption using asymmetric public keys. To achieve end-to-end security, applications usually invoke these services directly. IEEE 1609.2 also indicates whether a participant in a V2X application is authorized to send certain data objects over the V2X communications interface using provider service identifier (PSID) and service specific permissions (SSP). The recommended design approach to design an SSP associated with a specific idea is defined in SAE J2945/5. The ASN.1 objects defined in this document do not contain security content or use indexes to SSP. Previous versions of SAE J2735 have included these SSP indexes within certain objects, but in this revision of the document, these indexes are not used by applications. In order to maintain backward compatibility, the fields have remained where previously defined, but the fields are set to zero and ignored upon reception.

In addition to IEEE 1609.2, when using IP-based interfaces, ISO 21177—which specifies features that support transport layer security (TLS) using 1609.2 certificates—may be used.

4.3 Philosophy of Message Design (Informative)

This document defines ASN.1 types as follows:

1. The smallest divisions of information content to be standardized are called data elements.
2. Data frames are the next, more complex data structures that contain data elements and other data frames.
3. The top level of complexity in the data structure is called a message, which contains one or more data frames or elements.

The data objects specified in this document are defined using abstract syntax notation revision one (ASN.1, referred to as ASN hereafter). These ASN modules follow the typical style used for message sets defined in ITS standards by SAE and the other SDOs engaged in V2X applications development. The complete ASN specification of the standard is available to developers to download at the SAE V2X support site (see Appendix A).

4.4 Message Encoding (Normative)

Instantiations of ASN objects specified by this standard are encoded for transport using one of the standard sets of encoding rules available for ASN.1-defined objects (BER, DER, UPER, OER, XER, JER, etc.). The data dictionary has been optimized for UPER encoding in most cases. If the encoding is not specified by a corresponding application specification, UPER encoding shall be used.

4.5 Additional Data Dictionary Constraints (Informative)

In some cases, the use of the messages, data frames, and data elements defined in this standard, including the various system performance levels required, can be found in other standards such as SAE J2945/1.

4.6 Deprecation of ASN.1 Unused Entities

Deprecation of unused data frames and data elements defined in this standard were evaluated by the technical committee, and the deprecation approach used is to change the left side of the data structure so as to not affect backward compatibility. The entities planned for deprecation will be changed to the NULL ASN.1 operator on the right side of the data structure wherever they occur in the next version of J2735. New entities may also be identified for deprecation in the next revision. The deprecation strategy adopted by the technical committee is summarized follows:

Current revision (this document):

Left side: Right side:

deprecated OldASN1Entity OPTIONAL --To be deprecated in next revision of J2735

Next revision (future version of this document):

Left side: Right side:

deprecated NULL OPTIONAL --Deprecated in 202x revision

Note that the OldASN1Entity ASN.1 definition may be removed from this document entirely after the two revision cycles if no stakeholders have been identified who use it. If a stakeholder is identified, the left side can be changed back to the most recent version in which the entity was not planned for deprecation.

For this version of J2735, some existing data frames and data elements were considered for deprecation. The following Data Frames and Elements will be deprecated from [SupplementalVehicleExtensions](#) in order to streamline the Basic Safety Message in support of SAE J2945/1B:

[WeatherReport](#)

[WeatherProbe](#)

[DisabledVehicle](#)

[SpeedProfile](#)

[RTCMPackage](#)

[TrailerData](#) is being deprecated from [SupplementalVehicleExtensions](#) in support of SAE J2945/1B.

5. MESSAGE SET

This section defines the precise structure of the messages defined by this standard.

All text in this clause is normative unless expressly marked otherwise. The definitions for each data object in this dictionary set is presented in the following sub clauses. The section titled “Use” provides a general overview of the data concept and broadly explains the informational concept and its intended use. It may also provide illustrative use cases. It may assert normative details regarding such use. In addition, each standard that makes use of the data concept may further constrain aspects of its use (for example defining a minimum accuracy level under given operational conditions). The ASN is presented in a section titled “ASN Representation” and is also available from SAE in a downloadable format. The ASN defines, at the least, the precise structural details of the data concept, such as precision and range of valid values. The section titled “Used By” provides a listing and a set of hyperlinks to other places in the document where this data concept is used. The section titled “Remarks” is used to provide additional information regarding the data concept, often denoting changes made to the concept from prior published editions.

The ASN definitions that follow are normative. While the majority of the normative content is reflected in the actual syntax of the ASN, some entries also have additional statements in the ASN comments which are also normative. 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. Users of this standard seeking to be in conformance with it shall follow the normative text outlined here.

In this SAE data dictionary, all ASN entities are formally named data element (DE), data frame (DF), or message (MSG). This is the name that appears in the title of the section where the object is defined. When citing ASN entities in this and other documents, they should be referred to only by their proper names and not by the numerical index which they have, as that value will change over time as other entries are added or removed. For example, the ASN definition of DSRCmsgID, which is a data element, is referred to in the text by its formal name, which is DE_DSRC_MessageID.

Some entities are indicated as deprecated in this revision of the standard. Deprecated data structures are no longer used. A receiver implementation can assume that a deprecated data structure will not be included in any message conforming to this standard. Refer to section 4.6 for details regarding the deprecation strategy.

The MessageFrame entry represents the top most entry of the data dictionary and contains data frame and data elements.

5.1 Message: MSG_MessageFrame (FRAME)

Use: The MessageFrame message is used to hold all the defined messages of this standard. Each of the defined messages in this standard has one or more selected locations where additional “regional information” can be inserted into data frames in the message. The methodology used to do this is further described in 11.2. The provided set of test messages are intended for testing use only. Note that the entire MSG_MessageFrame is encoded using the encoding method specified in the corresponding application specification or using UPER if not specified.

ASN.1 Representation:

```

MessageFrame ::= SEQUENCE {
    messageId    MESSAGE-ID-AND-TYPE.&id({MessageTypes}),
    value        MESSAGE-ID-AND-TYPE.&Type({MessageTypes}{@.messageId}),
    ...
}

MESSAGE-ID-AND-TYPE ::= CLASS {
    &id    DSRCmsgID UNIQUE,
    &Type
} WITH SYNTAX {&Type IDENTIFIED BY &id}

MessageTypes MESSAGE-ID-AND-TYPE ::= {
    { BasicSafetyMessage          IDENTIFIED BY basicSafetyMessage      } |
    { MapData                      IDENTIFIED BY mapData                  } |
    { SPAT                          IDENTIFIED BY signalPhaseAndTimingMessage } |
    { CommonSafetyRequest          IDENTIFIED BY commonSafetyRequest    } |
    { EmergencyVehicleAlert        IDENTIFIED BY emergencyVehicleAlert  } |
    { IntersectionCollision        IDENTIFIED BY intersectionCollision  } |
    { NMEAcorrections              IDENTIFIED BY nmeaCorrections        } |
    { ProbeDataManagement          IDENTIFIED BY probeDataManagement    } |
    { ProbeVehicleData              IDENTIFIED BY probeVehicleData        } |
    { RoadSideAlert                 IDENTIFIED BY roadSideAlert           } |
    { RTCMcorrections              IDENTIFIED BY rtcmCorrections         } |
    { SignalRequestMessage          IDENTIFIED BY signalRequestMessage    } |
    { SignalStatusMessage          IDENTIFIED BY signalStatusMessage     } |
    { TravelerInformation          IDENTIFIED BY travelerInformation     } |
    { PersonalSafetyMessage        IDENTIFIED BY personalSafetyMessage   } |
    { RoadSafetyMessage            IDENTIFIED BY roadSafetyMessage        } |
    { RoadWeatherMessage           IDENTIFIED BY roadWeatherMessage      } |
    { ProbeDataConfigMessage        IDENTIFIED BY probeDataConfigMessage  } |
    { ProbeDataReportMessage        IDENTIFIED BY probeDataReportMessage  } |
    { TollAdvertisementMessage       IDENTIFIED BY tollAdvertisementMessage } |
    { TollUsageMessage             IDENTIFIED BY tollUsageMessage         } |
    { TollUsageAckMessage           IDENTIFIED BY tollUsageAckMessage      } |
    { CooperativeControlMessage     IDENTIFIED BY cooperativeControlMessage } |
    { SensorDataSharingMessage      IDENTIFIED BY sensorDataSharingMessage } |
    { ManeuverSharingAndCoordinatingMessage IDENTIFIED BY maneuverSharingAndCoordinatingMessage } |
    { RoadGeometryAndAttributes     IDENTIFIED BY roadGeometryAndAttributes } |
    { PersonalSafetyMessage2        IDENTIFIED BY personalSafetyMessage2   } |
    { TrafficSignalPhaseAndTiming   IDENTIFIED BY trafficSignalPhaseAndTiming } |
    { SignalControlAndPrioritizationRequest IDENTIFIED BY signalControlAndPrioritizationRequest } |
    { SignalControlAndPrioritizationStatus IDENTIFIED BY signalControlAndPrioritizationStatus } |
    { TestMessage00                IDENTIFIED BY testMessage00           } |
    { TestMessage01                IDENTIFIED BY testMessage01           } |
    { TestMessage02                IDENTIFIED BY testMessage02           } |
    { TestMessage03                IDENTIFIED BY testMessage03           } |
    { TestMessage04                IDENTIFIED BY testMessage04           } |
    { TestMessage05                IDENTIFIED BY testMessage05           } |
    { TestMessage06                IDENTIFIED BY testMessage06           } |
    { TestMessage07                IDENTIFIED BY testMessage07           } |
    { TestMessage08                IDENTIFIED BY testMessage08           } |
    { TestMessage09                IDENTIFIED BY testMessage09           } |
    { TestMessage10               IDENTIFIED BY testMessage10           } |
    { TestMessage11               IDENTIFIED BY testMessage11           } |
    { TestMessage12               IDENTIFIED BY testMessage12           } |

```



```

{ TestMessage13          IDENTIFIED BY testMessage13 } |
{ TestMessage14          IDENTIFIED BY testMessage14 } |
{ TestMessage15          IDENTIFIED BY testMessage15 } ,
... -- Expansion to be used only by the SAE V2X Core TC
}

-- Regional extensions support
REG-EXT-ID-AND-TYPE ::= CLASS {
    &id      RegionId UNIQUE,
    &Type
} WITH SYNTAX {&Type IDENTIFIED BY &id}

RegionalExtension {REG-EXT-ID-AND-TYPE : Set} ::= SEQUENCE {
    regionId      REG-EXT-ID-AND-TYPE.&id( {Set} ),
    regExtValue   REG-EXT-ID-AND-TYPE.&Type( {Set}{@regionId} )
}

```

Remarks: Use of regional extensions is discouraged for security reasons (refer to SAE J2945/5, 2.7.5).

5.2 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 to surrounding vehicles with 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 when congestion control algorithms do not prescribe a reduced rate. Part I data shall be included in every BSM. Part II data items 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 optional content is a valid message.

ASN.1 Representation:

```

BasicSafetyMessage ::= SEQUENCE {
    -- Part I, Sent at all times with each message
    coreData      BSMcoreData,

    -- Part II Content
    partII        SEQUENCE (SIZE(1..8)) OF
                    PartIIcontent {{ BSMpartIIExtension }} OPTIONAL,

    regional      SEQUENCE (SIZE(1..4)) OF
                    RegionalExtension {{Reg-BasicSafetyMessage}} OPTIONAL,
    ...
}

-- BSM Part II content support
PARTII-EXT-ID-AND-TYPE ::= CLASS {
    &id      PartII-Id UNIQUE,
    &Type
} WITH SYNTAX {&Type IDENTIFIED BY &id}

PartIIcontent { PARTII-EXT-ID-AND-TYPE: Set} ::= SEQUENCE {
    partII-Id      PARTII-EXT-ID-AND-TYPE.&id( {Set} ),
    partII-Value   PARTII-EXT-ID-AND-TYPE.&Type( {Set}{@partII-Id} )
}

PartII-Id ::= INTEGER (0..63)
vehicleSafetyExt      PartII-Id::= 0 -- VehicleSafetyExtensions
specialVehicleExt     PartII-Id::= 1 -- SpecialVehicleExtensions
supplementalVehicleExt PartII-Id::= 2 -- SupplementalVehicleExtensions
-- NOTE: new registered Part II content IDs will be denoted here

```

```
-- In a given message there may be multiple extensions present
-- but at most one instance of each extension type.
BSMpartIIExtension  PARTII-EXT-ID-AND-TYPE ::= {
  { VehicleSafetyExtensions          IDENTIFIED BY vehicleSafetyExt} |
  { SpecialVehicleExtensions        IDENTIFIED BY specialVehicleExt} |
  { SupplementalVehicleExtensions    IDENTIFIED BY supplementalVehicleExt} ,
  ...
}
```

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

5.3 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 send unicast requests to other vehicles for additional 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 standards.

Additional 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 {
  timeStamp    MinuteOfTheYear          OPTIONAL,
  msgCnt       MsgCount                  OPTIONAL,
  id           TemporaryID              OPTIONAL, -- targeted remote device
  requests     RequestedItemList,
  -- Note: Above no longer uses the same request as probe management
  regional     SEQUENCE (SIZE(1..4)) OF
                RegionalExtension {{Reg-CommonSafetyRequest}} OPTIONAL,
  ...
}
```

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

5.4 Message: MSG_CooperativeControlMessage (CCM)

Use: Reserved.

5.5 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 {
    timeStamp      MinuteOfTheYear OPTIONAL,
    id              TemporaryID OPTIONAL,
    rsaMsg          RoadSideAlert,
    -- the DSRCmsgID inside this
    -- data frame is set as per the
    -- RoadSideAlert.
    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    VehicleGroupAffected OPTIONAL,
    responseEquip   IncidentResponseEquipment OPTIONAL,
    responderType   ResponderGroupAffected OPTIONAL,
    regional        SEQUENCE (SIZE(1..4)) OF
    RegionalExtension {{Reg-EmergencyVehicleAlert}} OPTIONAL,
    ...
}

```

Remarks: The TemporaryID data element shall be sent only if the vehicle is to be identified 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 road side alert message shall be a valid message within the emergency vehicle message.

5.6 Message: MSG_IntersectionCollisionAvoidance (ICA)

Use: This message is intended to be used to broadcast to other V2X devices in the area a warning of a potential collision with a vehicle that is likely to be entering an intersection without the right of way. The sender may be either an equipped vehicle or another source such as the infrastructure.

ASN.1 Representation:

```

IntersectionCollision ::= SEQUENCE {
    msgCnt          MsgCount,
    id              TemporaryID,
    timeStamp       MinuteOfTheYear OPTIONAL,
    partOne         BSMcoreData OPTIONAL,
    path            PathHistory OPTIONAL,
    -- a set of recent path points forming a history
    pathPrediction  PathPrediction OPTIONAL,
    -- the predicted path
    intersectionID   IntersectionReferenceID,
    -- the applicable Intersection
    laneNumber       ApproachOrLane,
    -- the best estimate of the applicable Lane or Approach
    eventFlag        VehicleEventFlags,
    -- used to convey vehicle Panic Events,
    -- Set to indicate "Intersection Violation"
    regional         SEQUENCE (SIZE(1..4)) OF
    RegionalExtension {{Reg-IntersectionCollision}} OPTIONAL,
    ...
}

```

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

5.7 Message: MSG_ManeuverSharingAndCoordinatingMessage (MSCM)

Use: Reserved.

5.8 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 applications). A given single MapData message may convey descriptions of one or more geographic areas or intersections. The contents of this message 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 {
    timeStamp          MinuteOfTheYear OPTIONAL,
    msgIssueRevision   MsgCount,
    layerType          LayerType OPTIONAL,
    layerID            LayerID OPTIONAL,
    intersections      IntersectionGeometryList OPTIONAL,
                      -- All Intersection definitions
    roadSegments       RoadSegmentList OPTIONAL,
                      -- All roadway descriptions

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

    restrictionList     RestrictionClassList OPTIONAL,
                      -- Any restriction ID tables which have
                      -- established for these map entries

    regional           SEQUENCE (SIZE(1..4)) OF
                      RegionalExtension {{Reg-MapData}} OPTIONAL,

    -- NOTE:
    -- Other map data will be added here as it is defined
    -- Examples of the type of content to be added include
    -- curve warnings, construction routes, etc.
    ...
}
```

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

5.9 Message: MSG_NMEACorrections (NMEA)

Use: The NMEA Corrections message is used to encapsulate NMEA 183 style differential corrections for GPS/GNSS radio navigation signals as defined by the NMEA (National Marine Electronics Association) committee in its Protocol 0183 standard. These messages are encapsulated within MSG_NMEACorrections for transport on V2X media, when then can be re-constructed by a receiver of the message.

ASN.1 Representation:

```

NMEACorrections ::= SEQUENCE {
    timeStamp MinuteOfTheYear OPTIONAL,
    rev NMEA-Revision OPTIONAL,
    -- the specific edition of the standard
    -- that is being sent, 4.x at the time of publication
    msg NMEA-MessageType OPTIONAL,
    -- the message and sub-message type, as
    -- defined in the revision being used
    -- NOTE The message type is also in the payload expressed as a string,
    wdCount ObjectCount OPTIONAL,
    -- a count of octets to follow
    -- observe that not all NMEA sentences are limited to 82 characters
    payload NMEA-Payload,
    regional SEQUENCE (SIZE(1..4)) OF
        RegionalExtension {{Reg-NMEACorrections}} OPTIONAL,
    ...
}

```

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

Remarks: As a rule, NMEA 183 messages (called sentences in the NMEA work) are not used in V2X due to the inherently large size of expressing the data in a text format. This message primarily has use as an aid in debugging and it is for this reason that it is included in the standard. The NMEA 183 messages provide a means for private vendors to add their own messages (such messages all start with "\$P") and the developer is cautioned that such messages may not be interoperable with different vendors' GNSS devices. The newer NMEA 2000 standard, which involves a denser binary message format, may also be sent using this message. The NMEA 2000 standard operates over an SAE J1939 CAN bus protocol, but NMEA does not coordinate its messages with SAE in this regard.

5.10 Message: MSG_PersonalSafetyMessage (PSM)

Use: The Personal Safety Message (PSM) is used to broadcast safety data regarding the kinematic state of various types of Vulnerable Road Users (VRU), such as pedestrians, cyclists, or road workers. Data items which are optional are included in a PSM as needed according to policies that are beyond the scope of this standard.

ASN.1 Representation:

```

PersonalSafetyMessage ::= SEQUENCE {
    basicType PersonalDeviceUserType,
    secMark DSecond,
    msgCnt MsgCount,
    id TemporaryID,
    position Position3D, -- Lat, Long, Elevation
    accuracy PositionalAccuracy,
    speed Velocity,
    heading Heading,
    accelSet AccelerationSet4Way OPTIONAL,
    pathHistory PathHistory OPTIONAL,
    pathPrediction PathPrediction OPTIONAL,
    propulsion PropelledInformation OPTIONAL,
    useState PersonalDeviceUsageState OPTIONAL,
    crossRequest PersonalCrossingRequest OPTIONAL,
    crossState PersonalCrossingInProgress OPTIONAL,
    clusterSize NumberOfParticipantsInCluster OPTIONAL,
    clusterRadius PersonalClusterRadius OPTIONAL,
    eventResponderType PublicSafetyEventResponderWorkerType OPTIONAL,
    activityType PublicSafetyAndRoadWorkerActivity OPTIONAL,
    activitySubType PublicSafetyDirectingTrafficSubType OPTIONAL,
    assistType PersonalAssistive OPTIONAL,
    sizing UserSizeAndBehaviour OPTIONAL,
}

```

```

attachment          Attachment          OPTIONAL,
attachmentRadius     AttachmentRadius     OPTIONAL,
animalType           AnimalType           OPTIONAL,

regional SEQUENCE (SIZE(1..4)) OF
    RegionalExtension {{Reg-PersonalSafetyMessage}} OPTIONAL,
...
}

```

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

Remarks: The optional PathPrediction field is only intended to be included when the PSM sender is traveling along a roadway, e.g., in a bicycle lane.

5.11 Message: MSG_PersonalSafetyMessage2 (PSM2)

Use: Reserved for future use.

5.12 Message: MSG_ProbeDataConfigMessage (PDC)

Use: Refer to SAE J2945/C.

5.13 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.

Note that the PDM will remain in J2735, but it will not be further revised. PDM-related functionality can be migrated to the newer Probe Data Configuration message as defined in SAE J2945/C.

ASN.1 Representation:

```

ProbeDataManagement ::= SEQUENCE {
    timeStamp          MinuteOfTheYear OPTIONAL,
    sample             Sample,           -- Identifies the vehicle
                                     -- population affected by this
    directions         HeadingSlice,     -- Applicable headings/directions
    term CHOICE {
        termtime       TermTime,           -- Terminate this 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
                                     -- the value 0 indicates forever
        snapshotDistance SnapshotDistance -- Collect snapshots based on combination
                                     -- of vehicle Speed and Distance
    },
    txInterval         SecondOfTime,     -- Time Interval at which to send snapshots
    dataElements        VehicleStatusRequestList OPTIONAL,
                                     -- Control data frames and associated
                                     -- trigger thresholds to be changed
    regional           SEQUENCE (SIZE(1..4)) OF
        RegionalExtension {{Reg-ProbeDataManagement}} OPTIONAL,
    ...
}

```

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

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.

5.14 Message: MSG_ProbeDataReportMessage (PDR)

Use: Refer to SAE J2945/C.

5.15 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) V2X devices to collect vehicle traveling behaviors along a segment of road. The exchange of this message, as well as the event which caused the collection of various elements defined in the message, is defined elsewhere. In typical use, the reporting vehicle has collected one or more snapshots which it will send to RSUs along with information (the vector) about the point in time and space when the snapshot event occurred. Because snapshots within a limited range of time and space are related, some data compression is used in the message to reduce redundant information.

Note that the PVD message will remain in J2735, but it will not be further revised. PDV-related functionality can be migrated to the newer Probe Data Report message as defined in SAE J2945/C.

ASN.1 Representation:

```
ProbeVehicleData ::= SEQUENCE {
    timeStamp          MinuteOfTheYear OPTIONAL,
    segNum             ProbeSegmentNumber OPTIONAL,
                                -- a short term Ident value
                                -- not used when ident is used
    probeID            VehicleIdent OPTIONAL,
                                -- identity data for selected
                                -- types of vehicles
    startVector        FullPositionVector, -- the space and time of
                                -- transmission to the RSU
    vehicleType        VehicleClassification, -- type of vehicle,
    snapshots          SEQUENCE (SIZE(1..32)) OF Snapshot,
                                -- a seq of name-value pairs
                                -- along with the space and time
                                -- of the first measurement set
    regional           SEQUENCE (SIZE(1..4)) OF
                        RegionalExtension {{Reg-ProbeVehicleData}} OPTIONAL,
    ...
}
```

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

Remarks: Builders are urged to follow SAE J2945/C for implementation of Probe Data.

5.16 Message: MSG_RoadGeometryAndAttributes (RGA)

Use: Reserved for future use.

5.17 Message: MSG_RoadSafetyMessage (RSM)

Use: Reserved for future use.

5.18 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 via V2X, this message provides simple alerts to travelers (both in vehicle and 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 expected to be most frequently used.

This message is for alerting about 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 it is neither a requirement to receive and understand these messages, nor is having a local base map.

The position section of the message gives a simple 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 information 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 J2540-2 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 is explained in the other supporting ATISmessages, and a linkage value is given when it is available.

ASN.1 Representation:

```
RoadSideAlert ::= SEQUENCE {
    msgCnt          MsgCount,
    timeStamp       MinuteOfTheYear OPTIONAL,
    typeEvent       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
    description      SEQUENCE (SIZE(1..8)) OF ITIScodes OPTIONAL,
                    -- up to eight ITIS code set entries to further
                    -- describe the event, give advice, or any
                    -- other ITIS codes
    priority         Priority OPTIONAL,
                    -- the urgency of this message, a relative
                    -- degree of merit compared with other
                    -- similar messages for this type (not other
                    -- messages being sent by the device), nor a
                    -- priority of display urgency
    heading          HeadingSlice OPTIONAL,
                    -- Applicable headings/direction
    extent           Extent OPTIONAL,
                    -- the spatial distance over which this
                    -- message applies and should be presented
                    -- to the driver
    position         FullPositionVector OPTIONAL,
                    -- a compact summary of the position,
                    -- heading, speed, etc. of the
                    -- event in question. Including stationary
```

```

-- and wide area events.
furtherInfoID FurtherInfoID OPTIONAL,
-- an index link to any other incident
-- information data that may be available
-- in the normal ATIS incident description
-- or other messages
-- 1~2 octets in length
regional SEQUENCE (SIZE(1..4)) OF
RegionalExtension {{Reg-RoadSideAlert}} OPTIONAL,
...
}

```

Used By: This entry is directly used by the following two other data structures in this standard:

MSG [MSG_EmergencyVehicleAlert \(EVA\)](#) [<ASN>](#), and

MSG [MSG_MessageFrame \(FRAME\)](#) [<ASN>](#).

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

Remarks: This message is also used as a building block for other V2X messages. When used in other public safety messages, additional elements may be appended to form new message types.

5.19 Message: MSG_RoadWeatherMessage (RWM)

Use: Refer to SAE J2945/3.

5.20 Message: MSG_RTCMcorrections (RTCM)

Use: The RTCM Corrections message is used to encapsulate RTCM differential corrections for GNSS and other radio navigation signals as defined by the RTCM (Radio Technical Commission for Maritime Services) special committee number 104 in its various standards.

ASN.1 Representation:

```

RTCMcorrections ::= SEQUENCE {
    msgCnt      MsgCount,
    rev         RTCM-Revision,
               -- the specific edition of the standard
               -- that is being sent
    timeStamp   MinuteOfTheYear OPTIONAL,

    -- Observer position, if needed
    anchorPoint FullPositionVector OPTIONAL,
    -- Precise ant position and noise data for a rover
    rtcHeader   RTCMheader OPTIONAL,

    -- one or more RTCM messages
    msgs        RTCMmessageList,
    regional    SEQUENCE (SIZE(1..4)) OF
                RegionalExtension {{Reg-RTCMcorrections}} OPTIONAL,
    ...
}

```

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

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.

5.21 Message: MSG_SensorDataSharingMessage (SDSM)

Use: Reserved for future use.

5.22 Message: MSG_SignalControlAndPrioritizationRequest (SCPR)

Use: Reserved for future use.

5.23 Message: MSG_SignalControlAndPrioritizationStatus (SCPS)

Use: Reserved for future use.

5.24 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 (SSM).

ASN.1 Representation:

```
SPAT ::= SEQUENCE {
    timeStamp      MinuteOfTheYear 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       SEQUENCE (SIZE(1..4)) OF
                  RegionalExtension {{Reg-SPAT}} OPTIONAL,
    ...
}
```

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

5.25 Message: MSG_SignalRequestMessage (SRM)

Use: The signal request message (SRM) is a message sent by a V2X-equipped entity (such as 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 each request is set. Each request defines a path through the intersection which is desired in terms of lanes and approaches to be used. Each request can also contain the time of arrival and the expected duration of the service. Multiple requests to multiple intersections are supported. The requestor identifies itself in various ways (using methods supported by the RequestorDescription data frame), and its current speed, heading, and location can be placed in this structure as well. The specific request for service is typically based on previously decoding and examining the list of lanes and approaches for that intersection (sent in 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:

```
SignalRequestMessage ::= SEQUENCE {
    timeStamp      MinuteOfTheYear  OPTIONAL,
    second         DSecond,
    sequenceNumber MsgCount          OPTIONAL,

    requests       SignalRequestList OPTIONAL,
    -- Request Data for one or more signalized
    -- intersections that support SRM dialogs

    requestor      RequestorDescription,
    -- Requesting Device and other User Data
    -- contains vehicle ID (if from a vehicle)
    -- as well as type data and current position
    -- and may contain additional transit data

    regional       SEQUENCE (SIZE(1..4)) OF
    RegionalExtension {{Reg-SignalRequestMessage}} OPTIONAL,
    ...
}
```

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

5.26 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 the collection of pending or active preemption or priority requests acknowledged by the controller. It is also used to send information about preemption or priority requests which were denied. This in turn allows a dialog acknowledgment mechanism between any requester and the signal controller. The data contained in this message allows other users to determine their “ranking” for any request they have made as well as to see the currently active events. When there have been no recently received requests for service messages, this message may not be sent. While the outcome of all pending requests to a signal can be found in the signal status message, the current active event (if any) will be reflected in the SPAT message contents.

ASN.1 Representation:

```
SignalStatusMessage ::= SEQUENCE {
    timeStamp      MinuteOfTheYear  OPTIONAL,
    second         DSecond,
    sequenceNumber MsgCount          OPTIONAL,

    -- Status Data for one of more signalized intersections
    status         SignalStatusList,

    regional       SEQUENCE (SIZE(1..4)) OF
    RegionalExtension {{Reg-SignalStatusMessage}} OPTIONAL,
    ...
}
```

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

5.27 Message: MSG_TollAdvertisementMessage (TAM)

Use: Refer to SAE J3217.

5.28 Message: MSG_TollUsageAckMessage (TUMack)

Use: Refer to SAE J3217.

5.29 Message: MSG_TollUsageMessage (TUM)

Use: Refer to SAE J3217.

5.30 Message: MSG_TrafficSignalPhaseAndTiming (TSPaT)

Use: Reserved for future use.

5.31 Message: MSG_TravelerInformation Message (TIM)

Use: The traveler information message is used to send various types of information (advisory and road sign types) to equipped devices. 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 octets 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 one of the systems of short defined regions, similar to the way roadway geometry is defined in the MAP messages.

ASN.1 Representation:

```

TravelerInformation ::= SEQUENCE {
    msgCnt      MsgCount,
    timeStamp   MinuteOfTheYear OPTIONAL,
    packetID    UniqueMSGID      OPTIONAL,
    urlB        URL-Base          OPTIONAL,

    -- A set of one or more self contained
    -- traveler information messages (frames)
    dataFrames  TravelerDataFrameList,

    regional    SEQUENCE (SIZE(1..4)) OF
                  RegionalExtension {{Reg-TravelerInformation}} OPTIONAL,
    ...
}

```

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

5.32 Message: MSG_TestMessages

Use: The set of TestMessage messages are used to provide expandable messages for local and regional deployment use. This is intended to support the development new message and information exchanges of their own within the common framework of the overall V2X message set and this data dictionary. A few common data elements are provided for consistency, while the remainder of the message content can be defined by the developer using the normal regional methods. It is anticipated that over time the concepts developed in these messages will migrate into the data dictionary and message set itself.

ASN.1 Representation:

```

TestMessage00 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage00}} OPTIONAL,
    ...
}

TestMessage01 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage01}} OPTIONAL,
    ...
}

TestMessage02 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage02}} OPTIONAL,
    ...
}

TestMessage03 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage03}} OPTIONAL,
    ...
}

TestMessage04 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage04}} OPTIONAL,
    ...
}

TestMessage05 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage05}} OPTIONAL,
    ...
}

TestMessage06 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage06}} OPTIONAL,
    ...
}

TestMessage07 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage07}} OPTIONAL,
    ...
}

TestMessage08 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage08}} OPTIONAL,
    ...
}

TestMessage09 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage09}} OPTIONAL,
    ...
}

```

```

TestMessage10 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage10}} OPTIONAL,
    ...
}
TestMessage11 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage11}} OPTIONAL,
    ...
}
TestMessage12 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage12}} OPTIONAL,
    ...
}
TestMessage13 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage13}} OPTIONAL,
    ...
}
TestMessage14 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage14}} OPTIONAL,
    ...
}
TestMessage15 ::= SEQUENCE {
    header      Header      OPTIONAL,
    regional    RegionalExtension {{Reg-TestMessage15}} OPTIONAL,
    ...
}

```

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

Remarks: Note that developers are free to create sub-message types within each defined message, but that no further top level messages will be created. Note that this message set data dictionary provides no coordination between different regional deployments. The possibility of message structure conflict due to overlapping regions is left to the developers to detect and resolve. Like all messages defined in this standard, the end receiver device is under no obligation to decode or understand any message where the internal content is not known. However, such reception shall not cause other functionality in the device to break. This is simply a restatement of the conformance rules expressed elsewhere applied to this type of message.

6. DATA FRAMES

This section defines the precise structure of data frames defined by this standard.

6.1 Data Frame: DF_AccelerationSet4Way

Use: This data frame is a set of acceleration values in three orthogonal directions of the vehicle and with yaw rotation rates, expressed as a structure. 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 downward with the zero point at the bottom of the vehicle’s tires. The frame of reference and axis of rotation used shall be accordance with that defined in Section 11 of this standard.

ASN.1 Representation:

```

AccelerationSet4Way ::= SEQUENCE {
    long Acceleration,           -- Along the Vehicle Longitudinal axis
    lat  Acceleration,           -- Along the Vehicle Lateral axis
    vert VerticalAcceleration,    -- Along the Vehicle Vertical axis
    yaw  YawRate
}

```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_BSMcoreData | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> , and |
| MSG | MSG_PersonalSafetyMessage (PSM) | <ASN> . |

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

6.2 Data Frame: DF_AccelSteerYawRateConfidence

Use: The DF_AccelSteerYawRateConfidence data frame combines multiple related values.

ASN.1 Representation:

```

AccelSteerYawRateConfidence ::= SEQUENCE {
    yawRate           YawRateConfidence,
    acceleration      AccelerationConfidence,
    steeringWheelAngle SteeringWheelAngleConfidence
}

```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_ConfidenceSet](#) [<ASN>](#). 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 Section 11 for converting and translating speed
    -- expressed in mph into units of m/s
    -- This element is optional ONLY when superceded
    -- by the presence of a regional speed element found in
    -- Reg-AdvisorySpeed entry
    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
}

```

```

    regional    SEQUENCE (SIZE(1..4)) OF
                RegionalExtension {{Reg-AdvisorySpeed}} OPTIONAL,
    ...
}

```

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](#) <ASN>. In addition, this item may be used by data structures in other ITS standards.

6.5 Data Frame: DF_AntennaOffsetSet

Use: The DF_AntennaOffsetSet data frame is a collection of three offset values in an orthogonal coordinate system which describe how far the electrical phase center of an antenna is in each axis from a nearby known anchor point in units of 1 cm. When the antenna being described is on a vehicle, the signed offset shall be in the coordinate system defined in 11.4.

ASN.1 Representation:

```

AntennaOffsetSet ::= SEQUENCE {
    antOffsetX Offset-B12, -- a range of +- 20.47 meters
    antOffsetY Offset-B09, -- a range of +- 2.55 meters
    antOffsetZ Offset-B10 -- a range of +- 5.11 meters
}

```

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

Remarks: In the prior editions of the standard (pre-2015), this was constructed as a BLOB; it has now been converted for UPER use and the ranges reset to conserve bits.

6.6 Data Frame: DF_ApproachOrLane

Use: The ApproachOrLane data frame is used to indicate a single approach or lane of interest. A typical use case would be to relate where a vehicle was located with respect to the indexing system used in a V2X map. Under many operational conditions the precise lane may be unknown, and it is typical to then indicate the approach. (The relationship between lane indexes and approach indexes is defined in the map.) A value of zero is used when the lane or approach is unknown. See the entries for each data concept for further details.

ASN.1 Representation:

```

ApproachOrLane ::= CHOICE {
    approach ApproachID,
    lane LaneID
}

```

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

6.7 Data Frame: DF_AspphaltOrTar

Use: Indicates the type of asphalt or tar. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```
AsphaltOrTar ::= SEQUENCE {
    type      AsphaltOrTarType,
    ...
}
```

Used By: This entry is directly used by the following data structure in this standard:

DF [DF_DescriptionOfRoadSurface](#) [<ASN>](#).

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

6.8 Data Frame: DF_Axles

Use: The Axles data frame is used to indicate the axle configuration of a vehicle or a trailer.

ASN.1 Representation:

```
Axles ::= SEQUENCE {
    -- In the following, the value 10 indicates 10 or more axles
    totalAxles    INTEGER (1..10, ...),
    frontAxles    INTEGER (0..10, ...)    OPTIONAL,
    rearAxles     INTEGER (0..10, ...)    OPTIONAL,
    ...
}
```

Used By: This data frame is used by [DF_VehicleData](#) and [DF_TrailerUnitDescJ2945Slash1B](#).

6.9 Data Frame: 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. The structure consists of a sequence of items which provide status flags for any active brakes per wheel, 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 ::= SEQUENCE {
    wheelBrakes    BrakeAppliedStatus,
    traction       TractionControlStatus,
    abs            AntiLockBrakeStatus,
    scs            StabilityControlStatus,
    brakeBoost     BrakeBoostApplied,
    auxBrakes      AuxiliaryBrakeStatus
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_BSMcoreData](#) [<ASN>](#), and

DF [DF_VehicleStatus](#) [<ASN>](#).

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.

6.10 Data Frame: DF_BSMcoreData

Use: The DF_BSMcoreData data frame contains the critical core data elements deemed to be needed with every BSM issued. This data frame's contents are often referred to as the "BSM Part One," although it is reused in other places as well.

ASN.1 Representation:

```
BSMcoreData ::= SEQUENCE {
    msgCnt      MsgCount,
    id          TemporaryID,
    secMark     DSecond,
    lat         Latitude,
    long        Longitude,
    elev        Elevation,
    accuracy    PositionalAccuracy,
    transmission TransmissionState,
    speed       Speed,
    heading     Heading,
    angle       SteeringWheelAngle,
    accelSet    AccelerationSet4Way,
    brakes      BrakeSystemStatus,
    size        VehicleSize
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|-----|--|-----------------------------------|
| MSG | MSG_BasicSafetyMessage (BSM) | <ASN> , and |
| MSG | MSG_IntersectionCollisionAvoidance (ICA) | <ASN> . |

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

6.11 Data Frame: DF_BumperHeights

Use: The DF Bumper Heights data frame conveys the height of the front and rear bumper of the vehicle or object (can also be used with trailers).

ASN.1 Representation:

```
BumperHeights ::= SEQUENCE {
    front      BumperHeight,
    rear       BumperHeight
}
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|---|-----------------------------------|
| DF | DF_TrailerUnitDescription | <ASN> , and |
| DF | DF_VehicleData | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> . |

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

6.12 Data Frame: DF_Cinders

Use: Indicates the type of cinders. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```
Cinders ::= SEQUENCE {
    type      CindersType,
    ...
}
```

Used By: This entry is directly used by the following data structure in this standard:

DF [DF_DescriptionOfRoadSurface](#) [<ASN>](#).

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

6.13 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    Radius-B12,
    units     DistanceUnits
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_GeometricProjection](#) [<ASN>](#), and

DF [DF_ValidRegion](#) [<ASN>](#).

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.

6.14 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
                        },
                        -- A path X offset value for translations of the
                        -- path's points when creating 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
                        -- initial path 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.
                        -- Rotation occurs about the initial path point.
    -- 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 or contracted based on the X
                        -- and Y and width values from the coordinates of
                        -- the reference lane's initial path point.
                        -- The Z axis remains untouched.
    regional              SEQUENCE (SIZE(1..4)) OF
                        RegionalExtension {{Reg-ComputedLane}} OPTIONAL,
    ...
}

```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF NodeListXY](#) <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). The order of the transformations shall be: the east-west and north-south offsets, the scaling factors, and finally the rotation.

6.15 Data Frame: DF_ConfidenceSet

Use: A set of various measurement confidence values about the vehicle or a moving V2X object.

ASN.1 Representation:

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

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

6.16 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.

6.17 Data Frame: DF_Connection

Use: The Connection data structure is used in the ConnectsToList 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 no 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

    -- 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.

6.18 Data Frame: DF_ConnectionManeuverAssist

Use: The ConnectionManeuverAssist data frame contains information about 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.

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
                           -- connecting 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              SEQUENCE (SIZE(1..4)) OF
                           RegionalExtension {{Reg-ConnectionManeuverAssist}} OPTIONAL,
    ...
}

```

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

6.19 Data Frame: DF_ConnectsToList

Use: The ConnectsToList data structure is used in the generic lane descriptions to provide a sequence of other defined lanes to which each lane connects beyond its stop point. See the Connection data frame entry for details. Note that this data frame 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](#) <ASN>. In addition, this item may be used by data structures in other ITS standards.

Remarks: The assignment of lanes in the connection 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.

6.20 Data Frame: DF_DataParameters

Use: The DataParameters data 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,
    ...
}
```

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.

6.21 Data Frame: DF_DDate

Use: The V2X 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,
    month     DMonth,
    day       DDay
}
```

6.22 Data Frame: DF_DDateTime

Use: The V2X 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,
    month     DMonth     OPTIONAL,
    day       DDay       OPTIONAL,
    hour      DHour      OPTIONAL,
    minute    DMinute    OPTIONAL,
    second    DSecond    OPTIONAL,
    offset    DOffset    OPTIONAL -- time zone
}
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|---------------------------------------|-----------------------------------|
| DF | DF_FullPositionVector | <ASN> , and |
| DF | DF_ObstacleDetection | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> . |

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.

6.23 Data Frame: DF_DescriptionOfRoadSurface

Use: Indicates the composition of the surface of the roadway for use in estimation of friction. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```

DescriptionOfRoadSurface ::= CHOICE {
    portlandCement    PortlandCement,
    asphaltOrTar      AsphaltOrTar,
    gravel            Gravel,
    grass             Grass,
    cinders           Cinders,
    rock              Rock,
    ice               Ice,
    snow              Snow,
    ...
}

```

Used By: This entry is directly used by the following data structure in this standard:

| | | |
|----|--|-------------------------------|
| DF | DF_FrictionInformation | <ASN> . |
|----|--|-------------------------------|

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

6.24 Data Frame: DF_DFullTime

Use: The V2X 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,
    month     DMonth,
    day       DDay,
    hour      DHour,
    minute    DMinute
}

```

6.25 Data Frame: DF_DMonthDay

Use: The V2X 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,
    day      DDay
}

```

6.26 Data Frame: DF_DTime

Use: The V2X 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. In V2X applications, there is no need to send the offset representing the local time zone, so the most common representation for the data frame occupies four payload octets and provides a resolution of 1 ms over a range of 1 day.

ASN.1 Representation:

```

DTime ::= SEQUENCE {
    hour      DHour,
    minute    DMinute,
    second    DSecond,
    offset    DOffset OPTIONAL -- time zone
}

```

6.27 Data Frame: DF_DYearMonth

Use: The V2X 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,
    month     DMonth
}

```

6.28 Data Frame: DF_DisabledVehicle

Use: The DF_DisabledVehicle data frame provides a means for a vehicle (or other equipped device) to describe its operational status and gross location to others using a subset of the ITIS codes. This data frame is most typically used to send information about a disabled vehicle to others. The vehicle's various classification values are handled by other data elements found in the BSM Part II content.

ASN.1 Representation:

```

DisabledVehicle ::= SEQUENCE {
    statusDetails    ITIScodes(523..541),
                    -- Codes 532 to 541, as taken from J2540:
                    -- Disabled, etc.
                    -- stalled-vehicle (532),
                    -- abandoned-vehicle (533),
                    -- disabled-vehicle (534),
                    -- disabled-truck (535),
                    -- disabled-semi-trailer (536), -- Alt: disabled
                    -- tractor-trailer
                    -- disabled-bus (537),
                    -- disabled-train (538),
                    -- vehicle-spun-out (539),
                    -- vehicle-on-fire (540),
                    -- vehicle-in-water (541),
    locationDetails  GenericLocations OPTIONAL,
    ...
}

```

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

6.29 Data Frame: DF_EmergencyDetails

Use: The EmergencyDetails data element combines several bit level items into a structure for efficient transmission about the vehicle during a response call.

ASN.1 Representation:

```
EmergencyDetails ::= SEQUENCE {
    notUsed      SSPindex,
    -- always set to 0 and carries no meaning;
    -- legacy field maintained for backward compatibility
    sirenUse     SirenInUse,
    lightsUse    LightbarInUse,
    multi        MultiVehicleResponse,
    events       PrivilegedEvents OPTIONAL,
    responseType ResponseType OPTIONAL,
    ...
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_SpecialVehicleExtensions | <ASN> , and |
| MSG | MSG_EmergencyVehicleAlert (EVA) | <ASN> . |

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

6.30 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](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

6.31 Data Frame: DF_EventDescription

Use: The EventDescription data frame provides a short summary of an event or incident. It is used by a sending device (often a public safety vehicle) to inform nearby equipped devices about an event or about the driving action the sending device is taking or is about to take. Typical use cases include such concepts as a slow moving vehicle as well as fire/police movement with flashing light details.

ASN.1 Representation:

```

EventDescription ::= SEQUENCE {
    typeEvent      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
    description    SEQUENCE (SIZE(1..8)) OF ITIScodes OPTIONAL,
                  -- Up to eight ITIS code set entries to further
                  -- describe the event, give advice, or any
                  -- other ITIS codes
    priority       Priority OPTIONAL,
                  -- The urgency of this message, a relative
                  -- degree of merit compared with other
                  -- similar messages for this type (not other
                  -- messages being sent by the device), nor
                  -- is it a priority of display urgency
    heading        HeadingSlice OPTIONAL,
                  -- Applicable headings/direction
    extent         Extent OPTIONAL,
                  -- The spatial distance over which this
                  -- message applies and should be presented to the driver
    regional       SEQUENCE (SIZE(1..4)) OF
                  RegionalExtension {{Reg-EventDescription}} OPTIONAL,
    ...
}

```

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

6.32 Data Frame: DF_FrictionInformation

Use: This DF provides information that allows a vehicle to estimate friction based on its own characteristics as well as the characteristics of the roadway.

ASN.1 Representation:

```

FrictionInformation ::= SEQUENCE {
    roadSurfaceDescription    DescriptionOfRoadSurface,
    dryOrWet                  RoadSurfaceCondition    OPTIONAL,
    roadRoughness             RoadRoughness           OPTIONAL,
    ...
}

```

Used By: This entry is directly used by the following data structures in this standard:

DF [DF_TravelerDataFrameNewPartIIIContent](#) <ASN>

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

6.33 Data Frame: DF_FullPositionVector

Use: A complete report of the vehicle's position, speed, and heading at 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,    -- units of 0.1 m
    heading          Heading OPTIONAL,
    speed            TransmissionAndSpeed OPTIONAL,
    posAccuracy      PositionalAccuracy OPTIONAL,
    timeConfidence   TimeConfidence OPTIONAL,
    posConfidence    PositionConfidenceSet OPTIONAL,
    speedConfidence  SpeedandHeadingandThrottleConfidence OPTIONAL,
    ...
}

```

Used By: This entry is directly used by the following six other data structures in this standard:

| | | |
|-----|--|-----------------------------------|
| DF | DF_PathHistory | <ASN> , and |
| DF | DF_Snapshot | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> , and |
| MSG | MSG_ProbeVehicleData (PVD) | <ASN> , and |
| MSG | MSG_RoadSideAlert (RSA) | <ASN> , and |
| MSG | MSG_RTCMcorrections (RTCM) | <ASN> . |

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

Remarks: In the 2006 edition of the standard, the first 2 octets were a DSecond followed by DFullTime in 6 octets. This produced a complete time value in 8 octets. In the 2009 edition (and reaffirmed in the 2015 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 or in XML.

6.34 Data Frame: DF_GenericLane

Use: The GenericLane data frame is used for all types of lanes, e.g., motorized vehicle lanes, crosswalks, medians. 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.

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        NodeListXY,
                    -- 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 formerly 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. An overlay
                    -- for one lane can be applied to parallel lanes
                    -- without repeating OverlayLaneList for each GenericLane
                    -- entry.

    regional        SEQUENCE (SIZE(1..4)) OF
                    RegionalExtension {{Reg-GenericLane}} OPTIONAL,
    ...
}

```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|------------------------------------|-----------------------------------|
| DF | DF LaneList | <ASN> , and |
| DF | DF RoadLaneSetList | <ASN> . |

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

Remarks: In the 2009 version of this standard, each lane type was specified in a distinct data frame, and there was no GenericLane data frame.

6.35 Data Frame: DF_GeographicalPath

Use: The DF_GeographicalPath data frame is used to support the cross-cutting need in many V2X messages to describe arbitrary spatial areas (polygons, boundary lines, and other basic shapes) required by various message types in a small message size. This data frame can describe a complex path or region of arbitrary size using either one of the two supported node offset methods (XY offsets or LL offsets) or using simple geometric projections. Both open and closed paths are supported, as well as a simple index and naming methodology.

ASN.1 Representation:

```
GeographicalPath ::= SEQUENCE {
    name                DescriptiveName                OPTIONAL,
    id                  RoadSegmentReferenceID          OPTIONAL,
    anchor              Position3D                      OPTIONAL,
    laneWidth           LaneWidth                      OPTIONAL,
    directionality      DirectionOfUse                  OPTIONAL,
    closedPath          BOOLEAN                        OPTIONAL,
    -- when true, last point closes to first
    direction           HeadingSlice                  OPTIONAL,
    -- field of view over which this applies
    description CHOICE {
        path            OffsetSystem,
        -- The XYZ and LLH system of paths
        geometry         GeometricProjection,
        -- A projected circle from a point
        oldRegion        ValidRegion,
        -- Legacy method, no longer recommended for use
        ...
    } OPTIONAL,

    regional            SEQUENCE (SIZE(1..4)) OF
        RegionalExtension {{Reg-GeographicalPath}} OPTIONAL,
    ...
}
```

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

6.36 Data Frame: DF_GeometricProjection

Use: The DF_GeometricProjection data frame is used to describe various geometric spatial areas (circles and other basic shapes) required by various message types in a small message size.

ASN.1 Representation:

```
GeometricProjection ::= 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
    laneWidth           LaneWidth OPTIONAL, -- used when a width is needed
    circle              Circle, -- A point and radius

    regional            SEQUENCE (SIZE(1..4)) OF
        RegionalExtension {{Reg-GeometricProjection}} OPTIONAL,
    ...
}
```

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

6.37 Data Frame: DF_Grass

Use: Indicates the surface of the roadway is grass. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```
Grass ::= SEQUENCE {
    type      GrassType,
    ...
}
```

Used By: This entry is directly used by the following data structure in this standard:

DF [DF_DescriptionOfRoadSurface](#) [<ASN>](#).

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

6.38 Data Frame: DF_Gravel

Use: Indicates the surface of the roadway is gravel. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```
Gravel ::= SEQUENCE {
    type      GravelType,
    ...
}
```

Used By: This entry is directly used by the following data structure in this standard:

DF [DF_DescriptionOfRoadSurface](#) [<ASN>](#).

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

6.39 Data Frame: DF_Header

Use: The DF_Header data frame is a set of basic time and sequence values used at the start of each TestMessage to provide such values in a consistent way.

ASN.1 Representation:

```
Header ::= SEQUENCE {
    -- Basic time and sequence values for the message
    year          DYear          OPTIONAL,
    timeStamp     MinuteOfTheYear OPTIONAL,
    secMark       DSecond        OPTIONAL,
    msgIssueRevision MsgCount    OPTIONAL,
    ...
}
```

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

6.40 Data Frame: DF_Ice

Use: Indicates the surface of the roadway is ice. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```
Ice ::= SEQUENCE {
    type      IceType,
    ...
}
```

Used By: This entry is directly used by the following data structure in this standard:

DF [DF_DescriptionOfRoadSurface](#) [<ASN>](#).

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

6.41 Data Frame: DF_IntersectionAccessPoint

Use: The IntersectionAccessPoint data frame is used to specify the index of either a single approach or a single lane at which a service is needed. This is used, for example, with the signal request message (SRM) to indicate the inbound and outbound points by which the requestor (such as a public safety vehicle) can traverse an intersection.

ASN.1 Representation:

```
IntersectionAccessPoint ::= CHOICE {
    lane      LaneID,
    approach  ApproachID,
    connection LaneConnectionID,
    ...
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_SignalRequest](#) [<ASN>](#), and

DF [DF_SignalStatusPackage](#) [<ASN>](#).

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

Remarks: Note that the value of zero has a reserved meaning for these two indexing systems. In both cases, this value is used to indicate the concept of “none” in use. When the value is of zero is used here, it implies the center of the intersection itself. For example, requesting an outbound point of zero implies the requestor wishes to have the intersection itself be the destination. Alternatively, an inbound value of zero implies the requestor is within the intersection itself and wishes to depart for the outbound value provided. This special meaning for the value zero can be used in either the lane or approach with the same results.

6.42 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,
                    -- A globally unique value set,
                    -- consisting of a regionID and
                    -- intersection ID assignment
    revision      MsgCount,

    -- Required default values about lane descriptions follow
    refPoint      Position3D, -- 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 Section 11 for converting and
                    -- translating speed expressed in mph
                    -- into units of 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 Additional 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      SEQUENCE (SIZE(1..4)) OF
                    RegionalExtension {{Reg-IntersectionGeometry}} OPTIONAL,
    ...,
    roadAuthorityID RoadAuthorityID OPTIONAL
    -- Mandatory if roadRegulatorID is set to 0
}

```

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 value that a vehicle would use when making a request.

6.43 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.

6.44 Data Frame: DF_IntersectionReferenceID

Use: The IntersectionReferenceID data frame conveys the combination of an optional RoadRegulatorID and of an IntersectionID that is unique within that region. When the RoadRegulatorID 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 six other data structures in this standard:

| | | |
|-----|--|-----------------------------------|
| DF | DF Connection | <ASN> , and |
| DF | DF IntersectionGeometry | <ASN> , and |
| DF | DF IntersectionState | <ASN> , and |
| DF | DF SignalRequest | <ASN> , and |
| DF | DF SignalStatus | <ASN> , and |
| MSG | MSG IntersectionCollisionAvoidance (ICA) | <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 RoadRegulatorID). Taken together, these form a unique value which is never repeated.

6.45 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      DSecond 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
               -- may contain both active and future states
maneuverAssistList ManeuverAssistList OPTIONAL,
               -- Assist data

regional       SEQUENCE (SIZE(1..4)) OF
               RegionalExtension {{Reg-IntersectionState}} OPTIONAL,
... ,
roadAuthorityID RoadAuthorityID OPTIONAL
-- Mandatory if roadRegulatorID is set to 0
}

```

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.

6.46 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.

6.47 Data Frame: DF_ITIS_Phase_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 than the normal ITIS format in order to conserve bandwidth. All ITIS phrase data, when encoded in a DER or UPER form, shall be expressed as integer values rather than their full text equivalents.

ASN.1 Representation:

```
ExitService ::= SEQUENCE (SIZE(1..16)) OF SEQUENCE {
  item CHOICE {
    itis ITIScodes,
    text ITIS textPhrase
  }
}
```

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

6.48 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 than the normal ITIS format in order to conserve bandwidth. All ITIS phrase data, when encoded in a DER or UPER form, shall be expressed as integer values rather than their full text equivalents.

ASN.1 Representation:

```
GenericSignage ::= SEQUENCE (SIZE(1..16)) OF SEQUENCE {
    item CHOICE {
        itis     ITIScodes,
        text     ITIS textPhrase
    }
}
```

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

6.49 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 than the normal ITIS format in order to conserve bandwidth. All ITIS phrase data, when encoded in a DER or UPER form, shall be expressed as integer values rather than their full text equivalents.

ASN.1 Representation:

```
SpeedLimit ::= SEQUENCE (SIZE(1..16)) OF SEQUENCE {
    item CHOICE {
        itis     ITIScodes,
        text     ITIS textPhrase
    }
}
```

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

6.50 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 than the normal ITIS format in order to conserve bandwidth. All ITIS phrase data, when encoded using UPER, shall be expressed as integer values rather than their full text equivalents.

ASN.1 Representation:

```
WorkZone ::= SEQUENCE (SIZE(1..16)) OF SEQUENCE {
    item CHOICE {
        itis     ITIScodes,
        text     ITIS textPhrase
    }
}
```

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

6.51 Data Frame: DF_J1939-Data Items

Use: This data frame used to send various SAE J1939 defined data elements from the vehicle.

ASN.1 Representation:

```

J1939data ::= SEQUENCE {
    -- Tire conditions by tire
    tires                TireDataList                OPTIONAL,
    -- Vehicle Weights by axle
    axles                AxleWeightList              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,
    ...
}

TireDataList ::= SEQUENCE (SIZE(1..16)) OF TireData

TireData ::= SEQUENCE {
    location              TireLocation                OPTIONAL,
    pressure              TirePressure                OPTIONAL,
    temp                  TireTemp                    OPTIONAL,
    wheelSensorStatus     WheelSensorStatus            OPTIONAL,
    wheelEndElectFault    WheelEndElectFault            OPTIONAL,
    leakageRate           TireLeakageRate              OPTIONAL,
    detection             TirePressureThresholdDetection OPTIONAL,
    ...
}

AxleWeightList ::= SEQUENCE (SIZE(1..16)) OF AxleWeightSet

AxleWeightSet ::= SEQUENCE {
    location              AxleLocation                OPTIONAL,
    weight                AxleWeight                  OPTIONAL,
    ...
}

```

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

6.52 Data Frame: DF_LaneAttributes

Use: The DF_LaneAttributes 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 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      RegionalExtension {{Reg-LaneAttributes}} OPTIONAL
}

```

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

6.53 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

    -- Add others as needed, in regional space
}

```

```

    regional SEQUENCE (SIZE(1..4)) OF
        RegionalExtension {{Reg-LaneDataAttribute}},
    ...
}

```

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. Re-using a lane path (previously called a computed lane) is another example. In this case the reference lane to be re-used 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.

6.54 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 directly used by the following two other data structures in this standard:

| | | |
|----|---------------------------------------|-----------------------------------|
| DF | DF_NodeAttributeSetLL | <ASN> , and |
| DF | DF_NodeAttributeSetXY | <ASN> . |

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

6.55 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](#) <ASN>. In addition, this item may be used by data structures in other ITS standards.

6.56 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 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
    ...
}

```

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.

6.57 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 two other data structures in this standard:

DF [DF IntersectionState](#) [<ASN>](#), and

DF [DF MovementState](#) [<ASN>](#).

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

6.58 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.

6.59 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 SignalGroupID.

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 Section 11 for converting and translating
-- speed expressed in mph into units of m/s

regional      SEQUENCE (SIZE(1..4)) OF
               RegionalExtension {{Reg-MovementEvent}} OPTIONAL,
...
}

```

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.

6.60 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](#) <ASN>. In addition, this item may be used by data structures in other ITS standards.

6.61 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          SEQUENCE (SIZE(1..4)) OF
                      RegionalExtension {{Reg-MovementState}} OPTIONAL,
    ...
}

```

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 time mark 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 SignalGroupID 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 U.S. deployments. Under such operating conditions, the unused phase states are simply skipped.

6.62 Data Frame: DF_Node_LL_24B

Use: A 24-bit node type with offset values from the last point in latitude and longitude form.

ASN.1 Representation:

```

Node-LL-24B ::= SEQUENCE {
    -- ranges of +- 0.0002047 degrees
    -- ranges of +- 22.634554 meters at the equator
    lon  OffsetLL-B12,
    lat  OffsetLL-B12
}

```

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

6.63 Data Frame: DF_Node_LL_28B

Use: A 28-bit node type with offset values from the last point in latitude and longitude form.

ASN.1 Representation:

```

Node-LL-28B ::= SEQUENCE {
    -- ranges of +- 0.0008191 degrees
    -- ranges of +- 90.571389 meters at the equator
    lon  OffsetLL-B14,
    lat  OffsetLL-B14
}

```

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

6.64 Data Frame: DF_Node_LL_32B

Use: A 32-bit node type with offset values from the last point in latitude and longitude form.

ASN.1 Representation:

```
Node-LL-32B ::= SEQUENCE {
    -- ranges of +- 0.0032767 degrees
    -- ranges of +- 362.31873 meters at the equator
    lon OffsetLL-B16,
    lat OffsetLL-B16
}
```

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

6.65 Data Frame: DF_Node_LL_36B

Use: A 36-bit node type with offset values from the last point in latitude and longitude form.

ASN.1 Representation:

```
Node-LL-36B ::= SEQUENCE {
    -- ranges of +- 0.0131071 degrees
    -- ranges of +- 01.449308 Kometers at the equator
    lon OffsetLL-B18,
    lat OffsetLL-B18
}
```

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

6.66 Data Frame: DF_Node_LL_44B

Use: A 44-bit node type with offset values from the last point in latitude and longitude form.

ASN.1 Representation:

```
Node-LL-44B ::= SEQUENCE {
    -- ranges of +- 0.2097151 degrees
    -- ranges of +- 23.189096 Kometers at the equator
    lon OffsetLL-B22,
    lat OffsetLL-B22
}
```

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

6.67 Data Frame: DF_Node_LL_48B

Use: A 48-bit node type with offset values from the last point in latitude and longitude form.

ASN.1 Representation:

```
Node-LL-48B ::= SEQUENCE {
    -- ranges of +- 0.8388607 degrees
    -- ranges of +- 92.756481 Kometers at the equator
    lon OffsetLL-B24,
    lat OffsetLL-B24
}
```


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

6.68 Data Frame: DF_Node_LLMd_64b

Use: A 64-bit node type with lat-long values expressed in standard SAE 1/10th of a microdegree.

ASN.1 Representation:

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

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_NodeOffsetPoint_LL](#) [<ASN>](#), and

DF [DF_NodeOffsetPointXY](#) [<ASN>](#).

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

6.69 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_NodeOffsetPointXY<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

6.70 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_NodeOffsetPointXY<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

6.71 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 directly used by the following three other data structures in this standard:

DF [DF_NodeOffsetPointXY](#) [<ASN>](#), and

DF [DF_TrailerHistoryPoint](#) [<ASN>](#), and

DF [DF_TrailerUnitDescription](#) [<ASN>](#).

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

6.72 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_NodeOffsetPointXY](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

6.73 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_NodeOffsetPointXY](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

6.74 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_NodeOffsetPointXY](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

6.75 Data Frame: DF_NodeAttributeLLList

Use: The NodeAttributeLLList data frame consists of a list of NodeAttributeLL entries.

ASN.1 Representation:

```
NodeAttributeLLList ::= SEQUENCE (SIZE(1..8)) OF NodeAttributeLL
```

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

6.76 Data Frame: DF_NodeAttributeSetLL

Use: The DF_NodeAttributeSetLL is a data frame used to convey one or more changes in the attribute set which occur 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:

```
NodeAttributeSetLL ::= SEQUENCE {
    localNode      NodeAttributeLLList OPTIONAL,
                    -- Attribute states which pertain to this node point
    disabled       SegmentAttributeLLList OPTIONAL,
                    -- Attribute states which are disabled at this node point
    enabled        SegmentAttributeLLList 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
    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 1 cm steps
                    -- elevations between nodes are a linear taper between pts
                    -- the value of zero shall not be sent here
    regional       SEQUENCE (SIZE(1..4)) OF
                    RegionalExtension {{Reg-NodeAttributeSetLL}} OPTIONAL,
    ...
}
```

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

Remarks: See also DF_NodeAttributeSetXY

6.77 Data Frame: DF_NodeAttributeSetXY

Use: The DF_NodeAttributeSetXY is a data frame used to convey one or more changes in the attribute set which occur 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:

```

NodeAttributeSetXY ::= SEQUENCE {
    localNode      NodeAttributeXYList OPTIONAL,
                    -- Attribute states which pertain to this node point
    disabled       SegmentAttributeXYList OPTIONAL,
                    -- Attribute states which are disabled at this node point
    enabled        SegmentAttributeXYList 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
    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
    regional       SEQUENCE (SIZE(1..4)) OF
                    RegionalExtension {{Reg-NodeAttributeSetXY}} OPTIONAL,
    ...
}

```

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

Remarks: See also DF_NodeAttributeSetLL.

6.78 Data Frame: DF_NodeAttributeXYList

Use: The NodeAttributeXYList data frame consists of a list of NodeAttributeXY entries.

ASN.1 Representation:

```

NodeAttributeXYList ::= SEQUENCE (SIZE(1..8)) OF NodeAttributeXY

```

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

6.79 Data Frame: DF_NodeListLL

Use: The NodeListLL data structure provides the sequence of signed offset node point values for determining the latitude and longitude (and possibly elevation above the ellipsoid when present) using the then current Position3D object to build a path for the centerline of the subject lane type. Each LL point is referred to as a node point. The straight line paths between these points are referred to as segments. Note that these offsets are straight with respect to the LLH coordinate system, not a localized XYZ coordinate system. All nodes may have various optional attributes, the state of which can vary along the path and which are enabled and disabled by the sequence of objects found in the list of node structures. See the explanatory text in Section 11 for a description of how to correctly encode and decode this type of the data element.

ASN.1 Representation:

```

NodeListLL ::= CHOICE {
    nodes      NodeSetLL,
               -- a path made up of two or more
               -- LL node points and any attributes
               -- defined in those nodes
               -- Additional choices will be added in time
    ...
}

```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_OffsetSystem](#) <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 anchor point, typically chosen as the beginning point of a roadway segment. Typically, this is located on the stop line for lanes and approaches. For general geometric description needs, the starting point may be chosen arbitrarily to simply bound a region of interest. Subsequent offsets then describe the path, using the current zoom scale in combination with the offsets. The last node point may imply that path returns to the original anchor point (hence describing a closed path) or not depending on the context in which it is used.

6.80 Data Frame: DF_NodeListXY

Use: The NodeListXY 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.

All nodes may have various optional attributes the state of which can vary along the path and which are enabled and disabled by the sequence of objects found in the list of node structures. See the explanatory text in Section 11 for a description of how to correctly encode and decode this type of the data element. 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 one 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:

```

NodeListXY ::= CHOICE {
    nodes      NodeSetXY,
               -- a lane made up of two or more
               -- XY 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 directly used by the following three other data structures in this standard:

| | | |
|----|----------------------------------|------------|
| DF | DF_GenericLane | <ASN>, and |
| DF | DF_OffsetSystem | <ASN>, and |
| DF | DF_ShapePointSet | <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.

6.81 Data Frame: DF_NodeLL

Use: The DF_NodeLL data frame presents a structure to hold data for a signal node point in a lane. Each selected node has a latitude and longitude offset from the prior node point (or a complete lat-long representation in some cases), as well as optional attribute information. A lane node list is made up of a sequence of these to describe the lane path.

ASN.1 Representation:

```
NodeLL ::= SEQUENCE {
    delta      NodeOffsetPointLL,
               -- A choice of which Lat,Lon offset value to use
               -- this includes various delta values as well a regional choices
    attributes NodeAttributeSetLL 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_NodeSetLL](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

6.82 Data Frame: DF_NodeOffsetPoint_LL

Use: The DF_NodeOffsetPointLL data frame presents a structure to hold different sized data frames for a single node geometry path. Nodes are described in terms of latitude and longitude offsets in units of 0.1 microdegrees (when the zoom scaling is set to 1:1). 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 or the required precision is less, the smaller entries can (and should) be chosen.

Each single selected node is computed as a latitude and longitude 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 should not be sent over the air due to its additional message payload size.

The general usage guidance is to construct the content of each lane node point with the smallest possible 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:

```
NodeOffsetPointLL ::= CHOICE {
    -- Nodes with LL content      Span at the equator when using a zoom of one:
    node-LL1      Node-LL-24B,      -- within +- 22.634554 meters of last node
    node-LL2      Node-LL-28B,      -- within +- 90.571389 meters of last node
    node-LL3      Node-LL-32B,      -- within +- 362.31873 meters of last node
    node-LL4      Node-LL-36B,      -- within +- 01.449308 Kmeters of last node
    node-LL5      Node-LL-44B,      -- within +- 23.189096 Kmeters of last node
    node-LL6      Node-LL-48B,      -- within +- 92.756481 Kmeters of last node
    node-LatLon    Node-LLmD-64b,    -- node is a full 32b Lat/Lon range
    regional      RegionalExtension {{Reg-NodeOffsetPointLL}}
               -- node which follows is of a
               -- regional definition type
}
```

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

6.83 Data Frame: DF_NodeOffsetPointXY

Use: The DF_NodeOffsetPointXY data frame presents a structure to hold different sized data frames for a single node point in a lane. Nodes are described in terms of X and Y offsets in units of 1 cm (when zoom is 1:1). 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 should not be sent over the air due to its additional message payload size.

The general usage guidance is to construct the content of each lane node point with the smallest possible 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:

```
NodeOffsetPointXY ::= 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
  regional      RegionalExtension {{Reg-NodeOffsetPointXY}}
  -- node which follows is of a
  -- regional definition type
}
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_NodeXY | <ASN> , and |
| DF | DF_REG_ConnectionManeuverAssist_EU | <ASN> , and |
| DF | DF_SignalHeadLocation_EU | <ASN> . |

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

Remarks: Was called NodeOffsetPoint in the April 2015 edition of the standard.

6.84 Data Frame: DF_NodeSetLL

Use: The NodeSetLL data frame consists of a list of NodeLL entries using LL offsets.

ASN.1 Representation:

```
NodeSetLL ::= SEQUENCE (SIZE(2..63)) OF NodeLL
```

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

6.85 Data Frame: DF_NodeSetXY

Use: The NodeSetXY data frame consists of a list of Node entries using XY offsets.

ASN.1 Representation:

```
NodeSetXY ::= SEQUENCE (SIZE(2..63)) OF NodeXY
```

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

6.86 Data Frame: DF_NodeXY

Use: The DF_NodeXY data frame presents a structure to hold data for a single node point in a path. 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. The node list for a lane (or other object) is made up of a sequence of these to describe the desired path. The X,Y points are selected to reflect the centerline of the path 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 a 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:

```
NodeXY ::= SEQUENCE {
    delta      NodeOffsetPointXY,
               -- A choice of which X,Y offset value to use
               -- this includes various delta values as well as regional choices
    attributes NodeAttributeSetXY 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_NodeSetXY](#) <ASN>. In addition, this item may be used by data structures in other ITS standards.

6.87 Data Frame: DF_ObstacleDetection

Use: The DF_ObstacleDetection data frame is used to relate basic location information about a detected obstacle or a road hazard in a vehicle's path.

ASN.1 Representation:

```
ObstacleDetection ::= SEQUENCE {
    obDist      ObstacleDistance,           -- Obstacle Distance
    obDirect    ObstacleDirection,         -- Obstacle Direction
    description  ITIScodes(523..541) OPTIONAL,
               -- Uses a limited set of ITIS codes
    locationDetails GenericLocations OPTIONAL,
    dateTime     DDateTime,                 -- Time detected
    vertEvent    VerticalAccelerationThreshold OPTIONAL,
               -- Any wheels which have
               -- exceeded the acceleration point
    ...
}
```


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

6.88 Data Frame: DF_OffsetSystem

Use: The DF_OffsetSystem data frame selects a sequence of node offsets described in either the X-Y offset method or the Lat-Long offset method. The sequence of node offsets then describes a path or polygon in the system selected. As a broad rule, the X-Y offset method is used to describe lanes, roadways, and intersections over smaller areas of interest where coordinate systems can be considered flat and orthogonal. This system also supports an attribute description process. The Lat-Long offset method is used for describing larger distance spans when the curvature of the earth's surface can be a factor that must be accounted for. Both systems use one of more anchor points expressed in 0.1 microdegree units of the WGS-84 coordinate systems.

ASN.1 Representation:

```
OffsetSystem ::= SEQUENCE {
    scale      Zoom OPTIONAL,
    offset     CHOICE {
        xy      NodeListXY, -- offsets of 1.0 centimeters
        ll      NodeListLL  -- offsets of 0.1 microdegrees
    }
}
```

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

6.89 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](#) <ASN>. In addition, this item may be used by data structures in other ITS standards.

6.90 Data Frame: DF_PathHistory

Use: The PathHistory data frame defines a geometric path reflecting time-tagged vehicle movement over some period of time and/or distance. A sequence of path history points is used along with an initial position (and the GNSS status at that time) to create a set of straight line segments representing the path.

The points present in the history represent a concise representation 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. These positions are each called PathHistoryPoint.

The initial anchor point shall be the initialPosition data frame or be provided in the message in which the PathHistory is sent (such as the BSM Part I). If the PathHistory 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. Note that this methodology produces offsets where positive is in the south, west, and down directions. The sign of these offsets is inverted from conventions used elsewhere in this standard.

ASN.1 Representation:

```
PathHistory ::= SEQUENCE {
    initialPosition  FullPositionVector    OPTIONAL,
    currGNSSstatus  GNSSstatus            OPTIONAL,
    crumbData       PathHistoryPointList,
    ...
}
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|-----|--|-----------------------------------|
| DF | DF_VehicleSafetyExtensions | <ASN> , and |
| MSG | MSG_IntersectionCollisionAvoidance (ICA) | <ASN> , and |
| MSG | MSG_PersonalSafetyMessage (PSM) | <ASN> . |

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

6.91 Data Frame: DF_PathHistoryPointList

Use: The PathHistoryPointList data frame consists of a list of PathHistoryPoint entries. Note that implementations may use fewer than the maximum number of path history points allowed.

ASN.1 Representation:

```
PathHistoryPointList ::= SEQUENCE (SIZE(1..23)) OF PathHistoryPoint
```

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

6.92 Data Frame: DF_PathHistoryPoint

Use: The PathHistoryPoint data frame is used to convey a single point in the path of an object (typically a motor vehicle) described as a sequence of such position points. The sequence and number of these points (defined in another data frame) is selected to convey the desired level of accuracy and precision required by the application.

The lat-long offset units used in the PathHistoryPointType data frame support units of 1/10th microdegrees of lat and long. The elevation offset units are in 10 cm units. The time is expressed in units of 10 ms. The PositionalAccuracy entry uses three elements to 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 these items are defined further in the relevant data entries.

ASN.1 Representation:

```

PathHistoryPoint ::= SEQUENCE {
    latOffset      OffsetLL-B18,
    lonOffset      OffsetLL-B18,
    elevationOffset VertOffset-B12,
    timeOffset      TimeOffset,
    -- Offset backwards in time

    speed          Speed OPTIONAL,
    -- Speed over the reported period

    posAccuracy     PositionalAccuracy OPTIONAL,
    -- The accuracy of this value

    heading         CoarseHeading OPTIONAL,
    -- overall heading

    ...
}

```

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

6.93 Data Frame: DF_PathPrediction

Use: The DF_PathPrediction data frame allows vehicles and other type of users to share their predicted path trajectory by estimating a future 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 PathPrediction data element are represented by the RadiusOfCurvature element. The algorithmic approach and allowed error limits are defined in a relevant standard using the data frame. 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 RadiusOfCurvature,
    -- LSB units of 10cm
    -- straight path to use value of 32767

    confidence     Confidence,
    -- LSB units of 0.5 percent

    ...
}

```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|-----|--|------------|
| DF | DF_VehicleSafetyExtensions | <ASN>, and |
| MSG | MSG_IntersectionCollisionAvoidance (ICA) | <ASN>, and |
| MSG | MSG_PersonalSafetyMessage (PSM) | <ASN>. |

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

6.94 Data Frame: DF_PivotPointDescription

Use: The DF_PivotPointDescription data frame is used to describe the geometric relationship between a vehicle and a trailer; or a dolly and another object to which it is connected. This point of connection can be fixed (non-pivoting) or can rotate in the horizontal plane at the connection point. The connection point itself is presumed to be along the centerline of the object in question. Rotation in the vertical plane (pitch and roll) is not modeled.

The offset of the PivotPointDescription is with respect to the length and tangential to the width of the object in question. It should be noted that the length and width values are typically sent in the same message in which the PivotPointDescription is used. Given the known length of an object, the magnitude and sign of the pivotOffset projects the point of connection/rotation along the object's centerline. If either of the objects pivot (has the element PivotingAllowed set true), the connection point pivots and the heading of the vehicle changes. The current angle between the two objects (one expressed with respect to the next) is provided by the pivotAngle entry. It should be noted that this is the only dynamic value when the vehicle is underway. It should also be noted that the heading and reported positions of the trailers are given with respect to the object in front of them. Only the lead vehicle and its BSM contain the absolute LLH and heading angle.

ASN.1 Representation:

```
PivotPointDescription ::= SEQUENCE {
    pivotOffset    Offset-B11,
    -- This gives a +/- 10m range from the edge of the outline
    -- measured from the edge of the length of this unit
    -- a negative value is offset to inside the units
    -- a positive value is offset beyond the unit
    pivotAngle    Angle,
    -- Measured between the center-line of this unit
    -- and the unit ahead which is pulling it.
    -- This value is required to project the units relative position
    pivots        PivotingAllowed,
    -- true if this unit can rotate about the pivot connection point
    ...
}
```

Used By: This entry is directly used by the following data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_TrailerData | <ASN> , and |
| DF | DF_TrailerUnitDescription | <ASN> , and |
| DF | DF_TrailerUnitDescJ2945Slash1B | <ASN> , and |
| DF | DF_VehicleData | <ASN> . |

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

6.95 Data Frame: DF_PortlandCement

Use: Indicates the surface of the roadway is portland cement. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```
PortlandCement ::= SEQUENCE {
    type    PortlandCementType,
    ...
}
```

Used By: This entry is directly used by the following data structure in this standard:

| | | |
|----|---|-------------------------------|
| DF | DF_DescriptionOfRoadSurface | <ASN> . |
|----|---|-------------------------------|

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

6.96 Data Frame: DF_Position3D

Use: The DF_Position3D data frame provides a precise location in the WGS-84 coordinate system, from which short offsets may be used to create additional data using a flat earth projection centered on this location. Position3D is typically used in the description of maps and intersections, as well as signs and traveler data.

ASN.1 Representation:

```
Position3D ::= SEQUENCE {
    lat          Latitude,          -- in 1/10th microdegrees
    long         Longitude,         -- in 1/10th microdegrees
    elevation    Elevation OPTIONAL, -- in 10 cm units
    regional     SEQUENCE (SIZE(1..4)) OF
                  RegionalExtension {{Reg-Position3D}} OPTIONAL,
    ...
}
```

Used By: This entry is directly used by the following nine other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF Circle | <ASN> , and |
| DF | DF GeographicalPath | <ASN> , and |
| DF | DF IntersectionGeometry | <ASN> , and |
| DF | DF RegionPointSet | <ASN> , and |
| DF | DF RequestorPositionVector | <ASN> , and |
| DF | DF RoadSegment | <ASN> , and |
| DF | DF RoadSignID | <ASN> , and |
| DF | DF ShapePointSet | <ASN> , and |
| MSG | MSG PersonalSafetyMessage (PSM) | <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 from this point (and thereafter from the prior point) or in order to determine the absolute position to be described.

6.97 Data Frame: DF_PositionalAccuracy

Use: The DF_PositionalAccuracy data frame consists of various parameters of quality used to model the accuracy of the positional determination with respect to each given axis.

ASN.1 Representation:

```
PositionalAccuracy ::= SEQUENCE {
    -- NMEA-183 values expressed in strict ASN form
    semiMajor    SemiMajorAxisAccuracy,
    semiMinor    SemiMinorAxisAccuracy,
    orientation   SemiMajorAxisOrientation
}
```

Used By: This entry is directly used by the following four other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_BSMcoreData | <ASN> , and |
| DF | DF_FullPositionVector | <ASN> , and |
| DF | DF_PathHistoryPoint | <ASN> , and |
| MSG | MSG_PersonalSafetyMessage (PSM) | <ASN> . |

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

Remarks: In the prior editions of the standard (pre-2015), this concept was constructed as a BLOB. It has now been converted for UPER use.

6.98 Data Frame: DF_PositionConfidenceSet

Use: The DF_PositionConfidenceSet data frame combines multiple related bit fields into a single concept.

ASN.1 Representation:

```
PositionConfidenceSet ::= SEQUENCE {
    pos      PositionConfidence, -- for both horizontal directions
    elevation ElevationConfidence
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|---------------------------------------|-----------------------------------|
| DF | DF_ConfidenceSet | <ASN> , and |
| DF | DF_FullPositionVector | <ASN> . |

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

Remarks: In the prior editions of the standard (pre-2015), this was constructed as a BLOB. It has now been converted for UPER use.

6.99 Data Frame: DF_PreemptPriorityList

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

ASN.1 Representation:

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

SignalControlZone ::= SEQUENCE {
    zone RegionalExtension {{Reg-SignalControlZone}},
    ...
}
```

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

6.100 Data Frame: DF_PrivilegedEvents

Use: The DF_PrivilegedEvents data frame provides a means to describe various public safety events. The information in this data frame (along with the BSM message in which it is sent) can be used to determine various aspects about the sender.

ASN.1 Representation:

```
PrivilegedEvents ::= SEQUENCE {

    notUsed    SSPindex,
    -- always set to 0 and carries no meaning;
    -- legacy field maintained for backward compatibility
    -- The active event list
    event      PrivilegedEventFlags,
    ...
}
```

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

6.101 Data Frame: DF_PropelledInformation

Use: The DF_PropelledInformation data frame relates details about type of propulsion that a VRU is being conveyed by.

ASN.1 Representation:

```
PropelledInformation ::= CHOICE {
    human      HumanPropelledType, -- PersonalDeviceUserType would be a aPEDESTRIAN
    animal     AnimalPropelledType,
    motor      MotorizedPropelledType,
    ...
}
```

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

6.102 Data Frame: DF_RegionList

Use: The DF_RegionList data frame 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.
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_RegionPointSet](#) [<ASN>](#). 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 points as necessary to characterize curvature “within tolerance.”

6.103 Data Frame: DF_RegionOffsets

Use: The DF_RegionOffsets data frame provides one set of signed offset values for determining the Xs and Ys (and, possibly Zs, when present) using the then-current reference point object (the Position3D used as the current anchor) to build a single point in a path. Typically, it is used to describe large enclosed regions.

ASN.1 Representation:

```

RegionOffsets ::= SEQUENCE {
    xOffset OffsetLL-B16,
    yOffset OffsetLL-B16,
    zOffset OffsetLL-B16 OPTIONAL
    -- all in signed values where
    -- the LSB is in units of 1 meter
}

```

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

Remarks: Note that while latitude, 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 m) of offset. When a value for zOffset is given, that value persists until changed again for additional nodes in the list.

6.104 Data Frame: DF_RegionPointSet

Use: The DF_RegionPointSet data frame 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,
    scale Zoom OPTIONAL,
    nodeList RegionList,
    -- path details of the regions outline
    ...
}

```

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

6.105 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
    -- See Section 11 for converting and translating
    -- speed expressed in mph into units of 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.

6.106 Data Frame: DF_RequestedItem

Use: The DE_RequestedItemList data frame consists of a list of RequestedItem entries.

ASN.1 Representation:

```
RequestedItemList ::= SEQUENCE (SIZE(1..32)) OF RequestedItem
```

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

6.107 Data Frame: DF_RequestorDescription

Use: The DF_RequestorDescription data frame is used to provide identity information about a selected vehicle or users. This data frame is typically used with fleet type vehicles which can (or which must) safely release such information for use with probe measurements or with other interactions (such as a signal request).

ASN.1 Representation:

```
RequestorDescription ::= SEQUENCE {
    id VehicleID,
        -- The ID used in the BSM or CAM of the requestor
        -- This ID is presumed not to change
        -- during the exchange
    type RequestorType OPTIONAL,
        -- Information regarding all type and class data
        -- about the requesting vehicle
    position RequestorPositionVector OPTIONAL,
        -- The location of the requesting vehicle
    name DescriptiveName OPTIONAL,
        -- A human readable name for debugging use
    -- Support for Transit requests
    routeName DescriptiveName OPTIONAL,
        -- A string for transit operations use
    transitStatus TransitVehicleStatus OPTIONAL,
        -- current vehicle state (loading, etc.)
    transitOccupancy TransitVehicleOccupancy OPTIONAL,
        -- current vehicle occupancy
    transitSchedule DeltaTime OPTIONAL,
        -- current vehicle schedule adherence

    regional SEQUENCE (SIZE(1..4)) OF
        RegionalExtension {{Reg-RequestorDescription}} OPTIONAL,
    ...
}
```

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

Remarks: Note that the requestor description elements which are used when the request (the req) is made differ from those used when the status of an active or pending request is reported (the ack). Typically, when reporting the status to other parties, less information is required and only the TemporaryID (contained in the VehicleID) and request number (a unique ID used in the original request) are used.

6.108 Data Frame: DF_RequestorPositionVector

Use: The DF_RequestorPositionVector data frame provides a report of the requestor's position, speed, and heading. Used by a vehicle or other type of user to request services and at other times when the larger FullPositionVector is not required.

ASN.1 Representation:

```
RequestorPositionVector ::= SEQUENCE {
    position          Position3D,
    heading           Angle OPTIONAL,
    speed             TransmissionAndSpeed OPTIONAL,
    ...
}
```

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

6.109 Data Frame: DF_RequestorType

Use: The DF_RequestorType data frame is used when a V2X-equipped device is requesting service from another device. The most common use case is when a vehicle is requesting a signal preemption or priority service call from the signal controller in an intersection. This data frame provides the details of the requestor class taxonomy required to support the request. Depending on the precise use case and the local implementation, these details can vary considerably. As a result, besides the basic role of the vehicle, the other classification systems supported are optional. It should also be observed that often only a subset of the information in the RequestorType data frame is used to report the “results” of such a request to others. As an example, a police vehicle might request service based on being in a police vehicle role (and any further sub-type if required) and on the type of service call to which the vehicle is then responding (perhaps a greater degree of emergency than another type of call), placing these information elements in the RequestorType, which is then part of the signal request message (SRM). This allows the roadway operator to define suitable business rules regarding how to reply. When informing the requestor and other nearby drivers of the outcome, using the signal status message (SSM) message, only the fact that the preemption was granted or denied to some vehicle with a unique request ID is conveyed.

ASN.1 Representation:

```
RequestorType ::= SEQUENCE {
    -- Defines who is requesting
    role          BasicVehicleRole, -- Basic role of this user at this time
    subrole       RequestSubRole OPTIONAL, -- A local list with role based items

    -- Defines what kind of request (a level of importance in the Priority Scheme)
    request       RequestImportanceLevel OPTIONAL, -- A local list with request items

    -- Additional classification details
    iso3883       Iso3833VehicleType OPTIONAL,
    hpmsType      VehicleType OPTIONAL, -- HPMS classification types

    regional      RegionalExtension {{Reg-RequestorType}} OPTIONAL,
    ...
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|---|-----------------------------------|
| DF | DF_RequestorDescription | <ASN> , and |
| DF | DF_SignalRequesterInfo | <ASN> . |

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

6.110 Data Frame: DF_RestrictionClassAssignment

Use: The DF_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 message, 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.

6.111 Data Frame: DF_RestrictionClassList

Use: The DF_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.

6.112 Data Frame: DF_RestrictionUserTypeList

Use: The DF_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.

6.113 Data Frame: DF_RestrictionUserType

Use: The DF_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.

ASN.1 Representation:

```

RestrictionUserType ::= CHOICE {
    basicType      RestrictionAppliesTo,
                  -- a set of the most commonly used types
    regional      SEQUENCE (SIZE(1..4)) OF
                  RegionalExtension {{Reg-RestrictionUserType}},
    ...
}

```

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.

6.114 Data Frame: DF_RoadAuthorityID

Use: The DF_RoadAuthorityID data frame is used to provide a more extensible and structured means of identifying infrastructure owner operator agencies and corresponding agencies divisions and assets. It was first used in SAE J2945/C, and it was added to the SPAT and MAP messages in this document to support future applications.

ASN.1 Representation:

```

RoadAuthorityID ::= CHOICE {
    -- This data frame defines the Object Identifier (OID) of the Road Authority.
    fullRdAuthID    FullRoadAuthorityID,
    relRdAuthID     RelativeRoadAuthorityID,
    ...
}

```

Used By: This entry is used directly by [IntersectionState](#) and [IntersectionGeometry](#). This item is also used by data structures in other ITS standards such as J2945/C.

6.115 Data Frame: DF_RoadLaneSetList

Use: The DF_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](#) <ASN>. In addition, this item may be used by data structures in other ITS standards.

6.116 Data Frame: DF_RoadRoughness

Use: This DF enables a receiving entity to estimate friction characteristics. The mean vertical and horizontal variations of the roadway are in microns, and a standard deviation may be applied to provide a more accurate statistical representation of the roadway roughness.

ASN.1 Representation:

```

RoadRoughness ::= SEQUENCE {
    meanVerticalVariation      MeanVariation,
    verticalVariationStdDev    VariationStdDev OPTIONAL,
    meanHorizontalVariation    MeanVariation OPTIONAL,
    horizontalVariationStdDev  VariationStdDev OPTIONAL,
    ...
}

```

Used By: This entry is directly used by the following data structure in this standard:

DF DF_FrictionInformation [<ASN>](#).

This item may also be used by data structures in other ITS standards.

6.117 Data Frame: DF_RoadSegmentList

Use: The DF_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.

6.118 Data Frame: DF_RoadSegmentReferenceID

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

ASN.1 Representation:

```
RoadSegmentReferenceID ::= SEQUENCE {
    region RoadRegulatorID OPTIONAL,
        -- a globally unique regional assignment value
        -- typically 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 assignment and use
        -- note that unlike intersectionID values,
        -- this value can be reused by the region
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_GeographicalPath](#) [<ASN>](#), and

DF [DF_RoadSegment](#) [<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 its region ID (the RoadRegulatorID). Taken together, these form a unique value which is never repeated during the same period of time.

6.119 Data Frame: DF_RoadSegment

Use: The DF_RoadSegment data frame is 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, -- 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 Section 11 for converting and
                                -- translating speed expressed in mph
                                -- into units of 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,

    regional      SEQUENCE (SIZE(1..4)) OF
                    RegionalExtension {{Reg-RoadSegment}} OPTIONAL,
    ...
}

```

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.

6.120 Data Frame: DF_RoadSignID

Use: The DF_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
}

```

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

6.121 Data Frame: DF_Rock

Use: Indicates the surface of the roadway is rock. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```
Rock ::= SEQUENCE {
    type      RockType,
    ...
}
```

Used By: This entry is directly used by the following data structure in this standard:

DF [DF_DescriptionOfRoadSurface](#) [<ASN>](#).

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

6.122 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 not required or used when sending RTCM data from a corrections source to end users (from a base station to devices deployed in the field which are called rovers).

ASN.1 Representation:

```
RTCMheader ::= SEQUENCE {
    status      GNSSstatus,
    offsetSet   AntennaOffsetSet
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_RTCMPackage](#) [<ASN>](#), and

MSG [MSG_RTCMcorrections \(RTCM\)](#) [<ASN>](#).

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

Remarks: Note that the offset value provided in the ASN is used to convey the XYZ offset of the phase center point of an antenna with respect to the length and width of an object (typically a V2X-equipped device) and its current LLH position. It is not the phase center point of an antenna used as a base station in an RTK system from which differential corrections are issued. That base station information should be sent in a normal RTCM message and using the customary millimeter-accurate values expressed in the current WGS-84 ECEF frame of reference.

6.123 Data Frame: DF_RTCMmessageList

Use: The DF_RTCMmessageList data frame consists of a list of RTCMmessage entries.

ASN.1 Representation:

```
RTCMmessageList ::= SEQUENCE (SIZE(1..5)) OF RTCMmessage
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_RTCMPackage](#) [<ASN>](#), and

MSG [MSG_RTCMcorrections \(RTCM\)](#) [<ASN>](#).

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

6.124 Data Frame: DF_RTCMPackage

Use: The DF_RTCMPackage data frame is used to convey RTCM messages which deal with differential corrections between users from one mobile device to another. Encapsulated messages are those defined in RTCM Standard 10403.1 for Differential GNSS (Global Navigation Satellite Systems) Services - Version 3 adopted on July 1, 2011, and its successors.

ASN.1 Representation:

```

RTCMPackage ::= SEQUENCE {
    -- precise antenna position and noise data for a rover
    rtcHeader RTCMheader OPTIONAL,

    -- one or more RTCM messages
    msgs      RTCMmessageList,
    ...
}

```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_SupplementalVehicleExtensions](#) <ASN>. 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.

6.125 Data Frame: DF_Sample

Use: The DF_Sample data frame allows the Probe Management message to apply its settings to a subset of vehicles (e.g., all vehicles within the stated range). The subset is defined as from-to range, using the last 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 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 half sample.

ASN.1 Representation:

```

Sample ::= SEQUENCE {
    sampleStart  INTEGER(0..255),  -- Sample Starting Point
    sampleEnd    INTEGER(0..255)  -- Sample Ending Point
}

```

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

6.126 Data Frame: DF_SegmentAttributeLLList

Use: The DF_SegmentAttributeLLList data frame consists of a list of SegmentAttributeLL entries.

ASN.1 Representation:

```

SegmentAttributeLLList ::= SEQUENCE (SIZE(1..8)) OF SegmentAttributeLL

```

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

6.127 Data Frame: DF_SegmentAttributeXYList

Use: The DF_SegmentAttributeXYList data frame consists of a list of SegmentAttributeXY entries.

ASN.1 Representation:

```

SegmentAttributeXYList ::= SEQUENCE (SIZE(1..8)) OF SegmentAttributeXY

```


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

6.128 Data Frame: DF_ShapePointSet

Use: The DF_ShapePointSet DF used to represent a short segment of described roadway. It is typically employed to define a region where signs or advisories would be valid.

ASN.1 Representation:

```
ShapePointSet ::= SEQUENCE {
    anchor          Position3D          OPTIONAL,
    laneWidth       LaneWidth           OPTIONAL,
    directionality  DirectionOfUse    OPTIONAL,
    nodeList        NodeListXY,         -- XY path details of the lane and width
    ...
}
```

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

6.129 Data Frame: DF_SignalRequesterInfo

Use: The DF_SignalRequesterInfo data frame is used to contain information regarding the entity that requested a given signal behavior. In addition to the VehicleID, the data frame also contains a request reference number used to uniquely refer to the request and some basic type of information about the request maker which may be used by other parties.

ASN.1 Representation:

```
SignalRequesterInfo ::= SEQUENCE {
    -- These three items serve to uniquely identify the requester
    -- and the specific request to all parties
    id          VehicleID,
    request     RequestID,
    sequenceNumber MsgCount,
    role        BasicVehicleRole OPTIONAL,

    typeData    RequestorType OPTIONAL,
                -- Used when addition data besides the role
                -- is needed, at which point the role entry
                -- above is not sent.
    ...
}
```

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

6.130 Data Frame: DF_SignalRequestList

Use: The DF_SignalRequestList data frame consists of a list of SignalRequest entries.

ASN.1 Representation:

```
SignalRequestList ::= SEQUENCE (SIZE(1..32)) OF SignalRequestPackage
```

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

6.131 Data Frame: DF_SignalRequestPackage

Use: The DF_SignalRequestPackage data frame contains both the service request itself (the preemption and priority details and the inbound-outbound path details for an intersection) and the time period (start and end time) over which this service is sought from one single intersection. One or more of these packages are contained in a list in the signal request message (SRM).

ASN.1 Representation:

```
SignalRequestPackage ::= SEQUENCE {
    request          SignalRequest,
                    -- The specific request to the intersection
                    -- contains IntersectionID, request type,
                    -- requested action (approach/lane request)

    -- The Estimated Time of Arrival (ETA) when the service is requested
    minute           MinuteOfTheYear OPTIONAL,
    second           DSecond OPTIONAL,
    duration          DSecond OPTIONAL,
                    -- The duration value is used to provide a short interval that
                    -- extends the ETA so that the requesting vehicle can arrive at
                    -- the point of service with uncertainty or with some desired
                    -- duration of service. This concept can be used to avoid needing
                    -- to frequently update the request.
                    -- The requester must update the ETA and duration values if the
                    -- period of services extends beyond the duration time.
                    -- It should be assumed that if the vehicle does not clear the
                    -- intersection when the duration is reached, the request will
                    -- be cancelled and the intersection will revert to
                    -- normal operation.

    regional         SEQUENCE (SIZE(1..4)) OF
                    RegionalExtension {{Reg-SignalRequestPackage}} OPTIONAL,
    ...
}
```

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

6.132 Data Frame: DF_SignalRequest

Use: The DF_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 information. Additional information includes the approach and egress values or lanes to be used.

ASN.1 Representation:

```

SignalRequest ::= SEQUENCE {
    -- the unique ID of the target intersection
    id IntersectionReferenceID,

    -- The unique requestID used by the requestor
    requestID RequestID,

    -- The type of request or cancel for priority or preempt use
    -- when a prior request is canceled, only the requestID is needed
    requestType PriorityRequestType,

    -- In typical use either an approach or a lane number would
    -- be given, this indicates the requested
    -- path through the intersection to the degree it is known.
    inBoundLane IntersectionAccessPoint,
    -- desired entry approach or lane
    outBoundLane IntersectionAccessPoint OPTIONAL,
    -- desired exit approach or lane
    -- the values zero is used to indicate
    -- intent to stop within the intersection
    regional SEQUENCE (SIZE(1..4)) OF
        RegionalExtension {{Reg-SignalRequest}} OPTIONAL,
    ...
}

```

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

6.133 Data Frame: DF_SignalStatusList

Use: The DF_SignalStatusList data frame consists of a list of SignalStatus entries.

ASN.1 Representation:

```

SignalStatusList ::= SEQUENCE (SIZE(1..32)) OF SignalStatus

```

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

6.134 Data Frame: DF_SignalStatusPackageList

Use: The SignalStatusPackageList data frame consists of a list of SignalStatusPackage entries.

ASN.1 Representation:

```

SignalStatusPackageList ::= SEQUENCE (SIZE(1..32)) OF SignalStatusPackage

```

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

6.135 Data Frame: DF_SignalStatusPackage

Use: The DF_SignalStatusPackage data frame contains all the data needed to describe the preemption or priority state of the signal controller with respect to a given request and to uniquely identify the party who requested that state to occur. It should be noted that this data frame describes both active and anticipated states of the controller. A requested service may not be active when the message is created and issued. A requested service may be rejected. This structure allows the description of pending requests that have been granted (accepted rather than rejected) but are not yet active and being serviced. It also provides for the description of rejected requests so that the initial message is acknowledged (completing a dialog using the broadcast messages).

ASN.1 Representation:

```

SignalStatusPackage ::= SEQUENCE {
    -- The party that made the initial SRM request
    requester      SignalRequesterInfo OPTIONAL,
    -- The lanes or approaches used in the request
    inboundOn      IntersectionAccessPoint, -- estimated lane/approach of vehicle
    outboundOn      IntersectionAccessPoint OPTIONAL,

    -- The Estimated Time of Arrival (ETA) when the service is requested
    -- This data echos the data of the request
    minute          MinuteOfTheYear OPTIONAL,
    second          DSecond OPTIONAL,
    duration         DSecond OPTIONAL,

    -- the SRM status for this request
    status          PrioritizationResponseStatus,
    -- Status of request, this may include rejection

    regional        SEQUENCE (SIZE(1..4)) OF
                    RegionalExtension {{Reg-SignalStatusPackage}} OPTIONAL,

    ...
}

```

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

6.136 Data Frame: DF_SignalStatus

Use: The DF_SignalStatus data frame is used to provide the status of a single intersection to others, including any active preemption or priority state in effect.

ASN.1 Representation:

```

SignalStatus ::= SEQUENCE {
    sequenceNumber  MsgCount,
    -- changed whenever the below contents have change

    id              IntersectionReferenceID,
    -- this provides a unique mapping to the
    -- intersection map in question
    -- which provides complete location
    -- and approach/movement/lane data
    -- as well as zones for priority/preemption

    sigStatus       SignalStatusPackageList,
    -- a list of detailed status containing all
    -- priority or preemption state data, both
    -- active and pending, and who requested it
    -- requests which are denied are also listed
    -- here for a short period of time

    regional        SEQUENCE (SIZE(1..4)) OF
                    RegionalExtension {{Reg-SignalStatus}} OPTIONAL,

    ...
}

```

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

6.137 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 (Distance1, Speed1 and Distance2, Speed2) to be used by the OBU as follows:

- If speed is \leq Speed1, then distance to next snapshot is Distance1.
- If speed is \geq Speed2, then distance to next snapshot is Distance2.
- If speed is $>$ Speed1 and $<$ Speed2, then distance to snapshot is linearly interpolated between Distance1 and Distance2.

If Speed1 is set to zero, then the distance to the next snapshot is always Distance1.

ASN.1 Representation:

```
SnapshotDistance ::= SEQUENCE {
    distance1    GrossDistance,    -- meters
    speed1       GrossSpeed,         -- meters/second
    distance2    GrossDistance,    -- meters
    speed2       GrossSpeed         -- meters/second
}
```

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

6.138 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      VehicleSafetyExtensions OPTIONAL,
    dataSet        VehicleStatus OPTIONAL,
                  -- a sequence of data frames
                  -- which encodes the data
    ...
}
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called [MSG ProbeVehicleData \(PVD\)](#) <ASN>. 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.

6.139 Data Frame: DF_SnapshotTime

Use: To allow network users to change the snapshot collection policy based on elapsed time. Two times and two speeds are included in the message (Time1, Speed1 and Time2, Speed2) to be used by the OBU as follows:

- If speed is \leq Speed1, then time to next snapshot is Time1 with a default of 20 mph (8.9 m/s) and 6 seconds.
- If speed is \geq Speed2, then time to next snapshot is Time2 with a default of 60 mph (26.8 m/s) and 20 seconds.
- If speed is $>$ Speed1 and $<$ Speed2, then time to snapshot is linearly interpolated between Time1 and Time2.

If Speed1 is set to zero, then the time to the next snapshot is always Time1.

ASN.1 Representation:

```

SnapshotTime ::= SEQUENCE {
    speed1 GrossSpeed, -- meters/sec - the instantaneous speed
                                -- when the calculation is performed
    time1 SecondOfTime, -- in seconds
    speed2 GrossSpeed, -- meters/sec - the instantaneous speed
                                -- when the calculation is performed
    time2 SecondOfTime -- in seconds
}

```

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

6.140 Data Frame: DF_Snow

Use: Indicates the surface of the roadway is snow. This DF may be extended in the future to support more specific characteristics. .

ASN.1 Representation:

```

Snow ::= SEQUENCE {
    type      SnowType,
    ...
}

```

Used By: This entry is directly used by the following data structure in this standard:

DF [DF_DescriptionOfRoadSurface](#) [<ASN>](#).

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

6.141 Data Frame: DF_SpecialVehicleExtensions

Use: The DF_SpecialVehicleExtensions data frame is used to send various additional optional information elements in the Part II BSM used by special vehicles. In this context, the term “special” indicates vehicles or other equipped devices which differ from other vehicles in their overall ability or intent to flow in traffic and which are likely to have additional certification permissions (CERTs) which expressly allow this information to be sent. As a broad rule, light passenger vehicles (when in non-special roles) will not send this type of content. A typical use case would be a police vehicle, actively engaged in a police vehicle role, sending additional information (the Emergency Details data frame) about its flashing lights and immediate movements. An alternative use case would be a garbage truck engaged in stop and go operations (irregular vehicle movements) sending the same data frame with different internal content details. A further example use case would be an equipped heavy truck sending content about the trailer it was hauling.

ASN.1 Representation:

```

SpecialVehicleExtensions ::= SEQUENCE {
    -- The entire EVA message has been reduced to these items
    vehicleAlerts EmergencyDetails OPTIONAL,
    -- Description or Direction from an emergency vehicle
    description EventDescription OPTIONAL, -- short ITIS description

    -- Trailers for both passenger vehicles and heavy trucks
    deprecated TrailerData OPTIONAL,
    --To be deprecated in next revision of J2735

    -- HAZMAT and Cargo details to be added in a future revision

    -- Wideload, oversized load to be added in a future revision

    ...
}

```

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

6.142 Data Frame: DF_SpeedHeadingThrottleConfidence

Use: The DF_SpeedHeadingThrottleConfidence data frame is a single data frame combining multiple related bit fields into one concept.

ASN.1 Representation:

```
SpeedandHeadingandThrottleConfidence ::= SEQUENCE {
    heading    HeadingConfidence,
    speed      SpeedConfidence,
    throttle    ThrottleConfidence
}
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|---------------------------------------|-----------------------------------|
| DF | DF_ConfidenceSet | <ASN> , and |
| DF | DF_FullPositionVector | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> . |

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

Remarks: In the prior editions of the standard (pre-2015), this was constructed as a BLOB; it has now been converted to a data frame.

6.143 Data Frame: DF_SpeedLimitList

Use: The DF_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 three other data structures in this standard:

| | | |
|----|---|-----------------------------------|
| DF | DF_IntersectionGeometry | <ASN> , and |
| DF | DF_LaneDataAttribute | <ASN> , and |
| DF | DF_RoadSegment | <ASN> . |

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

6.144 Data Frame: DF_SpeedProfileMeasurementList

Use: The DF_SpeedProfileMeasurementList data frame consists of a list of SpeedProfileMeasurementList entries. The first value in the sequence would be the last measurement collected. If the sequence is full as a new measurement value is added, the oldest would be deleted.

ASN.1 Representation:

```
SpeedProfileMeasurementList ::= SEQUENCE (SIZE(1..20)) OF SpeedProfileMeasurement
```

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

6.145 Data Frame: DF_SpeedProfile

Use: The DF_SpeedProfile data frame supports connected vehicles which will be collecting and parsing BSMs as they travel: these consist of speed data reported from the opposite direction. Each equipped vehicle collects the reported BSM speeds from the vehicles traveling in the opposite direction and store the average speed of these vehicles every 100 m. The BSM [TemporaryID](#) will be used to prevent duplicates. The opposite direction is considered to be the collecting vehicle's current direction +170 through 190 degrees. Up to 20 readings of average speed can be transmitted by the SpeedProfile. The SpeedProfile is added to the BSM Part II content, thus making it available to vehicles traveling in the opposite direction for whom it provides an up to 2 km SpeedProfile of the traffic on their road ahead. Should the vehicle collecting the SpeedProfile make a turn greater than 70 degrees, then the SpeedProfile currently stored would be deleted. Further details of these operational concepts can be found in relevant standards.

ASN.1 Representation:

```
SpeedProfile ::= SEQUENCE {
    -- Composed of set of measured average speeds
    speedReports SpeedProfileMeasurementList,
    ...
}
```

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

6.146 Data Frame: DF_SupplementalVehicleExtensions

Use: The DF_SupplementalVehicleExtensions data frame is used to send various optional additional information elements in the Part II BSM. The range of use cases supported by these elements is very broad and includes both additional V2V functionality and various V2I monitoring applications. A variety of "vehicle as probe" applications fit within this overall functionality as well. Further use cases and requirements are developed in relevant standards. It should be noted that the use of the regional extension mechanism here is intended to provide a means to develop experimental message content within this data frame. The `trailers` data structure in this data frame was added to this document in the 2022 revision to support SAE J2945/1B.

ASN.1 Representation:

```
SupplementalVehicleExtensions ::= SEQUENCE {
    -- Note that VehicleEventFlags, ExteriorLights,
    -- PathHistory, and PathPrediction are in VehicleSafetyExtensions

    -- Vehicle Type Classification Data
    classification BasicVehicleClass OPTIONAL,
    -- May be required to be present for non passenger vehicles
    classDetails VehicleClassification OPTIONAL,
    vehicleData VehicleData OPTIONAL,

    -- Various V2V Probe Data
    deprecated1 WeatherReport OPTIONAL,
    --To be deprecated in next revision of J2735
    deprecated2 WeatherProbe OPTIONAL,
    --To be deprecated in next revision of J2735

    -- Detected Obstacle data
    deprecated3 ObstacleDetection OPTIONAL,
    --To be deprecated in next revision of J2735

    -- Disabled Vehicle Report
    status DisabledVehicle OPTIONAL,

    -- Oncoming lane speed reporting
    deprecated4 SpeedProfile OPTIONAL,
    --To be deprecated in next revision of J2735
```



```

-- Raw GNSS measurements
deprecated5      RTCTMPackage      OPTIONAL,
--To be deprecated in next revision of J2735

regional SEQUENCE (SIZE(1..4)) OF
    RegionalExtension {{Reg-SupplementalVehicleExtensions}} OPTIONAL,
... ,
fhwaVehicleClass RptVehicleClass
-- Use FHWA vehicle classes, defined in J2945/C ProbeDataReport

trailers      TrailersJ2945Slash1B  OPTIONAL,
-- Used in J2945/1B

}

```

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

6.147 Data Frame: DF_TimeChangeDetails

Use: The DF_TimeChangeDetails data frame 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 is expected to start.

By this method, timing information 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. It should be noted that this also supports the sending of time periods regarding various red phases; however, this is not expected to be done commonly.

The element MinEndTime is used to convey the earliest time possible at which the phase could change, except when unpredictable events relating to a preemption or priority call disrupt a currently active timing plan. 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 latest time possible 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. In a phase where the time is fixed (as in a fixed yellow or clearance time), this element shall be used alone.

The element likelyTime is used to convey the most likely time the phase changes. This occurs 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.

The element nextTime is used to express a general (and presumably 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 future phase will start
    minEndTime     TimeMark,
                    -- Expected shortest end time
    maxEndTime     TimeMark          OPTIONAL,
                    -- Expected longest 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.
}

```

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

Remarks: It should be noted 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 is issued. This would require re-formulating the message content 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 an absolute value and can be used thereafter without change. The message content need only change when 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.

6.148 Data Frame: DF_TrailerData

Use: The DF_TrailerData data frame provides a means to describe trailers pulled by motor vehicles and/or other equipped devices. The span of use is intended to cover use cases from simple passenger vehicles with trailers to class 13 vehicles hauling one or more trailers and dollies. The information in this data frame (along with the BSM message in which it is sent) can be used to determine various aspects of the sender. These include the path of the vehicle and its trailer(s) under various maneuvering conditions (lane matching) as well as the rear of the final trailer, which is often useful in signal control optimization and in intersection safety.

ASN.1 Representation:

```

TrailerData ::= SEQUENCE {

    notUsed      SSPindex,
                -- always set to 0 and carries no meaning;
                -- legacy field maintained for backward compatibility

    -- Offset connection point details from the
    -- hauling vehicle to the first trailer unit
    connection   PivotPointDescription,

```

```

-- One of more Trailer or Dolly Descriptions
-- (each called a unit)
units      TrailerUnitDescriptionList,

...
}

```

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

Remarks: The mechanisms by which the rigid bodies of the vehicle and trailer connect at the pivot points can be modeled in various ways to determine the position and heading of the trailer with respect to the vehicle.

6.149 Data Frame: DF_TrailerHistoryPointList

Use: The DF_TrailerHistoryPointList data frame is a sequence of trailer position history points which relate to a trailer's movements.

ASN.1 Representation:

```
TrailerHistoryPointList ::= SEQUENCE (SIZE(1..23)) OF TrailerHistoryPoint
```

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

6.150 Data Frame: DF_TrailerHistoryPoint

Use: The DF_TrailerHistoryPoint data frame contains a single position point for a trailer, expressed relative to the vehicle's BSM positional estimate at the same point in time.

ASN.1 Representation:

```

TrailerHistoryPoint ::= SEQUENCE {
    pivotAngle      Angle,
                    -- angle with respect to the lead unit
    timeOffset      TimeOffset,
                    -- offset backwards in time
    -- Position relative to the hauling Vehicle
    positionOffset  Node-XY-24b,
    elevationOffset VertOffset-B07 OPTIONAL,
    heading         CoarseHeading OPTIONAL,
                    -- overall heading
    ...
}

```

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

6.151 Data Frame: DF_TrailersJ2945Slash1B

Use: The DF_TrailersJ2945Slash1B data frame provides a means to describe trailers pulled by a motor vehicle and/or other equipped device.

ASN.1 Representation:

```
TrailersJ2945Slash1B ::= SEQUENCE (SIZE(1..8), ...) OF TrailerUnitDescJ2945Slash1B
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_SupplementalVehicleExtensions](#). In addition, this item may be used by data structures in other ITS standards.

6.152 Data Frame: DF_TrailerUnitDescriptionList

Use: The DF_TrailerUnitDescriptionList data frame is a sequence of trailer descriptions which relate to each connected trailer. Up to eight such units can be described to support various double and other complex combinations.

ASN.1 Representation:

```
TrailerUnitDescriptionList ::= SEQUENCE (SIZE(1..8)) OF TrailerUnitDescription
```

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

6.153 Data Frame: DF_TrailerUnitDescription

Use: The DF_TrailerUnitDescription data frame provides a physical description for one trailer or a dolly element (called a unit), including details of how it connects with other elements fore and aft. Note that in the case of multiple trailer units the front and rear pivots of adjacent trailers may result in multiple entries for the same pivot point. Care must be taken to avoid discrepancies.

ASN.1 Representation:

```
TrailerUnitDescription ::= SEQUENCE {
    isDolly          IsDolly, -- if false this is a trailer
    width            VehicleWidth,
    length           VehicleLength,
    height           VehicleHeight OPTIONAL,
    mass             TrailerMass OPTIONAL,
    bumperHeights    BumperHeights OPTIONAL,
    centerOfGravity   VehicleHeight OPTIONAL,
    -- The front pivot point of the unit
    frontPivot        PivotPointDescription,
    -- The rear pivot point connecting to the next element,
    -- if present and used (implies another unit is connected)
    rearPivot         PivotPointDescription OPTIONAL,

    -- Rear wheel pivot point center-line offset
    -- measured from the rear of the above length
    rearWheelOffset   Offset-B12 OPTIONAL,
                        -- the effective center-line of the wheel set

    -- Current Position relative to the hauling Vehicle
    positionOffset     Node-XY-24b,
    elevationOffset    VertOffset-B07 OPTIONAL,

    -- Past Position history relative to the hauling Vehicle
    crumbData          TrailerHistoryPointList OPTIONAL,
    ...
}
```

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

6.154 Data Frame: DF_TrailerUnitDescJ2945Slash1B

Use: The DF_TrailerUnitDescJ2945Slash1B data frame provides a physical description for one trailer element (called a unit), including details of how it connects with other elements fore and aft. Note that in the case of multiple trailer units the front and rear pivots of adjacent trailers may result in multiple entries for the same pivot point. Care must be taken to avoid discrepancies. Up to eight trailer units may be defined, each unit representing one trailer in the order in which they are physically connected, and with the trailer connected to the pulling vehicle listed first. Note that any connected section, including a dolly or in the case of an articulated bus the connected rear section, is considered a trailer.

ASN.1 Representation:

```

TrailerUnitDescJ2945Slash1B ::= SEQUENCE {
    width           VehicleWidth,
    length          VehicleLength,
    height          VehicleHeight          OPTIONAL,
    weight          TrailerWeight          OPTIONAL,

    -- The front pivot point of the unit
    frontPivot      PivotPointDescription,
    -- The rear pivot point connecting to the next element,
    -- if present and used (implies another unit is connected)
    rearPivot       PivotPointDescription OPTIONAL,
    bumpers         BumperHeights          OPTIONAL,
    axles           Axles                    OPTIONAL,
    ...
}

```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF TrailersJ2945Slash1B](#). In addition, this item may be used by data structures in other ITS standards.

6.155 Data Frame: DF_TransmissionAndSpeed

Use: The DF_TransmissionAndSpeed data frame expresses the speed of the vehicle and the state of the transmission. The transmission state of “reverse” can be used as a sign value for the speed element when needed.

ASN.1 Representation:

```

TransmissionAndSpeed ::= SEQUENCE {
    transmisson    TransmissionState,
    speed          Velocity
}

```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_FullPositionVector | <ASN> , and |
| DF | DF_RequestorPositionVector | <ASN> . |

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

6.156 Data Frame: DF_TravelerDataFrameList

Use: The DF_TravelerDataFrameList data frame consists of a list of TravelerDataFrame entries.

ASN.1 Representation:

```

TravelerDataFrameList ::= SEQUENCE (SIZE(1..8)) OF TravelerDataFrame

```

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

6.157 Data Frame: DF_TravelerDataFrame

Use: The DF_TravelerDataFrame is used to send a single “message” in a TIM message. The data frame allows sending various advisory and road sign types of information to equipped devices. It uses 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 octets 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 (or set of areas) can be expressed using either a radius system or one of the two systems of short defined regions. This expression is similar to the way roadway geometry is defined in the map fragment messages.

ASN.1 Representation:

```
TravelerDataFrame ::= SEQUENCE {
    -- Part I, Frame header
    notUsed    SSPindex,
    -- always set to 0 and carries no meaning;
    -- legacy field maintained for backward compatibility
    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, -- only if needed
    startTime   MinuteOfTheYear,
    durationTime MinutesDuration,
    priority    SignPriority,

    -- Part II, Applicable Regions of Use
    notUsed1    SSPindex,
    regions SEQUENCE (SIZE(1..16)) OF GeographicalPath,

    -- Part III, Content
    notUsed2    SSPindex, -- set to 0
    notUsed3    SSPindex, -- set to 0
    content CHOICE {
        advisory      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 available services
        -- other types may be added in future revisions
    },
    url          URL-Short OPTIONAL, -- May link to image or other content
    ... ,
    -- New Part III content
    contentNew    TravelerDataFrameNewPartIIIContent
}
```

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

6.158 Data Frame: DF_TravelerDataFrameNewPartIIIContent

Use: The DF_TravelerDataFrameNewPartIIIContent data frame contains information that extends the original traveler data frame to enable addition of future entities. Friction information is the first entity included in the new part three content.

ASN.1 Representation:

```
TravelerDataFrameNewPartIIIContent ::= CHOICE {
    -- Add new content types for future revisions here
    frictionInfo      FrictionInformation,
    ...
}
```

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

6.159 Data Frame: DF_ValidRegion

Use: The DF_ValidRegion data frame is used to describe one or more geographic locations to which a message is applied or considered valid. These messages are typically road signs or advisories.

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
    }
}
```

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

Remarks: This entry was used in the 2009 and 2015 edition of the standard but is not recommended for further use. The TIM and other message now use the DF_GeographicalPath for the same needs.

6.160 Data Frame: DF_VehicleClassification

Use: The DF_VehicleClassification data frame is a structure with a composite set of common classification systems used in ITS. There are any number of such “types” that can be used to classify a vehicle based on different systems and needs. A given use case will typically use only a subset of the items noted below.

ASN.1 Representation:

```

VehicleClassification ::= SEQUENCE {
  -- Composed of the following elements:

  -- The 'master' V2X list used when space is limited
  keyType          BasicVehicleClass OPTIONAL,

  -- Types used in the MAP/SPAT/SSR/SRM exchanges
  role             BasicVehicleRole OPTIONAL, -- Basic CERT role at a given time
  iso3883          Iso3833VehicleType OPTIONAL,
  hpmsType         VehicleType OPTIONAL, -- HPMS classification types

  -- ITIS types for classes of vehicle and agency
  vehicleType      VehicleGroupAffected OPTIONAL,
  responseEquip    IncidentResponseEquipment OPTIONAL,
  responderType    ResponderGroupAffected OPTIONAL,

  -- Fuel types for vehicles
  fuelType         FuelType OPTIONAL,

  regional         SEQUENCE (SIZE(1..4)) OF
                  RegionalExtension {{Reg-VehicleClassification}} OPTIONAL,
  ...
}

```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|-----|--|-----------------------------------|
| DF | DF_SupplementalVehicleExtensions | <ASN> , and |
| MSG | MSG_ProbeVehicleData (PVD) | <ASN> . |

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

6.161 Data Frame: DF_VehicleData

Use: The DF_VehicleData data frame is used to convey additional data about the vehicle not found in the BSM Part I data frame.

ASN.1 Representation:

```

VehicleData ::= SEQUENCE {
  -- Values for width and length are sent in BSM part I
  height           VehicleHeight OPTIONAL,
  trailerPresent   BOOLEAN OPTIONAL,
  bumpers          BumperHeights OPTIONAL,
  mass            VehicleMass OPTIONAL,
  pivotPoint       PivotPointDescription OPTIONAL,
  -- Angle ignored in PivotPointDescription, set to 0
  axles            Axles OPTIONAL,
  rollAngle        INTEGER (-90..90) OPTIONAL,
  -- In 1 deg increments, for motorcycles only
  deprecated       TrailerWeight OPTIONAL,
  -- To be deprecated in the next revision of J2735
  ...
}

```

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

6.162 Data Frame: DF_VehicleIdent

Use: The DF_VehicleIdent data frame is used to provide identity information about a selected vehicle. This data frame is typically 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            VehicleID OPTIONAL,
                -- same value used in the BSM

    vehicleType   VehicleType OPTIONAL,
    vehicleClass  CHOICE {
        vGroup    VehicleGroupAffected,
        rGroup    ResponderGroupAffected,
        rEquip    IncidentResponseEquipment
    } OPTIONAL,

    ...
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|-----|--|-----------------------------------|
| DF | DF_VehicleStatus | <ASN> , and |
| MSG | MSG_ProbeVehicleData (PVD) | <ASN> . |

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

6.163 Data Frame: DF_VehicleID

Use: The DF_VehicleID data frame is used to contain either a (US) TemporaryID or an (EU) StationID in a simple frame. These two different value domains are used to uniquely identify a vehicle or other object in these two regional V2X environments. In normal use cases, this value changes over time to prevent tracking of the subject vehicle. When this value is unavailable but needed by another type of user (such as the roadside infrastructure sending data about an unequipped vehicle), the value zero shall be used. A typical restriction on the use of this value during a dialog or other exchange is that the value remains constant for the duration of that exchange. Refer to the performance requirements for a given application for details.

ASN.1 Representation:

```
VehicleID ::= CHOICE {
    entityID      TemporaryID,
    stationID     StationID
}
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|---|-----------------------------------|
| DF | DF_RequestorDescription | <ASN> , and |
| DF | DF_SignalRequesterInfo | <ASN> , and |
| DF | DF_VehicleIdent | <ASN> . |

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

6.164 Data Frame: DF_VehicleSafetyExtensions

Use: The DF_VehicleSafetyExtensions 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 or used in other messages at the same or reduced frequency. The `timestamp` and `height` data structures in this data frame were added to this document in the 2022 revision to support SAE J2945/1B.

ASN.1 Representation:

```
VehicleSafetyExtensions ::= SEQUENCE {
    events           VehicleEventFlags      OPTIONAL,
    pathHistory      PathHistory            OPTIONAL,
    pathPrediction   PathPrediction         OPTIONAL,
    lights           ExteriorLights         OPTIONAL,
    ...,
    timestamp        DDateTime              OPTIONAL,  -- Added for security
    height           VehicleHeight          OPTIONAL  -- Added for truck height
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|-----|--|-----------------------------------|
| DF | DF_Snapshot | <ASN> , and |
| MSG | MSG_BasicSafetyMessage (BSM) | <ASN> . |

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

6.165 Data Frame: DF_VehicleSize

Use: The DF_VehicleSize is a data frame representing the vehicle length and vehicle width in a single data concept.

ASN.1 Representation:

```
VehicleSize ::= SEQUENCE {
    width    VehicleWidth,
    length   VehicleLength
}
```

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

6.166 Data Frame: DF_VehicleStatusRequest

Use: The DF_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,
    sendOnLessThanValue INTEGER (-32767..32767) OPTIONAL,
    sendOnMoreThanValue INTEGER (-32767..32767) OPTIONAL,
    sendAll           BOOLEAN OPTIONAL,
    ...
}

```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_VehicleStatusRequestList](#) <ASN>. 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.

6.167 Data Frame: DF_VehicleStatusRequestList

Use: The DF_VehicleStatusRequestList data frame consists of a list of VehicleStatusRequest entries.

ASN.1 Representation:

```

VehicleStatusRequestList ::= SEQUENCE (SIZE(1..32)) OF VehicleStatusRequest

```

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

6.168 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 information types are used in data event snapshots which are gathered and periodically reported to an RSU or as part of the BSM Part II content.

It should be noted 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.

ASN.1 Representation:

```

VehicleStatus ::= SEQUENCE {
    lights          ExteriorLights OPTIONAL,           -- Exterior Lights
    lightBar        LightbarInUse OPTIONAL,             -- PS Lights

    wipers          WiperSet OPTIONAL,                  -- Wipers

    brakeStatus     BrakeSystemStatus OPTIONAL,

    brakePressure   BrakeAppliedPressure OPTIONAL,      -- Braking Data
    roadFriction    CoefficientOfFriction OPTIONAL,      -- Braking Pressure
                                                         -- 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 which has
                                                -- exceeded acceleration point
        yawRateCon      YawRateConfidence          OPTIONAL,
                                                -- Yaw Rate Confidence
        hozAccelCon      AccelerationConfidence        OPTIONAL,
                                                -- Acceleration Confidence
        confidenceSet    ConfidenceSet              OPTIONAL
                                                -- general ConfidenceSet
    } OPTIONAL,

    object SEQUENCE {
        obDist      ObstacleDistance,          -- Obstacle Distance
        obDirect     Angle,                      -- 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,          -- common vehicle identity data

    j1939data    J1939data  OPTIONAL,            -- Various SAE J1938 data items

    weatherReport SEQUENCE {
        isRaining    EssPrecipYesNo,
        rainRate     EssPrecipRate              OPTIONAL,
        precipSituation EssPrecipSituation        OPTIONAL,
        solarRadiation EssSolarRadiation          OPTIONAL,
        friction      EssMobileFriction          OPTIONAL
    } OPTIONAL,                                -- local weather data

    gnssStatus    GNSSstatus          OPTIONAL,    -- vehicle's GPS

    ...
}

```

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

6.169 Data Frame: DF_VerticalOffset

Use: The DF_VerticalOffset data frame represents a change in the vertical position above or below the reference ellipsoid (typically WGS-84) from a prior value. The numbering system has a resolution of 1 decimeter and supports several variations with different bit width sizes as well as the full range of the Elevation structure. In this respect, this entry is similar to the DF_NodeOffsetPointLL and DF_NodeOffsetPointLL entries used to express offsets in horizontal plane for positions.

ASN.1 Representation:

```
VerticalOffset ::= CHOICE {
  -- Vertical Offset
  -- All below in steps of 10cm above or below the reference ellipsoid
  offset1      VertOffset-B07, -- with a range of +- 6.3 meters vertical
  offset2      VertOffset-B08, -- with a range of +- 12.7 meters vertical
  offset3      VertOffset-B09, -- with a range of +- 25.5 meters vertical
  offset4      VertOffset-B10, -- with a range of +- 51.1 meters vertical
  offset5      VertOffset-B11, -- with a range of +- 102.3 meters vertical
  offset6      VertOffset-B12, -- with a range of +- 204.7 meters vertical
  elevation    Elevation,      -- with a range of -409.5 to + 6143.9 meters
  regional     RegionalExtension {{Reg-VerticalOffset}}
  -- offset which follows is of a
  -- regional definition type
}
```

6.170 Data Frame: DF_WeatherProbe

Use: The DF_WeatherProbe data frame provides basic data on the air temperature and barometric pressure experienced by a vehicle, as well as the current status of the wiper systems on the vehicle, including front and rear wiper systems (where equipped) to indicate coarse rainfall levels.

ASN.1 Representation:

```
WeatherProbe ::= SEQUENCE {
  airTemp      AmbientAirTemperature OPTIONAL,
  airPressure  AmbientAirPressure    OPTIONAL,
  rainRates    WiperSet              OPTIONAL,
  ...
}
```

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

6.171 Data Frame: DF_WeatherReport

Use: The DF_WeatherReport data frame is used to convey weather measurements made by the sending device.

ASN.1 Representation:

```
WeatherReport ::= SEQUENCE {
  isRaining    EssPrecipYesNo,
  rainRate     EssPrecipRate    OPTIONAL,
  precipSituation EssPrecipSituation OPTIONAL,
  solarRadiation EssSolarRadiation OPTIONAL,
  friction      EssMobileFriction OPTIONAL,
  roadFriction  CoefficientOfFriction OPTIONAL,
  ...
}
```

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

6.172 Data Frame: DF_WiperSet

Use: The DF_WiperSet data frame provides the current status of the wiper systems on the subject vehicle, including front and rear wiper systems (where equipped).

ASN.1 Representation:

```
WiperSet ::= SEQUENCE {
    statusFront      WiperStatus,
    rateFront        WiperRate,
    statusRear       WiperStatus    OPTIONAL,
    rateRear         WiperRate      OPTIONAL
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|----------------------------------|-----------------------------------|
| DF | DF_VehicleStatus | <ASN> , and |
| DF | DF_WeatherProbe | <ASN> . |

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

Remarks: It should be noted that when the wiper status 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 certain data elements defined by this standard.

7.1 Data Element: DE_Acceleration

Use: The DE_Acceleration data element represents the signed acceleration of the vehicle along some known axis in units of 0.01 m/s². A range of over 2Gs is supported. The coordinate system is as defined in 11.4.

Longitudinal acceleration is the acceleration along the X axis or the vehicle's direction of travel which is generally in parallel with a front to rear centerline. Negative values indicate deceleration, and possible braking action. Lateral acceleration is the acceleration along the Y axis or perpendicular to the vehicle's general direction of travel in parallel with a left-to-right centerline.

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
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_AccelerationSet4Way](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.2 Data Element: DE_AccelerationConfidence

Use: The DE_AccelerationConfidence data element is used to provide 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 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 reference and axis of rotation used shall be in accordance with that defined Section 11.

ASN.1 Representation:

```
AccelerationConfidence ::= ENUMERATED {
    unavailable (0), -- Not Equipped or data is unavailable
    accl-100-00 (1), -- 100 meters/second squared
    accl-010-00 (2), -- 10 meters/second squared
    accl-005-00 (3), -- 5 meters/second squared
    accl-001-00 (4), -- 1 meters/second squared
    accl-000-10 (5), -- 0.1 meters/second squared
    accl-000-05 (6), -- 0.05 meters/second squared
    accl-000-01 (7) -- 0.01 meters/second squared
} -- Encoded as a 3 bit value
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_AccelSteerYawRateConfidence](#) [<ASN>](#), and

DF [DF_VehicleStatus](#) [<ASN>](#).

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

7.3 Data Element: DE_AdvisorySpeedType

Use: The DE_AdvisorySpeedType data element relates the type of travel to which a given speed refers. This element is typically used as part of an AdvisorySpeed data frame for signal phase and timing data.

ASN.1 Representation:

```
AdvisorySpeedType ::= ENUMERATED {
    none (0),
    greenwave (1),
    ecoDrive (2),
    transit (3),
    ...
} -- Note: subject to further growth
```

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.

7.4 Data Element: DE_AllowedManeuvers

Use: The DE_AllowedMovements data element relates the allowed (possible) maneuvers from a lane, typically a motorized vehicle lane. It should be noted 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 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: a 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 two other data structures in this standard:

| | | |
|----|-----------------------------------|-----------------------------------|
| DF | DF_ConnectingLane | <ASN> , and |
| DF | DF_GenericLane | <ASN> . |

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

Remarks: When used by data frames, 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); and within each ConnectsTo structure. Each ConnectsTo structure contains a list 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. It should be noted 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 five-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 descriptions may contain an exhaustive set of ConnectsTo information (unsignalized intersections for example) and in such cases the AllowedManeuvers in the generic lane structure can be used. If present 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: The DE_AmbientAirPressure 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 1088

```


Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_VehicleStatus](#) [<ASN>](#), and

DF [DF_WeatherProbe](#) [<ASN>](#).

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

Remarks: Barometric pressure is the pressure exerted by the weight of the earth's atmosphere, equal to 1 bar, 100 kPa, 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 exhaust gas recirculation (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 0.14503773773020923.

7.6 Data Element: DE_AmbientAirTemperature

Use: The DE_AmbientAirTemperature data element is used to relate the measured Ambient Air Temperature from a vehicle or other device. Its measurement range and precision follow that defined by the relevant OBD-II standards. This provides for a precision of 1 °C and a range of -40 to +230 °C. In this use, we reduce the upper value allow to be +150 and to allow it to be encoded in a 1 octet value. The value of -40 °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 °C is transmitted as 40+25=65 or Hex 0x41.

ASN.1 Representation:

```
AmbientAirTemperature ::= INTEGER (0..191) -- in °C with a -40 offset
-- The value 191 shall indicate an unknown value
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_VehicleStatus](#) [<ASN>](#), and

DF [DF_WeatherProbe](#) [<ASN>](#).

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

7.7 Data Element: DE_Angle

Use: The DE_Angle data element Angle is used to describe an angular measurement in units of degrees. This data element is often used as a heading direction when in motion. In this use, the current heading of the sending device 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 value of 28800 shall be used when angle is unavailable.

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 directly used by the following six other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_ComputedLane | <ASN> , and |
| DF | DF_ObstacleDetection | <ASN> , and |
| DF | DF_PivotPointDescription | <ASN> , and |
| DF | DF_RequestorPositionVector | <ASN> , and |
| DF | DF_TrailerHistoryPoint | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> . |

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

Remarks: Note that other heading and angle data elements of various sizes and precisions are found in other parts of this standard and in ITS.

7.8 Data Element: DE_AnimalPropelledType

Use: The DE_AnimalPropelledType data element is used to describe the propulsion type that is performed by an animal.

ASN.1 Representation:

```
AnimalPropelledType ::= ENUMERATED {
    unavailable          (0),
    otherTypes           (1), -- any method not listed below
    animalMounted        (2), -- as in horseback
    animalDrawnCarriage (3),
    ...
}
```

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

7.9 Data Element: DE_AnimalType

Use: The DE_AnimalType data element is used to describe a type of animal.

ASN.1 Representation:

```
AnimalType ::= ENUMERATED {
    unavailable          (0),
    serviceUse          (1), -- Includes guide or police animals
    pet                 (2),
    farm                (3),
    ...
}
```

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

7.10 Data Element: DE_AntiLockBrakeStatus

Use: The DE_AntiLockBrakeStatus data element reflects the status of the vehicle ABS. The element can inform others that the vehicle is not equipped with ABS or, if equipped, if the ABS status is unavailable. If the vehicle is equipped with ABS and the status is available, the element reports whether the system is in an off, on, or engaged state.

ASN.1 Representation:

```

AntiLockBrakeStatus ::= ENUMERATED {
    unavailable (0), -- B'00 Vehicle Not Equipped with ABS Brakes
                        -- or ABS Brakes status is unavailable
    off (1), -- B'01 Vehicle's ABS are Off
    on (2), -- B'10 Vehicle's ABS are On ( but not Engaged )
    engaged (3) -- B'11 Vehicle's ABS control is Engaged on any wheel
}

```

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

7.11 Data Element: DE_ApproachID

Use: The DE_ApproachID data element is used to relate the index of an approach, either ingress or egress within the subject lane. In general, an approach index in the context 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 can be used to indicate the gross position of a moving object (vehicle) when its lane level accuracy is unknown. This value can also be used when a deployment represents sets of lanes as groups without further details (as is done in Japan).

ASN.1 Representation:

```

ApproachID ::= INTEGER (0..15) -- zero to be used when valid value is unknown

```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_ApproachOrLane | <ASN> , and |
| DF | DF_GenericLane | <ASN> , and |
| DF | DF_IntersectionAccessPoint | <ASN> . |

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

7.12 Data Element: DE_AsphaltOrTarType

Use: Indicates the surface of the roadway is asphalt or tar. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```

AsphaltOrTarType ::= ENUMERATED {
    newSharp,
    traveled,
    trafficPolished,
    excessTar,
    ...
}

```

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

7.13 Data Element: DE_Attachment

Use: The DE_Attachment data element is used to describe the attachment to another object which the (nonmotorized) pedestrian (considered here as a vulnerable road user) may have. This applies to the person/user/device who has the attachment, not the attachment itself, or any occupant of the attachment.

ASN.1 Representation:

```
Attachment ::= ENUMERATED {
    unavailable          (0), -- has some unknown attachment type
    stroller              (1),
    bicycleTrailer        (2),
    cart                  (3),
    wheelchair            (4),
    otherWalkAssistAttachments (5),
    pet                   (6),
    ...
}
```

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

7.14 Data Element: DE_AttachmentRadius

Use: The DE_AttachmentRadius data element is used to describe the radius of an attachment to another object which the (nonmotorized) pedestrian may have.

ASN.1 Representation:

```
AttachmentRadius ::= INTEGER (0..200) -- In LSB units of one decimeter
```

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

7.15 Data Element: DE_AuxiliaryBrakeStatus

Use: The DE_AuxiliaryBrakeStatus data element reflects the status of the auxiliary brakes (sometimes referred to as the parking brake) of the vehicle. The element can inform others that the vehicle is not equipped with auxiliary brakes or, if equipped, if the auxiliary brakes status is unavailable. If the vehicle is equipped with auxiliary brakes and the status is available, the element reports whether the auxiliary brakes are in a fully released (off) state or in an engaged or in the process of being engaged (on) state.

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
}
```

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

7.16 Data Element: DE_BasicVehicleClass

Use: The BasicVehicleClass data element is used to provide a common classification system to categorize V2X-equipped devices for various cross-cutting uses. Several other classification systems in this data dictionary can be used to provide more domain specific detail when required.

ASN.1 Representation:

```

BasicVehicleClass ::= INTEGER (0..255)
unknownVehicleClass      BasicVehicleClass ::= 0
                           -- Not Equipped, Not known or unavailable
specialVehicleClass      BasicVehicleClass ::= 1
                           -- Special use

--
-- Basic Passenger Motor Vehicle Types
--
passenger-Vehicle-TypeUnknown BasicVehicleClass ::= 10 -- default type
passenger-Vehicle-TypeOther   BasicVehicleClass ::= 11
-- various fuel types are handled in another element

--
-- Light Trucks, Pickup, Van, Panel
--
lightTruck-Vehicle-TypeUnknown BasicVehicleClass ::= 20 -- default type
lightTruck-Vehicle-TypeOther   BasicVehicleClass ::= 21

--
-- Trucks, Various axle types, includes HPMS items
--
truck-Vehicle-TypeUnknown BasicVehicleClass ::= 25 -- default type
truck-Vehicle-TypeOther BasicVehicleClass ::= 26
truck-axleCnt2 BasicVehicleClass ::= 27 -- Two axle, six tire single units
truck-axleCnt3 BasicVehicleClass ::= 28 -- Three axle, single units
truck-axleCnt4 BasicVehicleClass ::= 29 -- Four or more axle, single unit
truck-axleCnt4Trailer BasicVehicleClass ::= 30 -- Four or less axle, single trailer
truck-axleCnt5Trailer BasicVehicleClass ::= 31 -- Five or less axle, single trailer
truck-axleCnt6Trailer BasicVehicleClass ::= 32 -- Six or more axle, single trailer
truck-axleCnt5MultiTrailer BasicVehicleClass ::= 33 -- Five or less axle, multi-
trailer
truck-axleCnt6MultiTrailer BasicVehicleClass ::= 34 -- Six axle, multi-trailer
truck-axleCnt7MultiTrailer BasicVehicleClass ::= 35 -- Seven or more axle, multi-
trailer

--
-- Motorcycle Types
--
motorcycle-TypeUnknown      BasicVehicleClass ::= 40 -- default type
motorcycle-TypeOther        BasicVehicleClass ::= 41
motorcycle-Cruiser-Standard BasicVehicleClass ::= 42
motorcycle-SportUnclad      BasicVehicleClass ::= 43
motorcycle-SportTouring     BasicVehicleClass ::= 44
motorcycle-SuperSport       BasicVehicleClass ::= 45
motorcycle-Touring          BasicVehicleClass ::= 46
motorcycle-Trike            BasicVehicleClass ::= 47
motorcycle-wPassengers      BasicVehicleClass ::= 48 -- type not stated

--
-- Transit Types
--
transit-TypeUnknown      BasicVehicleClass ::= 50 -- default type
transit-TypeOther        BasicVehicleClass ::= 51
transit-BRT              BasicVehicleClass ::= 52
transit-ExpressBus       BasicVehicleClass ::= 53
transit-LocalBus         BasicVehicleClass ::= 54
transit-SchoolBus        BasicVehicleClass ::= 55
transit-FixedGuideway    BasicVehicleClass ::= 56
transit-Paratransit      BasicVehicleClass ::= 57

```

```

transit-Paratransit-Ambulance    BasicVehicleClass ::= 58

--
-- Emergency Vehicle Types
--
emergency-TypeUnknown           BasicVehicleClass ::= 60 -- default type
emergency-TypeOther             BasicVehicleClass ::= 61 -- includes federal users
emergency-Fire-Light-Vehicle    BasicVehicleClass ::= 62
emergency-Fire-Heavy-Vehicle    BasicVehicleClass ::= 63
emergency-Fire-Paramedic-Vehicle BasicVehicleClass ::= 64
emergency-Fire-Ambulance-Vehicle BasicVehicleClass ::= 65
emergency-Police-Light-Vehicle  BasicVehicleClass ::= 66
emergency-Police-Heavy-Vehicle  BasicVehicleClass ::= 67
emergency-Other-Responder       BasicVehicleClass ::= 68
emergency-Other-Ambulance       BasicVehicleClass ::= 69

--
-- Other V2X Equipped Travelers
--
otherTraveler-TypeUnknown       BasicVehicleClass ::= 80 -- default type
otherTraveler-TypeOther         BasicVehicleClass ::= 81
otherTraveler-Pedestrian        BasicVehicleClass ::= 82
otherTraveler-Visually-Disabled BasicVehicleClass ::= 83
otherTraveler-Physically-Disabled BasicVehicleClass ::= 84
otherTraveler-Bicycle           BasicVehicleClass ::= 85
otherTraveler-Vulnerable-Roadworker BasicVehicleClass ::= 86

--
-- Other V2X Equipped Device Types
--
infrastructure-TypeUnknown      BasicVehicleClass ::= 90 -- default type
infrastructure-Fixed            BasicVehicleClass ::= 91
infrastructure-Movable          BasicVehicleClass ::= 92
equipped-CargoTrailer           BasicVehicleClass ::= 93

```

Used By: This entry is directly used by the following two other data structures in this standard:

- DF [DF_SupplementalVehicleExtensions](#) [<ASN>](#), and
- DF [DF_VehicleClassification](#) [<ASN>](#).

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

Remarks: The DE_BasicVehicleClass should not be confused with the DE_BasicVehicleRole. All V2X-equipped devices always have a DE_BasicVehicleClass which is typically a value fixed over the operational life of the device. By contrast, some V2X-equipped devices depart from their normal role and assume other roles for periods of time. This is typically coordinated with a suitable certificate allowing the owner to assume such a role. As an example, a tow truck leaves the role of a duty passenger vehicle and assumes the role of an active tow truck at selected times (during a service call response and when towing or otherwise a potential hazard to nearby vehicles). During this period of time the BasicVehicleClass remains the same value. In the absence of a stated role a light duty passenger vehicle is presumed.

7.17 Data Element: DE_BasicVehicleRole

Use: The BasicVehicleRole data element indicates the current role that a V2X device is playing. This is most commonly employed when a vehicle needs to take on another role in order to send certain V2X message types. As an example, when a public safety vehicle, such as a police car, wishes to send a signal request message (SRM) to an intersection to request a preemption service, the vehicle takes on the role “police” from the below list in the SRM. The BasicVehicleRole entry is often used and combined with other information about the requester as well, such as details of why the request is being made.

ASN.1 Representation:

```

BasicVehicleRole ::= ENUMERATED {
    -- Values used in the EU and in the US
    basicVehicle      (0), -- Light duty passenger vehicle type
    publicTransport   (1), -- Used in EU for Transit use
    specialTransport  (2), -- Used in EU (e.g., heavy load)
    dangerousGoods    (3), -- Used in EU for any HAZMAT
    roadWork          (4), -- Used in EU for State and Local DOT uses
    roadRescue        (5), -- Used in EU and in the US to include tow trucks.
    emergency         (6), -- Used in EU for Police, Fire and Ambulance units
    safetyCar         (7), -- Used in EU for Escort vehicles
    -- Begin US unique numbering
    none-unknown      (8), -- added to follow current SAE style guidelines
    truck             (9), -- Heavy trucks with additional BSM rights and obligations
    motorcycle        (10), --
    roadSideSource    (11), -- For infrastructure generated calls such as
                        -- fire house, rail infrastructure, roadwork site, etc.

    police            (12), --
    fire              (13), --
    ambulance         (14), -- (does not include private para-transit etc.)
    dot               (15), -- all roadwork vehicles
    transit           (16), -- all transit vehicles
    slowMoving        (17), -- to also include oversize etc.
    stopNgo           (18), -- to include trash trucks, school buses and others
                        -- that routinely disturb the free flow of traffic
    cyclist           (19), --
    pedestrian        (20), -- also includes those with mobility limitations
    nonMotorized      (21), -- other, horse drawn, etc.
    military          (22), --
    ...
}

```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_RequestorType | <ASN> , and |
| DF | DF_SignalRequesterInfo | <ASN> , and |
| DF | DF_VehicleClassification | <ASN> . |

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

Remarks: It should be observed that V2X devices can at times change their roles (i.e., a fire operated by a volunteer fireman can assume a fire role for a period of time, or a pedestrian may assume a cyclist role when using a bicycle). It should be observed that not all V2X devices (or V2X vehicles) can assume all roles, or that a given device in a given role will be provided with a security certificate (CERT) that has suitable SSP credentials to provide the ability to send a particular message or message content. The ultimate responsibility to determine what role is to be used, and what CERTs would be provided for that role (which in turn controls the messages and message content that can be sent within SAE-defined PSIDs) rests with the regional deployment.

7.18 Data Element: DE_BrakeAppliedPressure

Use: The applied pressure of the vehicle brake system. The precise pressure of each value is not specified; however, the collection is presumed to be monotonic.

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

```

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

7.19 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 is; this is handled in another data element (DE_BrakeAppliedPressure).

ASN.1 Representation:

```

BrakeAppliedStatus ::= BIT STRING {
    unavailable (0), -- When set, the brake applied status is unavailable
    leftFront (1), -- Left Front Active
    leftRear (2), -- Left Rear Active
    rightFront (3), -- Right Front Active
    rightRear (4) -- Right Rear Active
} (SIZE (5))

```

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

7.20 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 reports by equipped vehicles activating their 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)
}
```

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

7.21 Data Element: DE_BumperHeight

Use: The DE_Bumper Height data element conveys the height of one of the bumpers of the vehicle or object. 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:

```
BumperHeight ::= INTEGER (0..127) -- in units of 0.01 meters from ground surface.
```

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

7.22 Data Element: DE_CindersType

Use: Indicates the surface of the roadway is cinders. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```
CindersType ::= ENUMERATED {
    packed,
    ...
}
```

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

7.23 Data Element: DE_CoarseHeading

Use: The DE_CoarseHeading data element is used to provide a coarser sense of heading than the DE_Heading provides.

ASN.1 Representation:

```
CoarseHeading ::= INTEGER (0..240)
    -- Where the LSB is in units of 1.5 degrees
    -- over a range of 0~358.5 degrees
    -- the value 240 shall be used for unavailable
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_PathHistoryPoint | <ASN> , and |
| DF | DF_TrailerHistoryPoint | <ASN> . |

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

7.24 Data Element: DE_CodeWord

Use: The DE_CodeWord is used to convey a prior known string of octets 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 octet string up to 16 octets
```

7.25 Data Element: DE_CoefficientOfFriction

Note: An alternative (more accurate) method for conveying friction information is provided in SAE J2945/3. This DE is likely to be deprecated in the future.

Use: Coefficient of Friction of an object, typically a wheel in contact with the ground. This data element is typically used in sets where the value at 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 (frictionless), also used when data is unavailable
-- and 50 = 1.00 micro, in steps of 0.02
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|----------------------------------|-----------------------------------|
| DF | DF_VehicleStatus | <ASN> , and |
| DF | DF_WeatherReport | <ASN> . |

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

7.26 Data Element: DE_Confidence

Use: The entry DE_Confidence is a data element representing the general confidence of another associated value.

ASN.1 Representation:

```
Confidence ::= INTEGER (0..200)
-- LSB units of 0.5 percent
```

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

7.27 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)
```

7.28 Data Element: DE_DDay

Use: The V2X 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
```

Used By: This entry is directly used by the following four other data structures in this standard:

| | | |
|----|------------------------------|-----------------------------------|
| DF | DF_DDate | <ASN> , and |
| DF | DF_DDateTime | <ASN> , and |
| DF | DF_DFullTime | <ASN> , and |
| DF | DF_DMonthDay | <ASN> . |

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

7.29 Data Element: DE_DeltaAngle

Use: The DeltaAngle data element provides the final angle used in the last point of the lane 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 axis or 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.

7.30 Data Element: DE_DeltaTime

Use: The DE_DeltaTime data element provides a time definition for an object's schedule adherence (typically a transit vehicle) within a limited range of time. When the reporting object is ahead of schedule, a positive value is used; when behind, a negative value is used. A value of zero indicates schedule adherence. This value is typically sent from a vehicle to the traffic signal controller's RSU to indicate the urgency of a signal request in the context of being within schedule or not. In another use case, the traffic signal controller may advise the transit vehicle to speed up (DeltaTime > 0) or to slow down (DeltaTime < 0) to optimize the transit vehicle distribution driving along a specific route (e.g., a bus route).

ASN.1 Representation:

```
DeltaTime ::= INTEGER (-122 .. 121)
-- Supporting a range of +/- 20 minute in steps of 10 seconds
-- the value of -121 shall be used when more than -20 minutes
-- the value of +120 shall be used when more than +20 minutes
-- the value -122 shall be used when the value is unavailable
```

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

7.31 Data Element: DE_DescriptiveName

Use: The DescriptiveName data element is used in maps and intersections to provide a 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))
```

Used By: This entry is directly used by the following nine other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_GenericLane | <ASN> , and |
| DF | DF_GeographicalPath | <ASN> , and |
| DF | DF_IntersectionGeometry | <ASN> , and |
| DF | DF_IntersectionState | <ASN> , and |
| DF | DF_MovementState | <ASN> , and |
| DF | DF_RequestorDescription | <ASN> , and |
| DF | DF_RoadSegment | <ASN> , and |
| DF | DF_VehicleIdent | <ASN> , and |
| MSG | MSG_SignalPhaseAndTiming Message (SPAT) | <ASN> . |

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

7.32 Data Element: DE_DHour

Use: The V2X hour consists 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 used in some transit applications to represent schedule adherence.

ASN.1 Representation:

```
DHour ::= INTEGER (0..31) -- units of hours
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|------------------------------|-----------------------------------|
| DF | DF_DDateTime | <ASN> , and |
| DF | DF_DFullTime | <ASN> , and |
| DF | DF_DTime | <ASN> . |

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

7.33 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 indicate a reverse direction or both directions as well as the original outward direction.

ASN.1 Representation:

```
DirectionOfUse ::= ENUMERATED {
    unavailable (0), -- unknown or NA, not typically used in valid expressions
    forward     (1), -- direction of travel follows node ordering
    reverse     (2), -- direction of travel is the reverse of node ordering
    both        (3)  -- direction of travel allowed in both directions
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_GeographicalPath](#) [<ASN>](#), and

DF [DF_ShapePointSet](#) [<ASN>](#).

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

7.34 Data Element: DE_DistanceUnits

Use: The DistanceUnits data element provides the LSB units to be used in an expression of distance.

ASN.1 Representation:

```
DistanceUnits ::= ENUMERATED {
    centimeter    (0),
    cm2-5         (1), -- Steps of 2.5 centimeters
    decimeter     (2),
    meter         (3),
    kilometer     (4),
    foot          (5), -- US foot, 0.3048 meters exactly
    yard          (6), -- three US feet
    mile          (7)  -- US mile (5280 US feet)
}
```

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

7.35 Data Element: DE_DMinute

Use: The V2X style minute is a simple value consisting of integer values from zero to 59 representing the minutes within an hour. The value of 60 shall represent an unknown value.

ASN.1 Representation:

```
DMinute ::= INTEGER (0..60) -- units of minutes
```

Used By: This entry is directly used by the following three other data structures in this standard:

DF [DF_DDateTime](#) [<ASN>](#), and

DF [DF_DFullTime](#) [<ASN>](#), and

DF [DF_DTime](#) [<ASN>](#).

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

7.36 Data Element: DE_DMonth

Use: The V2X month consists of integer values from one to 12, representing the month within a year. The value of zero shall represent an unknown value.

ASN.1 Representation:

```
DMonth ::= INTEGER (0..12) -- units of months
```

Used By: This entry is directly used by the following five other data structures in this standard:

| | | |
|----|-------------------------------|-----------------------------------|
| DF | DF_DDate | <ASN> , and |
| DF | DF_DDateTime | <ASN> , and |
| DF | DF_DFullTime | <ASN> , and |
| DF | DF_DMonthDay | <ASN> , and |
| DF | DF_DYearMonth | <ASN> . |

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

7.37 Data Element: DE_DOffset

Use: The V2X (time zone) offset consists of a signed integer representing an hour and minute value set from -14:00 to +14:00, representing all the world's local time zones in units of minutes. The value of zero (00:00) may also 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
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|------------------------------|-----------------------------------|
| DF | DF_DDateTime | <ASN> , and |
| DF | DF_DTime | <ASN> . |

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

7.38 Data Element: DE_DrivenLineOffsetLarge

Use: The DE_DrivenLineOffsetLarge data element is an integer value expressing the offset in a defined axis from a reference lane number from which a computed lane is offset. 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](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

Remarks: See also DE_DrivenLineOffsetSmall.

7.39 Data Element: DE_DrivenLineOffsetSmall

Use: The DrivenLineOffsetSmall data element is an integer value expressing the offset in a defined axis from a reference lane number from which a computed lane is offset. 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](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

Remarks: See also DE_DrivenLineOffsetLarge

7.40 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 degree and a range of ± 42.33 degrees. The value of zero shall be set when both wheels are pointed such as to drive the vehicle in a straight ahead direction (the toe-in angle of each side being equal and canceling each other out). A value of -128 shall be sent when unavailable.

ASN.1 Representation:

```
DrivingWheelAngle ::= INTEGER (-128..127)
-- LSB units of 0.3333 degrees.
-- a range of 42.33 degrees each way
```

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

7.41 Data Element: DE_DSecond

Use: The V2X second expressed in this data element consists 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. The values from 61000 to 65534 are reserved.

ASN.1 Representation:

```
DSecond ::= INTEGER (0..65535) -- units of milliseconds
```

Used By: This entry is directly used by the following 10 other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_BSMcoreData | <ASN> , and |
| DF | DF_DDateTime | <ASN> , and |
| DF | DF_DTime | <ASN> , and |
| DF | DF_Header | <ASN> , and |
| DF | DF_IntersectionState | <ASN> , and |
| DF | DF_SignalRequestPackage | <ASN> , and |
| DF | DF_SignalStatusPackage | <ASN> , and |
| MSG | MSG_PersonalSafetyMessage (PSM) | <ASN> , and |
| MSG | MSG_SignalRequestMessage (SRM) | <ASN> , and |
| MSG | MSG_SignalStatusMessage (SSM) | <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 V2X 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 varying difference between solar time and UTC time caused by changes in the earth's rotation rate.

7.42 Data Element: DE_DSRC_MessageID

Use: The V2X message ID is a data element used with each message in the framework to define which type of message follows from the message set defined by this standard.

ASN.1 Representation:

```
DSRCmsgID ::= INTEGER (0..32767)
--
-- DER forms,
-- All DER forms are now retired and not to be used
--
reservedMessageId-D          DSRCmsgID ::= 0 --'00'H
alaCarteMessage-D           DSRCmsgID ::= 1 --'01'H ACM
-- alaCarteMessage-D is Retired, not to be used
basicSafetyMessage-D         DSRCmsgID ::= 2 --'02'H BSM, heartbeat msg
basicSafetyMessageVerbose-D  DSRCmsgID ::= 3 --'03'H For testing only
commonSafetyRequest-D        DSRCmsgID ::= 4 --'04'H CSR
emergencyVehicleAlert-D      DSRCmsgID ::= 5 --'05'H EVA
intersectionCollision-D       DSRCmsgID ::= 6 --'06'H ICA
mapData-D                    DSRCmsgID ::= 7 --'07'H MAP, intersections
nmeaCorrections-D            DSRCmsgID ::= 8 --'08'H NMEA
probeDataManagement-D        DSRCmsgID ::= 9 --'09'H PDM
probeVehicleData-D           DSRCmsgID ::= 10 --'0A'H PVD
roadSideAlert-D              DSRCmsgID ::= 11 --'0B'H RSA
rtcmCorrections-D            DSRCmsgID ::= 12 --'0C'H RTCM
signalPhaseAndTimingMessage-D DSRCmsgID ::= 13 --'0D'H SPAT
signalRequestMessage-D        DSRCmsgID ::= 14 --'0E'H SRM
signalStatusMessage-D         DSRCmsgID ::= 15 --'0F'H SSM
travelerInformation-D         DSRCmsgID ::= 16 --'10'H TIM
uperFrame-D                   DSRCmsgID ::= 17 --'11'H UPER frame

--
-- UPER forms
--
mapData                       DSRCmsgID ::= 18 -- MAP, intersections
signalPhaseAndTimingMessage  DSRCmsgID ::= 19 -- SPAT
-- Above two entries were adopted in the 2015-04 edition
-- Message assignments added in 2015 follow below
basicSafetyMessage           DSRCmsgID ::= 20 -- BSM, heartbeat msg
commonSafetyRequest           DSRCmsgID ::= 21 -- CSR
emergencyVehicleAlert         DSRCmsgID ::= 22 -- EVA
intersectionCollision          DSRCmsgID ::= 23 -- ICA
nmeaCorrections               DSRCmsgID ::= 24 -- NMEA
probeDataManagement           DSRCmsgID ::= 25 -- PDM
probeVehicleData              DSRCmsgID ::= 26 -- PVD
roadSideAlert                 DSRCmsgID ::= 27 -- RSA
rtcmCorrections               DSRCmsgID ::= 28 -- RTCM
signalRequestMessage           DSRCmsgID ::= 29 -- SRM
signalStatusMessage           DSRCmsgID ::= 30 -- SSM
travelerInformation            DSRCmsgID ::= 31 -- TIM
personalSafetyMessage          DSRCmsgID ::= 32 -- PSM
roadSafetyMessage             DSRCmsgID ::= 33 -- RSM
```



```

roadWeatherMessage          DSRCmsgID ::= 34 -- RWM
probeDataConfigMessage      DSRCmsgID ::= 35 -- PDC
probeDataReportMessage      DSRCmsgID ::= 36 -- PDR
tollAdvertisementMessage     DSRCmsgID ::= 37 -- TAM
tollUsageMessage            DSRCmsgID ::= 38 -- TUM
tollUsageAckMessage         DSRCmsgID ::= 39 -- TUMack
cooperativeControlMessage    DSRCmsgID ::= 40 -- CCM
sensorDataSharingMessage     DSRCmsgID ::= 41 -- SDSM
maneuverSharingAndCoordinatingMessage DSRCmsgID ::= 42 -- MSCM
roadGeometryAndAttributes    DSRCmsgID ::= 43 -- RGA
personalSafetyMessage2       DSRCmsgID ::= 44 -- PSM2
trafficSignalPhaseAndTiming  DSRCmsgID ::= 45 -- TSPaT
signalControlAndPrioritizationRequest DSRCmsgID ::= 46 -- SCPR
signalControlAndPrioritizationStatus DSRCmsgID ::= 47 -- SCPS

```

```
--
```

```
-- The below values are reserved for local message testing use
```

```
--
```

```

testMessage00              DSRCmsgID ::= 240 -- Hex 0xF0
testMessage01              DSRCmsgID ::= 241
testMessage02              DSRCmsgID ::= 242
testMessage03              DSRCmsgID ::= 243
testMessage04              DSRCmsgID ::= 244
testMessage05              DSRCmsgID ::= 245
testMessage06              DSRCmsgID ::= 246
testMessage07              DSRCmsgID ::= 247
testMessage08              DSRCmsgID ::= 248
testMessage09              DSRCmsgID ::= 249
testMessage10              DSRCmsgID ::= 250
testMessage11              DSRCmsgID ::= 251
testMessage12              DSRCmsgID ::= 252
testMessage13              DSRCmsgID ::= 253
testMessage14              DSRCmsgID ::= 254
testMessage15              DSRCmsgID ::= 255-- Hex 0xFF

```

```
--
```

```
-- All other values are reserved for std use
```

```
--
```

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

Remarks: The three/four letter abbreviations shown in the ASN comments are sometimes used as shorthand terms for the subject messages in the documentation. This name space shall be used to indicate any revised messages and to assign a new message ID when revisions occur. The transition from the DER to UPER style of encoding in the current standard is an example of this process, resulting in new assignments for the new formats.

The assignment of additional message IDs, and of new message IDs, is performed only by of SAE V2X Communications Technical Committees. Local deployments are free to use the range of assigned test message IDs in any way they see fit but shall not define additional further IDs. Local deployments may use the ability to further sub-type within any message structures that they define to provide a method for evaluating or testing further types.

7.43 Data Element: DE_Duration

Use: The Duration data element provides a range of zero to 3600 seconds (1 hour) for a requested or described service. The value zero shall be used to indicate an unknown or indefinite duration.

ASN.1 Representation:

```
Duration ::= INTEGER (0..3600) -- units of seconds
```

7.44 Data Element: DE_DYear

Use: The V2X year consists of integer values from zero to 4095 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..4095) -- units of years
```

Used By: This entry is directly used by the following six other data structures in this standard:

| | | |
|----|--------------------------------------|-----------------------------------|
| DF | DF_DDate | <ASN> , and |
| DF | DF_DDateTime | <ASN> , and |
| DF | DF_DFullTime | <ASN> , and |
| DF | DF_DYearMonth | <ASN> , and |
| DF | DF_Header | <ASN> , and |
| DF | DF_TravelerDataFrame | <ASN> . |

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

Remarks: The prior max value of 9999 was reduced to be 4095 to save two additional bits.

7.45 Data Element: DE_ElevationConfidence

Use: The DE_ElevationConfidence data element is used to provide 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 reference and axis of rotation used shall be in accordance with that defined in Section 11.

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
```

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

7.46 Data Element: DE_Elevation

Use: The DE_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 m is represented as +61439. Any elevation lower than -409.5 m 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:

```
Elevation ::= 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 directly used by the following five other data structures in this standard:

| | | |
|----|---------------------------------------|-----------------------------------|
| DF | DF_BSMcoreData | <ASN> , and |
| DF | DF_FullPositionVector | <ASN> , and |
| DF | DF_Position3D | <ASN> , and |
| DF | DF_VerticalOffset | <ASN> , and |
| DF | DF_REG_Position3D_JPN | <ASN> . |

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

Remarks: When a vehicle is being measured, the elevation is taken from the horizontal spatial center of the vehicle projected downward, regardless of vehicle tilt, to the point where the vehicle meets the road surface.

7.47 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 supersede access to 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),
    useFor50000meters     (9),
    useFor100000meters    (10),
    useFor500000meters    (11),
    useFor1000000meters   (12),
    useFor5000000meters   (13),
    useFor10000000meters  (14),
    forever               (15) -- very wide area
} -- Encoded as a 4 bit value
```

Used By: This entry is directly used by the following four other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_EventDescription | <ASN> , and |
| DF | DF_GeometricProjection | <ASN> , and |
| DF | DF_ValidRegion | <ASN> , and |
| MSG | MSG_RoadSideAlert (RSA) | <ASN> . |

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

7.48 Data Element: DE_ExteriorLights

Use: The DE_ExteriorLights data element provides the status of various exterior lights (when such data is available) encoded in a bit string which can be used to relate the current vehicle settings.

ASN.1 Representation:

```
ExteriorLights ::= BIT STRING {
    -- All lights off is indicated by no bits set
    lowBeamHeadlightsOn      (0),
    highBeamHeadlightsOn     (1),
    leftTurnSignalOn         (2),
    rightTurnSignalOn        (3),
    hazardSignalOn           (4),
    automaticLightControlOn  (5),
    daytimeRunningLightsOn   (6),
    fogLightOn               (7),
    parkingLightsOn          (8)
} (SIZE (9, ...))
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_VehicleSafetyExtensions | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> . |

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

7.49 Data Element: DE_FuelType

Use: This data element provides the type of fuel used by a vehicle.

ASN.1 Representation:

```
FuelType ::= INTEGER (0..15)
    unknownFuel    FuelType ::= 0 -- Gasoline Powered
    gasoline       FuelType ::= 1
    ethanol        FuelType ::= 2 -- Including blends
    diesel         FuelType ::= 3 -- All types
    electric       FuelType ::= 4
    hybrid         FuelType ::= 5 -- All types
    hydrogen       FuelType ::= 6
    natGasLiquid   FuelType ::= 7 -- Liquefied
    natGasComp     FuelType ::= 8 -- Compressed
    propane        FuelType ::= 9
```

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

7.50 Data Element: DE_FullRoadAuthorityID

Use: The DE_FullRoadAuthorityID data element provides the identifier for the fully specified OID of the Road Authority.

ASN.1 Representation:

```
FullRoadAuthorityID ::= OBJECT IDENTIFIER
-- This data element provides the identifier for the fully specified OID of the
-- Road Authority.
```

Used By: This entry is used directly by DF_RoadAuthorityID, this item may be used by data structures in other ITS standards.

7.51 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 unknown 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
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_TravelerDataFrame | <ASN> , and |
| MSG | MSG_RoadSideAlert (RSA) | <ASN> . |

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 the events 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.

7.52 Data Element: DE_GNSSstatus

Use: The DE_GNSSstatus data element is used to relate the current state of a GPS/GNSS rover or base 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. A GNSS set with unknown health and no tracking or corrections would be represented by setting the unavailable bit to one. A value of zero shall be used when a defined data element is unavailable. The term “GPS” in any data element name in this standard does not imply that it is only to be used for GPS-type GNSS systems.

ASN.1 Representation:

```
GNSSstatus ::= BIT STRING {
    unavailable          (0), -- Not Equipped or unavailable
    isHealthy            (1),
    isMonitored          (2),
    baseStationType      (3), -- Set to zero if a moving base station,
                                -- or if a rover device (an OBU),
                                -- set to one if it is a fixed base station
    aPDOPofUnder5        (4), -- A dilution of precision greater than 5
    inViewOfUnder5       (5), -- Less than 5 satellites in view
    localCorrectionsPresent (6), -- DGPS type corrections used
```

```
networkCorrectionsPresent (7)  -- RTK type corrections used
} (SIZE(8))
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|----------------------------------|-----------------------------------|
| DF | DF_PathHistory | <ASN> , and |
| DF | DF_RTCMheader | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> . |

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

7.53 Data Element: DE_GrassType

Use: Indicates the surface of the roadway is grass with low speed limit. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```
GrassType ::= ENUMERATED {
    lessThan30Mph,
    ...
}
```

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

7.54 Data Element: DE_GravelType

Use: Indicates the type of gravel. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```
GravelType ::= ENUMERATED {
    packedOiled,
    loose,
    ...
}
```

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

7.55 Data Element: DE_GrossDistance

Use: The DE_GrossDistance data element represents the distance traveled of an object, typically a vehicle, expressed in unsigned units of 1.00 m.

ASN.1 Representation:

```
GrossDistance ::= INTEGER (0..1023) -- Units of 1.00 meters
-- The value 1023 shall indicate unavailable
```

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

7.56 Data Element: DE_GrossSpeed

Use: The DE_GrossSpeed data element represents the velocity of an object, typically a vehicle speed, expressed in unsigned units of 1.00 m/s. This data element is often used to represent traffic flow rates where precision is not of concern and where the major use cases involve reporting slow traffic flow. Note that velocity as used here is intended to be a scalar value and not a vector.

ASN.1 Representation:

```
GrossSpeed ::= INTEGER (0..31) -- Units of 1.00 m/s
-- The value 30 shall be used for speeds of 30 m/s or greater (67.1 mph)
-- The value 31 shall indicate that the speed is unavailable
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|-------------------------------------|-----------------------------------|
| DF | DF_SnapshotDistance | <ASN> , and |
| DF | DF_SnapshotTime | <ASN> , and |
| DF | DF_SpeedProfileMeasurement | <ASN> |

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

Remarks: Note the conversion guidance provided in 11.5 when units of mph and m/s are mixed.

7.57 Data Element: DE_HeadingConfidence

Use: The DE_HeadingConfidence data element is used to provide 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 reference and axis of rotation used shall be in accordance with that defined Section 11.

ASN.1 Representation:

```
HeadingConfidence ::= ENUMERATED {
    unavailable (0), -- B'000 Not Equipped or unavailable
    prec10deg (1), -- B'010 10 degrees
    prec05deg (2), -- B'011 5 degrees
    prec01deg (3), -- B'100 1 degrees
    prec0-1deg (4), -- B'101 0.1 degrees
    prec0-05deg (5), -- B'110 0.05 degrees
    prec0-01deg (6), -- B'110 0.01 degrees
    prec0-0125deg (7) -- B'111 0.0125 degrees, aligned with heading LSB
} -- Encoded as a 3 bit value
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_ConfidenceSet | <ASN> , and |
| DF | DF_Speed_Heading_Throttle_Confidence | <ASN> . |

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

7.58 Data Element: DE_Heading

Use: The DE_Heading data element provides 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 prescribed by the WGS-84 coordinate system and its reference ellipsoid. Headings “to the east” are defined as the positive direction. A value of 28800 shall be used when unavailable. This element indicates the direction of motion of the device. When the sending device is stopped and the trajectory (path) over which it traveled to reach that location is well known, the past heading may be used.

ASN.1 Representation:

```
Heading ::= INTEGER (0..28800)
-- LSB of 0.0125 degrees
-- A range of 0 to 359.9875 degrees
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_BSMcoreData | <ASN> , and |
| DF | DF_FullPositionVector | <ASN> , and |
| MSG | MSG_PersonalSafetyMessage (PSM) | <ASN> . |

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

Remarks: Note that other heading data elements of various sizes and precisions are found in other parts of this standard and in ITS. This element should no longer be used for new work: the DE_Angle entry is preferred.

7.59 Data Element: DE_HeadingSlice

Use: The DE_HeadingSlice data element is used to define a set of sixteen 22.5 degree slices of a unit circle (defined as 0~360 degrees of heading) which, when a given slice is set to one, indicates that travel, or motion, or message applicability along that slice of angles is allowed. Typically used to indicate a gross range of the direction to which the enclosing message or data frame applies. For example, in a use case indicating what directions of travel are to be considered, a value of 0x8181 would indicate travel in the direction of either due east or due west with a 45 degree cone about each of the cardinal axis.

ASN.1 Representation:

```
HeadingSlice ::= BIT STRING {
-- Each bit 22.5 degree starting from
-- North and moving Eastward (clockwise) as one bit
-- a value of noHeading means no bits set, while a
-- a value of allHeadings means all bits would be set
```

```
from000-0to022-5degrees (0),
from022-5to045-0degrees (1),
from045-0to067-5degrees (2),
from067-5to090-0degrees (3),

from090-0to112-5degrees (4),
from112-5to135-0degrees (5),
from135-0to157-5degrees (6),
from157-5to180-0degrees (7),

from180-0to202-5degrees (8),
from202-5to225-0degrees (9),
from225-0to247-5degrees (10),
from247-5to270-0degrees (11),

from270-0to292-5degrees (12),
from292-5to315-0degrees (13),
```



```

from315-0to337-5degrees  (14) ,
from337-5to360-0degrees  (15)
}  (SIZE (16))

```

Used By: This entry is directly used by the following seven other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_EventDescription | <ASN> , and |
| DF | DF_GeographicalPath | <ASN> , and |
| DF | DF_GeometricProjection | <ASN> , and |
| DF | DF_RoadSignID | <ASN> , and |
| DF | DF_ValidRegion | <ASN> , and |
| MSG | MSG_ProbeDataManagement (PDM) | <ASN> , and |
| MSG | MSG_RoadSideAlert (RSA) | <ASN> . |

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 V2X message set.

7.60 Data Element: DE_HumanPropelledType

Use: The DE_HumanPropelledType data element is used to describe the propulsion type that is performed by human user. When used in a message, the element PersonalDeviceUserType would be set to the value aPEDESTRIAN.

ASN.1 Representation:

```

HumanPropelledType ::= ENUMERATED {
    unavailable          (0),
    otherTypes           (1), -- any method not listed below
    onFoot               (2),
    skateboard           (3),
    pushOrKickScooter    (4),
    wheelchair           (5), -- implies manually powered
    ...
}

```

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

7.61 Data Element: DE_IceType

Use: Indicates the surface of the roadway is smooth ice. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```

IceType ::= ENUMERATED {
    smooth,
    ...
}

```

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

7.62 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 RoadRegulatorID under which this IntersectionID is assigned. Within the region the policies used to ensure an assigned value's uniqueness before that value is reused (if ever) is the responsibility of that region. Any such reuse would be expected to occur over a long epoch (many years).

ASN.1 Representation:

```
IntersectionID ::= INTEGER (0..65535)
-- The values zero through 255 are allocated for testing purposes
-- Note that the value assigned to an intersection will be
-- unique within a given regional ID only
```

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

7.63 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.

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),
    signalPriorityIsActive (4),

    -- 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 and 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 various lanes indexes) not available
    noValidSPATisAvailableAtThisTime (13)
    -- SPAT system is not working at this time
```

```
-- Bits 14,15 reserved at this time and shall be zero
} (SIZE(16))
```

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

Remarks: All zeros indicate normal operating mode with no recent changes. The duration of the term “recent” is defined by the system performance requirement in use.

7.64 Data Element: DE_IsDolly

Use: A DE_IsDolly data element is a flag which is set to true to indicate that the described element is a dolly type rather than a trailer type of object. It should be noted that dollies (like trailers) may or may not pivot at the front and back connection points, and that they do not carry cargo or placards. Dollies do have an outline and connection point offsets like a trailer. Dollies have some form of draw bar to connect to the power unit (the vehicle or trailer in front of it). The term “bogie” is also used for dolly in some markets. In this standard, there is no differentiation between a dolly for a full trailer and a semi-trailer or a converter dolly. The only difference between an A-dolly (single coupling point) and a C-dolly (a dolly with two coupling points arranged side by side) is the way in which the pivoting flag is set. (As a rule, a C-dolly does not pivot.)

ASN.1 Representation:

```
IsDolly ::= BOOLEAN -- When false indicates a trailer unit
```

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

7.65 Data Element: DE_Iso3833VehicleType

Use: The DE_Iso3833VehicleType data element represents the value domain provided by ISO 3833 for general vehicle types. It is a European list similar to the list used for the Highway Performance Monitoring System (HPMS) in the U.S. region. In this standard, the HPMS list is used in the data concept named VehicleType.

ASN.1 Representation:

```
Iso3833VehicleType ::= INTEGER (0..100)
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_RequestorType](#) [<ASN>](#), and

DF [DF_VehicleClassification](#) [<ASN>](#).

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

7.66 Data Element: DE_ITISTextPhrase

Use: The DE_ITISTextPhrase data element is used to provide very short sections of text interspersed between the ITIS codes to create phrases. In general, this is used for expressing proper nouns, such as street names reflecting local expressions that do not appear in the ITIS tables.

ASN.1 Representation:

```
ITISTextPhrase ::= IA5String (SIZE(1..16))
```

Used By: This entry is directly used by the following four other data structures in this standard:

| | | |
|----|---|-----------------------------------|
| DF | DF ITIS Phrase ExitService | <ASN> , and |
| DF | DF ITIS Phrase GenericSignage | <ASN> , and |
| DF | DF ITIS Phrase SpeedLimit | <ASN> , and |
| DF | DF ITIS Phrase WorkZone | <ASN> . |

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

7.67 Data Element: DE_J1939-71-Axle Location

Use: A data element re-used from the SAE J1939 standard and to be encoded as: 256 states/8 bit, 0 offset, Range: 0 to +255. Low order 4 bits represent a position number, counting left to right when facing the direction of normal vehicle travel. High order 4 bits represent a position number, counting front to back on the vehicle. See SPN 928, PGN reference 65258.

ASN.1 Representation:

```
AxleLocation ::= INTEGER (0..255)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF J1939-Data Items <ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.68 Data Element: DE_J1939-71-Axle Weight

Use: A data element re-used from the SAE J1939 standard and to be encoded as: 0.5 kg/bit, 0 offset, Range: 0 to +32127.5 kg. See SPN 582, PGN reference 65258.

ASN.1 Representation:

```
AxleWeight ::= INTEGER (0..64255)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF J1939-Data Items <ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.69 Data Element: DE_J1939-71-Cargo Weight

Use: A data element re-used from the SAE J1939 standard and encoded as: 2 kg/bit, 0 offset, Range: 0 to +128510 kg. See SPN 181, PGN reference 65258.

ASN.1 Representation:

```
CargoWeight ::= INTEGER (0..64255)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF J1939-Data Items <ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.70 Data Element: DE_J1939-71-Drive Axle Lift Air Pressure

Use: A data element re-used from the SAE J1939 standard and encoded as: Units of 4 kPa/bit, 0 offset, Range: 0 to +1000 kPa. See SPN 579, PGN reference 65273.

ASN.1 Representation:

```
DriveAxleLiftAirPressure ::= INTEGER (0..1000)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF J1939-Data Items <ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.71 Data Element: DE_J1939-71-Drive Axle Location

Use: A data element re-used from the SAE J1939 standard and encoded as: 256 states/8 bit, 0 offset, Range: 0 to +255. Low order 4 bits represent a position number, counting left to right when facing the direction of normal vehicle travel. High order 4 bits represent a position number, counting front to back on the vehicle. See SPN 930, PGN reference 65273.

ASN.1 Representation:

```
DriveAxleLocation ::= INTEGER (0..255)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_J1939-Data Items](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.72 Data Element: DE_J1939-71-Drive Axle Lube Pressure

Use: A data element re-used from the SAE J1939 standard and encoded as: 4 kPa/bit, 0 offset, Range: 0 to +1000 kPa. See SPN 2613, PGN reference 65273.

ASN.1 Representation:

```
DriveAxleLubePressure ::= INTEGER (0..250)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_J1939-Data Items](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.73 Data Element: DE_J1939-71-Drive Axle Temperature

Use: A data element re-used from the SAE J1939 standard and encoded as: 1 °C/bit, -40 °C offset, Range: -40 to +210 °C. Note that in this definition of the value, which uses UPER encoding, the offset in the range is handled by the ASN encoder layer. See SPN 578, PGN reference 65273.

ASN.1 Representation:

```
DriveAxleTemperature ::= INTEGER (-40..210)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_J1939-Data Items](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.74 Data Element: DE_J1939-71-Steering Axle Lube Pressure

Use: A data element re-used from the SAE J1939 standard and encoded as: 4 kPa/bit, 0 offset, Range: 0 to +1000 kPa. See SPN 2614, PGN reference 65273.

ASN.1 Representation:

```
SteeringAxleLubePressure ::= INTEGER (0..250)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_J1939-Data Items](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.75 Data Element: DE_J1939-71-Steering Axle Temperature

Use: A data element re-used from the SAE J1939 standard and encoded as: 1 °C/bit, -40 °C offset, Range: -40 to +210 °C. Note that in this definition of the value, which uses UPER encoding, the offset in the range is handled by the ASN encoder layer. See SPN 75, PGN reference 65273.

ASN.1 Representation:

```
SteeringAxleTemperature ::= INTEGER (-40..210)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_J1939-Data Items](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.76 Data Element: DE_J1939-71-Tire Leakage Rate

Use: A data element re-used from the SAE J1939 standard and encoded as: 0.1 Pa/s per bit, 0 offset, Range: 0 to +6425.5 Pa/s. See SPN 2586, PGN reference 65268.

ASN.1 Representation:

```
TireLeakageRate ::= INTEGER (0..64255)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_J1939-Data Items](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.77 Data Element: DE_J1939-71-Tire Location

Use: A data element re-used from the SAE J1939 standard and encoded as: 256 states/8 bit, 0 offset, Range: 0 to 255. Low order 4 bits represent a position number, counting left to right when facing the direction of normal vehicle travel. High order 4 bits represent a position number, counting front to back on the vehicle. See SPN 3190, PGN reference 64953.

ASN.1 Representation:

```
TireLocation ::= INTEGER (0..255)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_J1939-Data Items](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.78 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. See SPN 2587, PGN reference 65268.

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'
} -- Encoded as a 3 bit value
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_J1939-Data Items](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.79 Data Element: DE_J1939-71-Tire Pressure

Use: A data element re-used from the SAE J1939 standard and encoded as: 4 kPa/bit, 0 offset, Range: 0 to +1000 kPa. See SPN 241, PGN reference 65268.

ASN.1 Representation:

```
TirePressure ::= INTEGER (0..250)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_J1939-Data Items](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.80 Data Element: DE_J1939-71-Tire Temp

Use: A data element re-used from the SAE J1939 standard and encoded as: 0.03125 °C /bit, -273 °C offset, Range: -273 to +1734.96875 °C. See SPN 242, PGN reference 65268.

ASN.1 Representation:

```
TireTemp ::= INTEGER (-8736..55519)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF J1939-Data Items](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.81 Data Element: DE_J1939-71-Trailer Weight

Use: A data element re-used from the SAE J1939 standard and encoded as: 2 kg/bit, 0 degree offset, Range: 0 to +128510 kg. See SPN 180, PGN reference 65258.

ASN.1 Representation:

```
TrailerWeight ::= INTEGER (0..64255)
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF J1939-Data Items | <ASN> , and |
| DF | DF_VehicleData | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> , and |
| DF | Data Frame: DF_TrailerUnitDescJ2945Slash1B | <ASN> . |

Note that TrailerWeight is deprecated in DF_VehicleData. In addition, this item may be used by data structures in other ITS standards.

Remarks: The term “weight” is used in SAE J1939, while the term “mass” is used in SAE J2735.

7.82 Data Element: DE_J1939-71-Wheel End Elect. Fault

Use: A data element re-used from the SAE J1939 standard and encoded in UPER to match values defined in that standard. See SPN 1697, PGN reference 65268.

ASN.1 Representation:

```
WheelEndElectFault ::= ENUMERATED {
    isOk                (0), -- No fault
    isNotDefined        (1),
    isError             (2),
    isNotSupported      (3)
}
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF J1939-Data Items](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.83 Data Element: DE_J1939-71-Wheel Sensor Status

Use: A data element re-used from the SAE J1939 standard to encode status values. See SPN 1699, PGN reference 65268.

ASN.1 Representation:

```
WheelSensorStatus ::= ENUMERATED {
    off                (0),
    on                 (1),
    notDefined         (2),
    notSupported       (3)
}
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF J1939-Data Items <ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.84 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). It should be noted 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.

7.85 Data Element: DE_LaneAttributes-Bike

Use: The LaneAttributes-Bike data element relates specific properties found in a bicycle lane type. It should be noted 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 entries

```



```

-- in the Connect follow this same pattern in pairs.
isolatedByBarrier      (5),
unsignalizedSegmentsPresent  (6)
-- 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.

7.86 Data Element: DE_LaneAttributes-Crosswalk

Use: The LaneAttributes-Crosswalk data element relates specific properties found in a crosswalk lane type. It should be noted 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
  bicycleUseAllowed      (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 entries
  -- 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.

7.87 Data Element: DE_LaneAttributes-ParkingLane

Use: The LaneAttributes-Parking data element relates specific properties found in a vehicle parking lane type. It should be noted 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 as
                                -- 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.

7.88 Data Element: DE_LaneAttributes-Sidewalk

Use: The LaneAttributes-Sidewalk data element relates specific properties found in a sidewalk lane type. It should be noted 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

    bicycleUseAllowed             (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.

7.89 Data Element: DE_LaneAttributes-Striping

Use: The LaneAttributes-Striping data element relates specific properties found in various types of ground striping 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. It should be noted 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:
  stripeToConnectingLanesRevocableLane      (0),
    -- this lane may be activated or not activated based
    -- on the current SPAT message contents
    -- if not asserted, the lane is ALWAYS present
  stripeDrawOnLeft                          (1),
  stripeDrawOnRight                         (2),
    -- which side of lane to mark
  stripeToConnectingLanesLeft               (3),
  stripeToConnectingLanesRight              (4),
  stripeToConnectingLanesAhead              (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.

7.90 Data Element: DE_LaneAttributes-TrackedVehicle

Use: The LaneAttributes-Special data element relates specific properties found in a tracked vehicle lane type (trolley and train lanes). The term “rail vehicle” can be considered synonymous. In this case, the term does not relate to vehicle types with tracks or treads. It should be noted that various common lane attribute properties (such as travel directions and allowed movements or maneuvers) can be found in other entries. It should also be noted that often this type of lane object does not 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.

7.91 Data Element: DE_LaneAttributes-Vehicle

Use: The LaneAttributes-Vehicle data element relates specific properties found in a vehicle lane type. This data element provides a means to denote that the use of a lane is restricted to certain vehicle types. 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),
    permissionOnRequest            (7) -- e.g., to inform about a lane for e-cars

    } (SIZE (8,...))

```

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.

7.92 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. It should be noted that the index may be shared with other lanes (for example, two left turn lanes may share the same dynamic clearance data). It should also be noted that a given lane to lane connection may be part of more than one GroupID due to signal phase considerations but will only have one ConnectionID.

ASN.1 Representation:

```

LaneConnectionID ::= INTEGER (0..255)

```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|---|-----------------------------------|
| DF | DF_Connection | <ASN> , and |
| DF | DF_ConnectionManeuverAssist | <ASN> , and |
| DF | DF_IntersectionAccessPoint | <ASN> . |

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

Remarks: It should be noted 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.

7.93 Data Element: DE_LaneDirection

Use: The LaneDirection data element 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. It should be noted that some lane objects are not used for travel and that some lane objects allow bi-directional travel.

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.

7.94 Data Element: DE_LaneID

Use: The DE_LaneID data element conveys an assigned index 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 region.

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 eight other data structures in this standard:

| | | |
|----|---|-----------------------------------|
| DF | DF ApproachOrLane | <ASN> , and |
| DF | DF ComputedLane | <ASN> , and |
| DF | DF ConnectingLane | <ASN> , and |
| DF | DF EnabledLaneList | <ASN> , and |
| DF | DF GenericLane | <ASN> , and |
| DF | DF IntersectionAccessPoint | <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” is 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 (depending on regional conventions) 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 a single lane object within the intersection. Deployments should remain aware of this distinction to avoid confusion.

7.95 Data Element: DE_LaneSharing

Use: The DE_LaneSharing data element 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 also 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.

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 that may share this lane:
    otherNonMotorizedTrafficTypes (2), -- horse drawn etc.
    individualMotorizedVehicleTraffic (3),
    busVehicleTraffic (4),
    taxiVehicleTraffic (5),
    pedestriansTraffic (6),
    cyclistVehicleTraffic (7),
    trackedVehicleTraffic (8),
    reserved (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.

7.96 Data Element: DE_LaneWidth

Use: The DE_LaneWidth data element conveys the width of a lane in LSB units of 1 cm. Maximum value for a lane is 327.67 m in width

ASN.1 Representation:

```
LaneWidth ::= INTEGER (0..32767) -- units of 1 cm
```

Used By: This entry is directly used by the following five other data structures in this standard:

| | | |
|----|---|-----------------------------------|
| DF | DF_GeographicalPath | <ASN> , and |
| DF | DF_GeometricProjection | <ASN> , and |
| DF | DF_IntersectionGeometry | <ASN> , and |
| DF | DF_RoadSegment | <ASN> , and |
| DF | DF_ShapePointSet | <ASN> . |

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

Remarks: It should be noted 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. In other words, to project a point from the lane centerline to the edge of the lane, one half the LaneWidth value is used. For lane width values which are odd values, the value used for representing one half the width may round up to the next whole centimeter value.

7.97 Data Element: DE_Latitude

Use: The geographic latitude of an object, expressed in 1/10th integer microdegrees, as a 31 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 microdegree
-- Providing a range of plus-minus 90 degrees
```

Used By: This entry is directly used by the following four other data structures in this standard:

| | | |
|----|---------------------------------------|-----------------------------------|
| DF | DF_BSMcoreData | <ASN> , and |
| DF | DF_FullPositionVector | <ASN> , and |
| DF | DF_Node_LLmD_64b | <ASN> , and |
| DF | DF_Position3D | <ASN> . |

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

7.98 Data Element: DE_LayerID

Use: The DE_LayerID is a data element 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.

7.99 Data Element: DE_LayerType

Use: The DE_LayerType is a data element used to uniquely identify the type of information to be found in a layer of a geographic map fragment such as an intersection.

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.

7.100 Data Element: DE_LightbarInUse

Use: The DE_LightbarInUse is 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 by a vehicle. 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 V2X 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),
    yellowCautionLights (3),
    schooldBusLights (4),
    arrowSignsActive (5),
    slowMovingVehicle (6),
    freqStops (7)
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|-------------------------------------|-----------------------------------|
| DF | DF_EmergencyDetails | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> . |

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

Remarks: See also the entry for ExteriorLights.

7.101 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 microdegree
-- Providing a range of plus-minus 180 degrees

```

Used By: This entry is directly used by the following four other data structures in this standard:

| | | |
|----|---------------------------------------|-----------------------------------|
| DF | DF BSMcoreData | <ASN> , and |
| DF | DF FullPositionVector | <ASN> , and |
| DF | DF Node LLmD 64b | <ASN> , and |
| DF | DF Position3D | <ASN> . |

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

7.102 Data Element: DE_MAYDAY_Location_quality_code

Use: A value representing the accuracy of the position estimate. The element is used to convey the relative quality of a GPS-generated location. This quality value is enumerated as shown 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)

```

Remarks: This element was originally defined in SAE J2313 Section 8.35 "Location-Quality." This element is used by the IEEE Incident Management standards effort relating to the accuracy of location information.

7.103 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 estimate. 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-GNSS      (1), -- GNSS technology only
    loc-tech-DGPS      (2), -- differential GNSS (DGPS) technology
    loc-tech-RTK        (3), -- differential GNSS (RTK) technology
    loc-tech-PPP        (4), -- precise point positioning (PPP) technology
    loc-tech-drGPS      (5), -- dead reckoning system w/GPS
    loc-tech-drDGPS     (6), -- dead reckoning system w/DGPS
    loc-tech-dr         (7), -- dead reckoning only
    loc-tech-nav        (8), -- autonomous navigation system on-board
    loc-tech-fault      (9), -- feature is not working
    ...
}

```

Remarks: This element was originally defined in SAE J2313, 8.15.

7.104 Data Element: DE_MeanVariation

Use: The mean variation in measured vertical or horizontal road roughness.

ASN.1 Representation:

```
MeanVariation ::= INTEGER (0..25000)
-- Measured in microns (.001 mm)
-- Range is 0 to 25 mm (0 to 25000 microns)
```

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

7.105 Data Element: DE_MergeDivergeNodeAngle

Use: The angle at 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 from 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.

7.106 Data Element: DE_MessageBLOB

Use: The MessageBLOB data element contains a UPER encoded message expressed as a sequence of octets (a BLOB) using the normal UPER encoding complete with any trailing filler bits to complete the final octet.

ASN.1 Representation:

```
MessageBLOB ::= OCTET STRING (SIZE(10..2000))
-- Final size range may be further
-- limited by the transport layer used
```

Remarks: In the 2015 edition of the standard this was called DE_UPER_Blob and was used to contain the UPER encoding placed inside a DER wrapper. In that edition, both DER and UPER encoding was supported. In the current edition, only UPER message encoding is provided.

7.107 Data Element: DE_MinuteOfTheYear

Use: The DE_MinuteOfTheYear data element 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 indicating 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 18 other data structures in this standard:

| | | |
|-----|--|-----------------------------------|
| DF | DF_Header | <ASN> , and |
| DF | DF_IntersectionState | <ASN> , and |
| DF | DF_SignalRequestPackage | <ASN> , and |
| DF | DF_SignalStatusPackage | <ASN> , and |
| DF | DF_TravelerDataFrame | <ASN> , and |
| MSG | MSG_CommonSafetyRequest (CSR) | <ASN> , and |
| MSG | MSG_EmergencyVehicleAlert (EVA) | <ASN> , and |
| MSG | MSG_IntersectionCollisionAvoidance (ICA) | <ASN> , and |
| MSG | MSG_MapData (MAP) | <ASN> , and |
| MSG | MSG_NMEAcorrections (NMEA) | <ASN> , and |
| MSG | MSG_ProbeDataManagement (PDM) | <ASN> , and |
| MSG | MSG_ProbeVehicleData (PVD) | <ASN> , and |
| MSG | MSG_RoadSideAlert (RSA) | <ASN> , and |
| MSG | MSG_RTCMcorrections (RTCM) | <ASN> , and |
| MSG | MSG_SignalPhaseAndTiming Message (SPAT) | <ASN> , and |
| MSG | MSG_SignalRequestMessage (SRM) | <ASN> , and |
| MSG | MSG_SignalStatusMessage (SSM) | <ASN> , and |
| MSG | MSG_TravelerInformation Message (TIM) | <ASN> . |

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

Remarks: It should be noted that at the yearly roll-over point there is no “zero” minute, in the same way that there 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.

7.108 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 provides for about 22.2 days of maximum duration.

ASN.1 Representation:

```
MinutesDuration ::= INTEGER (0..32000) -- units of minutes
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_TravelerDataFrame](#) [<ASN>](#). 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.

7.109 Data Element: DE_MotorizedPropelledType

Use: The DE_MotorizedPropelledType data element is used to describe the propulsion type that is performed by an motor(s).

ASN.1 Representation:

```
MotorizedPropelledType ::= ENUMERATED {
    unavailable          (0),
    otherTypes           (1), -- any method not listed below
    wheelChair           (2),
    bicycle              (3),
    scooter              (4),
    selfBalancingDevice (5), -- such as Segway
    ...
}
```

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

7.110 Data Element: DE_MovementPhaseState

Use: The DE_MovementPhaseState data element provides the overall state of the movement (in many cases, a signal state), including its core phase state and an indication of whether this state is permissive or protected.

Legend – Signal States

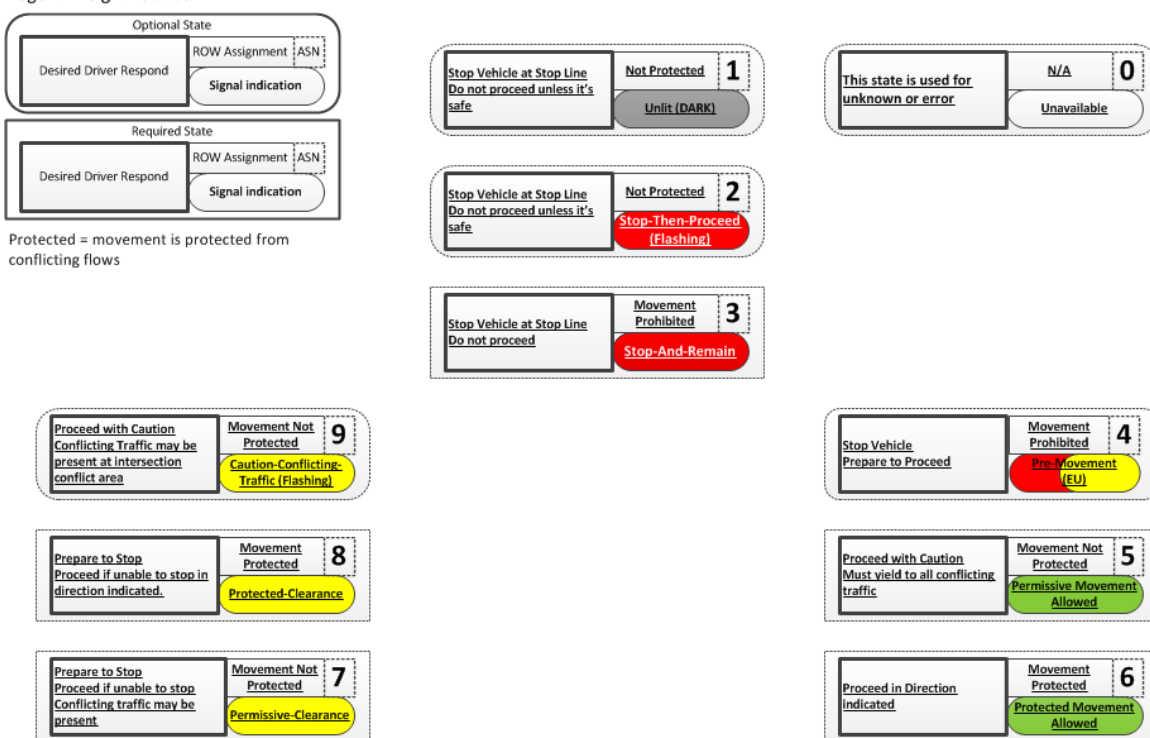


Figure 1 - State diagram

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 U.S., the MUTCD is used, as is indicated in the U.S. 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 be independent of these regional conventions.

In the U.S., 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.

    -- 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](#) <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).

7.111 Data Element: DE_MsgCount

Use: The DE_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 of zero to 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. Depending on the application the sequence number may change with every message or may remain fixed during a stream of messages when the content within each message has not changed from the prior message sent. 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 re-initialized due to an identity change.

ASN.1 Representation:

```
MsgCount ::= INTEGER (0..127)
```

Used By: This entry is directly used by the following 16 other data structures in this standard:

| | | |
|----|---|------------|
| DF | DF_BSMcoreData | <ASN>, and |
| DF | DF_Header | <ASN>, and |
| DF | DF_IntersectionGeometry | <ASN>, and |
| DF | DF_IntersectionState | <ASN>, and |
| DF | DF_RoadSegment | <ASN>, and |
| DF | DF_SignalRequesterInfo | <ASN>, and |

| | | |
|-----|--|-----------------------------------|
| DF | DF_SignalStatus | <ASN> , and |
| MSG | MSG_CommonSafetyRequest (CSR) | <ASN> , and |
| MSG | MSG_IntersectionCollisionAvoidance (ICA) | <ASN> , and |
| MSG | MSG_MapData (MAP) | <ASN> , and |
| MSG | MSG_PersonalSafetyMessage (PSM) | <ASN> , and |
| MSG | MSG_RoadSideAlert (RSA) | <ASN> , and |
| MSG | MSG_RTCMcorrections (RTCM) | <ASN> , and |
| MSG | MSG_SignalRequestMessage (SRM) | <ASN> , and |
| MSG | MSG_SignalStatusMessage (SSM) | <ASN> , and |
| MSG | MSG_TravelerInformation Message (TIM) | <ASN> . |

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

Remarks: In the absence of additional requirements defined in a standard using this data element, the follow guidelines shall be used.

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 re-use 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.

7.112 Data Element: DE_MsgCRC

Use: The DE_MsgCRC data element is a 2 octet value calculated over the payload octets 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 octets found in between. It is always placed as the very last 2 octets in the octet stream to which it applies. 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 the first octet of every BLOB to be encoded must never be zero or framing errors due to incorrectly clocking initial zero values will occur. Note that the MSB octet is always transmitted first, following the typical ASN octet ordering (this is sometimes called “network order”). When a well-formed V2X message (including its last 2 octets 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
```

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

7.113 Data Element: DE_MultiVehicleResponse

Use: DE_MultiVehicleResponse is 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 en-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 than 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 V2X “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
}
```

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

7.114 Data Element: DE_MUTCDCode

Use: The DE_MUTCDCode data element is used to define what basic MUTCD type a sign expression falls into.

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
    ...
}
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_RoadSignID](#) [<ASN>](#). 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”) for general ITIS codes not meeting a MUTCD definition.

7.115 Data Element: DE_NMEA_MsgType

Use: The NMEA-MessageType data element provides the message sentence values defined in the 0183 NMEA standards for each message. The NMEA messages are short strings referred to as sentences in that work.

ASN.1 Representation:

```
NMEA-MessageType ::= INTEGER (0..32767)
```

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

7.116 Data Element: DE_NMEA_Payload

Use: The NMEA Payload data element contains the stream of octets in the actual NMEA 0183 message that is being sent.

ASN.1 Representation:

```
NMEA-Payload ::= OCTET STRING (SIZE(1..1023))
```

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

7.117 Data Element: DE_NMEA_Revision

Use: The DE_NMEA_Revision data element conveys the specific revision of the NMEA standard which is being used (if present). This is needed to indicate the precise mapping of the message types to their definitions, as well as some minor transport layer ordering details when received in the mobile unit.

ASN.1 Representation:

```
NMEA-Revision ::= ENUMERATED {
    unknown      (0), -- default value
    reserved     (1),
    rev1          (2),
    rev2          (3), -- used for 2.x
    rev3          (4), -- used for 3.x
    rev4          (5), -- used for 4.x (NMEA 4.00 Published November 2008)
    rev5          (6),
    ...
}
```

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

7.118 Data Element: DE_NodeAttributeLL

Use: The DE_NodeAttributeXY data element 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 pertain 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:

```

NodeAttributeLL ::= 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_NodeAttributeLLList](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.119 Data Element: DE_NodeAttributeXY

Use: The DE_NodeAttributeXY data element 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:

```

NodeAttributeXY ::= 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_NodeAttributeXYList](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.120 Data Element: DE_NumberOfParticipantsInCluster

Use: The DE_NumberOfParticipantsInCluster data element is used to describe the number of participants of a cluster crossing an intersection or roadway to help vehicles assess the crossing time and minimize unnecessary warnings. It can be used to minimize unnecessary PSM transmission by other members of the cluster. The formation of clusters is handled in other standards.

ASN.1 Representation:

```

NumberOfParticipantsInCluster ::= ENUMERATED {
  unavailable (0),
  small (1),   -- 2-5
  medium (2),  -- 6-10
  large (3),   -- >10
  ...
}

```

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

7.121 Data Element: DE_ObjectCount

Use: The DE_ObjectCount provides a count of various types of objects. The object type and sizes may vary as needed. The data concept may also be used as a count of octets in messages. It should be observed that octet counts in general are not required to be transmitted when an ASN encoding is used.

ASN.1 Representation:

```
ObjectCount ::= INTEGER (0..1023) -- a count of objects
```

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

7.122 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 perspective of 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 ::= Angle
```

7.123 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
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_ObstacleDetection](#) [<ASN>](#), and

DF [DF_VehicleStatus](#) [<ASN>](#).

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

7.124 Data Element: DE_Offset_B09

Use: A 9-bit delta offset in X, Y, or Z direction from some known point. For non-vehicle centric coordinate frames of reference, offset is positive to the east (X) and to the north (Y) directions. The most negative value shall be used to indicate an unknown value.

ASN.1 Representation:

```
Offset-B09 ::= INTEGER (-256..255)
-- a range of +- 2.55 meters
```

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

7.125 Data Element: DE_Offset_B10

Use: A 10-bit delta offset in X, Y, or Z direction from some known point. For non-vehicle centric coordinate frames of reference, offset is positive to the east (X) and to the north (Y) directions. The most negative value shall be used to indicate an unknown value.

ASN.1 Representation:

```
Offset-B10 ::= INTEGER (-512..511)
-- a range of +- 5.11 meters
```

Used By: This entry is directly used by the following four other data structures in this standard:

| | | |
|----|---------------------------------------|-----------------------------------|
| DF | DF_AntennaOffsetSet | <ASN> , and |
| DF | DF_Node_XY_20b | <ASN> , and |
| DF | DF_NodeAttributeSetLL | <ASN> , and |
| DF | DF_NodeAttributeSetXY | <ASN> . |

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

7.126 Data Element: DE_Offset_B11

Use: An 11-bit delta offset in X or Y direction from some known point. For non-vehicle centric coordinate frames of reference, offset is positive to the east (X) and to the north (Y) directions. The most negative value shall be used to indicate an unknown value.

ASN.1 Representation:

```
Offset-B11 ::= INTEGER (-1024..1023)
-- a range of +- 10.23 meters
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_Node_XY_22b | <ASN> , and |
| DF | DF_PivotPointDescription | <ASN> . |

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

7.127 Data Element: DE_Offset_B12

Use: A 12-bit delta offset in X, Y, or Z direction from some known point. For non-vehicle centric coordinate frames of reference, non-vehicle centric coordinate frames of reference, offset is positive to the east (X) and to the north (Y) directions. The most negative value shall be used to indicate an unknown value.

ASN.1 Representation:

```
Offset-B12 ::= INTEGER (-2048..2047)
-- a range of +- 20.47 meters
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|---|-----------------------------------|
| DF | DF_AntennaOffsetSet | <ASN> , and |
| DF | DF_Node_XY_24b | <ASN> , and |
| DF | DF_TrailerUnitDescription | <ASN> . |

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

7.128 Data Element: DE_Offset_B13

Use: A 13-bit delta offset in X or Y direction from some known point. For non-vehicle centric coordinate frames of reference, offset is positive to the east (X) and to the north (Y) directions. The most negative value shall be used to indicate an unknown value.

ASN.1 Representation:

```
Offset-B13 ::= INTEGER (-4096..4095)
-- a range of +- 40.95 meters
```

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.

7.129 Data Element: DE_Offset_B14

Use: A 14-bit delta offset in X or Y direction from some known point. For non-vehicle centric coordinate frames of reference, offset is positive to the east (X) and to the north (Y) directions.

ASN.1 Representation:

```
Offset-B14 ::= INTEGER (-8192..8191)
-- a range of +- 81.91 meters
```

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.

7.130 Data Element: DE_Offset_B16

Use: A 16-bit delta offset in X, Y, or Z direction from some known point. For non-vehicle centric coordinate frames of reference, offset is positive to the east (X) and to the north (Y) directions. The most negative value shall be used to indicate an unknown value.

ASN.1 Representation:

```
Offset-B16 ::= INTEGER (-32768..32767)
-- a range of +- 327.67 meters
```

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.

7.131 Data Element: DE_OffsetLL-B12

Use: A 12-bit delta offset in lat or long direction from the last point. The offset is positive to the east and to the north directions. In LSB units of 0.1 microdegrees (unless a zoom is employed). The most negative value shall be used to indicate an unknown value. It should be noted that while the precise range of the data element in degrees is a constant value, the equivalent length in meters will vary with the position on the earth that is used.

ASN.1 Representation:

```
OffsetLL-B12 ::= INTEGER (-2048..2047)
-- A range of +- 0.0002047 degrees
-- In LSB units of 0.1 microdegrees (unless a zoom is employed)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF Node LL 24B <ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.132 Data Element: DE_OffsetLL-B14

Use: A 14-bit delta offset in lat or long direction from the last point. The offset is positive to the east and to the north directions. In LSB units of 0.1 microdegrees (unless a zoom is employed). The most negative value shall be used to indicate an unknown value. It should be noted that while the precise range of the data element in degrees is a constant value, the equivalent length in meters will vary with the position on the earth that is used.

ASN.1 Representation:

```
OffsetLL-B14 ::= INTEGER (-8192..8191)
-- A range of +- 0.0008191 degrees
-- In LSB units of 0.1 microdegrees (unless a zoom is employed)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF Node LL 28B <ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.133 Data Element: DE_OffsetLL-B16

Use: A 16-bit delta offset in lat or long direction from the last point. The offset is positive to the east and to the north directions. In LSB units of 0.1 microdegrees (unless a zoom is employed). The most negative value shall be used to indicate an unknown value. It should be noted that while the precise range of the data element in degrees is a constant value, the equivalent length in meters will vary with the position on the earth that is used.

ASN.1 Representation:

```
OffsetLL-B16 ::= INTEGER (-32768..32767)
-- A range of +- 0.0032767 degrees
-- In LSB units of 0.1 microdegrees (unless a zoom is employed)
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|----------------------------------|-----------------------------------|
| DF | DF Node LL 32B | <ASN> , and |
| DF | DF RegionOffsets | <ASN> . |

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

7.134 Data Element: DE_OffsetLL-B18

Use: An 18-bit delta offset in lat or long direction from the last point. The offset is positive to the east and to the north directions. In LSB units of 0.1 microdegrees (unless a zoom is employed). The most negative value shall be used to indicate an unknown value. It should be noted that while the precise range of the data element in degrees is a constant value, the equivalent length in meters will vary with the position on the earth that is used.

The above methodology is used when the offset is incorporated in data frames other than DF_PathHistoryPoint. Refer to the Use paragraph of DF_PathHistory for the methodology to calculate this data element for use in DF_PathHistoryPoint.

ASN.1 Representation:

```
OffsetLL-B18 ::= INTEGER (-131072..131071)
-- A range of +- 0.0131071 degrees
-- The value +131071 shall be used for values >= than +0.0131071 degrees
-- The value -131071 shall be used for values <= than -0.0131071 degrees
-- The value -131072 shall be used unknown
-- In LSB units of 0.1 microdegrees (unless a zoom is employed)
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF Node LL 36B](#) [<ASN>](#), and

DF [DF PathHistoryPoint](#) [<ASN>](#).

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

7.135 Data Element: DE_OffsetLL-B22

Use: A 22-bit delta offset in lat or long direction from the last point. The offset is positive to the east and to the north directions. In LSB units of 0.1 microdegrees (unless a zoom is employed). The most negative value shall be used to indicate an unknown value. It should be noted that while the precise range of the data element in degrees is a constant value, the equivalent length in meters will vary with the position on the earth that is used.

ASN.1 Representation:

```
OffsetLL-B22 ::= INTEGER (-2097152..2097151)
-- A range of +- 0.2097151 degrees
-- In LSB units of 0.1 microdegrees (unless a zoom is employed)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF Node LL 44B](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.136 Data Element: DE_OffsetLL-B24

Use: A 24-bit delta offset in lat or long direction from the last point. The offset is positive to the east and to the north directions. In LSB units of 0.1 microdegrees (unless a zoom is employed). The most negative value shall be used to indicate an unknown value. It should be noted that while the precise range of the data element in degrees is a constant value, the equivalent length in meters will vary with the position on the earth that is used.

ASN.1 Representation:

```
OffsetLL-B24 ::= INTEGER (-8388608..8388607)
-- A range of +- 0.8388607 degrees
-- In LSB units of 0.1 microdegrees (unless a zoom is employed)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF Node LL 48B](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.137 Data Element: DE_PayloadData

Use: A stream of octets to be exchanged.

ASN.1 Representation:

```
PayloadData ::= OCTET STRING (SIZE(1..2048))
```

7.138 Data Element: DE_PedestrianBicycleDetect

Use: The PedestrianBicycleDetect data element is used to provide an indication of whether pedestrians and/or bicyclists have been detected 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.

7.139 Data Element: DE_PersonalAssistive

Use: The DE_PersonalAssistive data element is used to imply a special need of a person associated with the message in which this element is transmitted. A service may be provided based on this information.

ASN.1 Representation:

```
PersonalAssistive ::= BIT STRING {
    unavailable      (0),
    otherType        (1),
    vision           (2),
    hearing          (3),
    movement         (4),
    cognition         (5)
} (SIZE (6, ...))
```

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

7.140 Data Element: DE_PersonalClusterRadius

Use: The DE_PersonalClusterRadius data element is used to describe the radius of nonmotorized user clusters. The center of the cluster is the position described by the standard which defines its use.

ASN.1 Representation:

```
PersonalClusterRadius ::= INTEGER (0..100) -- units of meters
```

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

7.141 Data Element: DE_PersonalCrossingInProgress

Use: The DE_PersonalCrossingInProgress data element is used to indicate whether a VRU is currently crossing a street.

ASN.1 Representation:

```
PersonalCrossingInProgress ::= BOOLEAN -- Use:
    -- True = Yes, is in maneuver
    -- False = No
```

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

7.142 Data Element: DE_PersonalCrossingRequest

Use: The DE_PersonalCrossingRequest data element is used to indicate the VRU's intention to cross the street. It is a binary value.

ASN.1 Representation:

```

PersonalCrossingRequest ::= BOOLEAN
-- Use:
-- True = On (request crossing)
-- False = Off (no request)

```

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

7.143 Data Element: DE_PersonalDeviceUsageState

Use: The DE_PersonalDeviceUsageState data element describes the VRU device usage state, mostly applicable to devices such as smart phones. It can be used to indicate the level of pedestrian distraction. The data element (if used) implies that the wireless transmitter is integrated in a device capable of interfacing with a human for one or more other purposes.

ASN.1 Representation:

```

PersonalDeviceUsageState ::= BIT STRING {
    unavailable      (0), -- Not specified
    other            (1), -- Used for states not defined below
    idle             (2), -- Human is not interacting with device
    listeningToAudio (3), -- Any audio source other then calling
    typing           (4), -- Including texting, entering addresses
                     -- and other manual input activity
    calling          (5),
    playingGames     (6),
    reading          (7),
    viewing          (8) -- Watching dynamic content, including following
                     -- navigation prompts, viewing videos or other
                     -- visual contents that are not static
} (SIZE (9, ...))
-- All bits shall be set to zero when unknown state

```

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

7.144 Data Element: DE_PersonalDeviceUserType

Use: The DE_PersonalDeviceUserType data element is used to describe the type of pedestrian or non-vehicular road users. The information relates to same person whose state information appears in the same message.

ASN.1 Representation:

```

PersonalDeviceUserType ::= ENUMERATED {
    unavailable      (0),
    aPEDESTRIAN     (1), -- Further details may be provided elsewhere
    aPEDALCYCLIST   (2), -- Presumed to be human propelled,
                     -- unless PropelledInformation indicates motorized
    aPUBLICSAFETYWORKER (3),
    anANIMAL         (4),
    ...
}

```

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

7.145 Data Element: DE_PivotingAllowed

Use: The DE_PivotingAllowed data element is a flag set to true when the described connection point allows pivoting to occur. It is used to describe a trailer or dolly connection point.

ASN.1 Representation:

```
PivotingAllowed ::= BOOLEAN
```

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

7.146 Data Element: DE_PortlandCementType

Use: Indicates the type of portland cement. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```
PortlandCementType ::= ENUMERATED {
    newSharp,
    traveled,
    trafficPolished,
    ...
}
```

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

7.147 Data Element: DE_PositionConfidence

Use: The DE_PositionConfidence entry is used to provide 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 reference and axis of rotation used shall be accordance with that defined in Section 11 of this standard.

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
```

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

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.

7.148 Data Element: DE_PrioritizationResponseStatus

Use: The PrioritizationResponseStatus data element is used in the PrioritizationResponse data frame to indicate the general status of a prior prioritization request.

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, other requests are prior)
    watchOtherTraffic (3),
        -- Cannot give full permission,
        -- therefore watch for other traffic
        -- Note that other requests may be present
    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),
        -- The Request has exceeded maxPresence time
        -- Used when the controller has determined that
        -- the requester should then back off and
        -- request an alternative.
    reserviceLocked   (7),
        -- Prior conditions have resulted in a reservice
        -- locked event: the controller requires the
        -- passage of time before another similar request
        -- will be accepted
    ...
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_SignalStatusPackage | <ASN> , and |
| DF | DF_PrioritizationResponse_EU | <ASN> . |

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

Remarks: The time periods which are to be used for these states are determined by the performance requirements which can be found in the relevant standards.

7.149 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 messages being sent by the device, nor a priority of display urgency at the receiver).

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 has only modest impact. The value 111xxxx shall be the highest level of priority and shall be considered 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 six levels shall be used as determined by local conventions.

ASN.1 Representation:

```
Priority ::= OCTET STRING (SIZE(1))
-- Follow definition notes on setting these bits
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_EventDescription | <ASN> , and |
| MSG | MSG_RoadSideAlert (RSA) | <ASN> . |

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

Remarks: It should be noted that well-managed priority schemes can be seriously disrupted when an incident occurs 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.

7.150 Data Element: DE_PriorityRequestType

Use: The PriorityRequestType data element provides a means to indicate if a request (found in the signal request message) represents a new service request, a request update, or a request cancellation for either preemption or priority services.

ASN.1 Representation:

```
PriorityRequestType ::= ENUMERATED {
    priorityRequestTypeReserved (0),
    priorityRequest               (1),
    priorityRequestUpdate         (2),
    priorityCancellation          (3),
    ...
}
```

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

7.151 Data Element: DE_PrivilegedEventFlags

Use: The PrivilegedEventFlags data element conveys various states of the sender (typically a V2X-equipped vehicle) and is most often used by various types of public safety vehicles in response to a service call. These flags are not required by common light duty passenger vehicles.

ASN.1 Representation:

```
PrivilegedEventFlags ::= BIT STRING {

    peUnavailable                (0), -- Not Equipped or unavailable
    peEmergencyResponse          (1),
        -- The vehicle is a properly authorized public safety vehicle,
        -- is engaged in a service call, and is currently moving
        -- or is within the roadway. Note that lights and sirens
        -- may not be evident during any given response call

    -- Emergency and Non Emergency Lights related
    peEmergencyLightsActive      (2),
    peEmergencySoundActive       (3),
    peNonEmergencyLightsActive   (4),
    peNonEmergencySoundActive    (5)

    -- this list is likely to grow with further peer review
} (SIZE (16))
```

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

7.152 Data Element: DE_ProbeSegmentNumber

Use: The DE_ProbeSegmentNumber (PSN) data frame enables vehicles to identify their trajectory for a limited amount of time or over a limited distance. It is randomly generated by a vehicle every 120 seconds or 1 km, whichever comes last. The interval between PSN changes is a random number of seconds between 0 second and 10 seconds or a random distance between 0 m and 200 m, 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
```

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

7.153 Data Element: DE_PublicSafetyAndRoadWorkerActivity

Use: The DE_PublicSafetyAndRoadWorkerActivity data element is used to describe the type of activity a worker or workers are engaged in.

ASN.1 Representation:

```
PublicSafetyAndRoadWorkerActivity ::= BIT STRING {
    unavailable                (0), -- Not specified
    workingOnRoad              (1), -- Road workers on foot, in or out of
        -- a closure, performing activities like:
        -- construction, land surveying,
        -- trash removal, or site inspection.
    settingUpClosures          (2), -- Road workers on foot performing
        -- activities like: setting up signs,
        -- placing cones/barrels/pylons, or placing
        -- flares. Note: People are in the road
        -- redirecting traffic, but the closure is
        -- not complete, so utmost care is required
```

```

-- to determine the allowed path to take to
-- avoid entering the work zone and/or
-- harming the workers.
respondingToEvents    (3), -- Public safety or other road workers on
-- foot performing activities like: treating
-- injured people, putting out fires,
-- cleaning chemical spills, aiding disabled
-- vehicles, criminal investigations,
-- or animal control. Note: These events tend
-- to be more dynamic than workingOnRoad
directingTraffic      (4), -- Public safety or other road workers on
-- foot directing traffic in situations like:
-- a traffic signal out of operation,
-- a construction or crash site with a short
-- term lane closure, a single lane flagging
-- operation, or ingress/egress to a special event.
otherActivities       (5) -- Designated by regional authorities
} (SIZE (6, ...))

```

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

7.154 Data Element: DE_PublicSafetyDirectingTrafficSubType

Use: The DE_PublicSafetyDirectingTrafficSubType data element is used to describe the sub type of activity a worker or workers are engaged in.

ASN.1 Representation:

```

PublicSafetyDirectingTrafficSubType ::= BIT STRING {
    unavailable                (0),
        -- Default.
        -- to be used if unknown or if the worker type is not otherwise identified
    policeAndTrafficOfficers    (1),
        -- Law enforcement officers, including traffic control officers,
        -- and adult school crossing guards.
    trafficControlPersons       (2),
        -- Road workers with special equipment for directing traffic.
    railroadCrossingGuards      (3),
        -- Railroad crossing guards who notify motorists of approaching trains
        -- at locations like private roads or driveways crossing train tracks
        -- and where automated equipment is disabled or not present.
    civilDefenseNationalGuardMilitaryPolice (4),
        -- while performing their regular duties or during National
        -- or local emergencies
    emergencyOrganizationPersonnel (5),
        -- Personnel belonging to emergency response organizations such as
        -- fire departments, hospitals, river rescue, or associated with
        -- emergency vehicles including ambulances as designated by the
        -- regional authority (relating to designation of emergency vehicles)
        -- while performing their duties.
    highwayServiceVehiclePersonnel (6)
        -- Associated with tow trucks and road service vehicles.
} (SIZE (7, ...))

```

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

7.155 Data Element: DE_PublicSafetyEventResponderWorkerType

Use: The DE_PublicSafetyEventResponderWorkerType data element is used to describe the type of a public safety worker who is responding to an event.

ASN.1 Representation:

```
PublicSafetyEventResponderWorkerType ::= ENUMERATED {
    unavailable                (0),
    towOperator                (1),
    fireAndEMSWorker           (2),
    aDOTWorker                 (3),
    lawEnforcement             (4),
    hazmatResponder            (5), -- also any toxicSubstanceCleanupCrew
    animalControlWorker        (6),
    otherPersonnel             (7),
    ...
}
```

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

7.156 Data Element: DE_RadiusOfCurvature

Use: The entry DE_RadiusOfCurvature is a data element representing an estimate of the current trajectory of the sender. The value is represented as 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.

ASN.1 Representation:

```
RadiusOfCurvature ::= INTEGER (-32767..32767)
-- LSB units of 10cm
-- A straight path to use value of 32767
```

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

7.157 Data Element: DE_Radius

Use: A 12-bit radius offset from a known point in the system of units that is indicated.

ASN.1 Representation:

```
Radius-B12 ::= INTEGER (0..4095)
-- with the LSB unit value determined elsewhere
-- the value 4095 shall be used for unknown
```

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

7.158 Data Element: DE_RainSensor

Use: A general sensor of rainfall intensity which requires further interpretation by the OEM (the systems developer) 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 to 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 drivers 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)
}
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_VehicleStatus](#) <ASN>. 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 eight resistance ranges corresponding to the above scale. For example: a sensor that has a resistance range from 12K Ω (max rain fall) to 250 Ω (no rain fall) will have the following resistance value ranges:

0=250 to 1749 Ω

1=1750 to 3249 Ω

2=3250 to 4749 Ω

3=4750 to 6249 Ω

4=6250 to 7749 Ω

5=7750 to 9249 Ω

6=9250 to 10749 Ω

7=10501 to 12000 Ω

7.159 Data Element: DE_RegionId

Use: The DE_RegionId is a data element used to define regions where unique additional content may be added and used in the message set. The index values defined below represent various regions known at the time of publication. This list is expected to grow over time. The index values assigned here can be augmented by local (uncoordinated) assignments in the allowed range. It should be noted that such a local value is specified in the “REGION” ASN module, so there is no need to edit the ASN specification of the standard. This process is further described in 11.1.

ASN.1 Representation:

```

RegionId ::= INTEGER (0..255)
noRegion      RegionId ::= 0  -- Use default supplied stubs
addGrpA       RegionId ::= 1  -- USA
addGrpB       RegionId ::= 2  -- Japan
addGrpC       RegionId ::= 3  -- EU
-- NOTE: new registered regional IDs will be added here
-- The values 128 and above are for local region use

```

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

7.160 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.

ASN.1 Representation:

```

RequestedItem ::= ENUMERATED {
    reserved,
    itemA,
        -- consisting of 2 elements:
        -- lights      ExteriorLights
        -- lightBar    LightbarInUse

    itemB,
        -- consisting of:
        -- wipers      a SEQUENCE

    itemC,
        -- consisting of:
        -- brakeStatus BrakeSystemStatus

    itemD,
        -- consisting of 2 elements:
        -- brakePressure BrakeAppliedPressure
        -- roadFriction  CoefficientOfFriction

    itemE,
        -- consisting of 4 elements:
        -- sunData      SunSensor
        -- rainData     RainSensor
        -- airTemp      AmbientAirTemperature
        -- airPres      AmbientAirPressure

    itemF,
        -- consisting of:
        -- steering      a SEQUENCE

    itemG,
        -- consisting of:
        -- accelSets     a SEQUENCE

    itemI,
        -- consisting of:
        -- fullPos       FullPositionVector

    itemJ,
        -- consisting of:
        -- position2D    Position2D

```

```

itemK,
    -- consisting of:
    -- position3D      Position3D

itemL,
    -- consisting of 2 elements:
    -- speedHeadC      SpeedandHeadingConfidence

itemM,
    -- consisting of:
    -- vehicleData a SEQUENCE

itemN,
    -- consisting of:
    -- vehicleIdent    VehicleIdent

itemO,
    -- consisting of:
    -- weatherReport a SEQUENCE

itemP,
    -- consisting of:
    -- breadcrumbs     PathHistory

itemQ,
    -- consisting of:
    -- GNSSStatus      GNSSstatus

...
}

```

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

7.161 Data Element: DE_RelativeRoadAuthorityID

Use: The DE_FullRoadAuthorityID data element provides the identifier for the partially specified OID of the Road Authority. This may be used when the base portion of the OID is known.

ASN.1 Representation:

```

RelativeRoadAuthorityID ::= RELATIVE-OID
-- This data element provides the identifier for the partially specified OID of the
-- Road Authority. This may be used when the base portion of the OID is known.

```

Used By: This entry is used directly by DF_RoadAuthorityID, this item may be used by data structures in other ITS standards.

7.162 Data Element: DE_RequestID

Use: The RequestID data element is used to provide a unique ID between two parties for various dialog exchanges. Combined with the sender's VehicleID (consisting of a [TemporaryID](#) or a Station ID), this provides a unique string for some mutually defined period of time. A typical example of use would be a signal preemption or priority request dialog containing multiple requests from one sender (denoted by the unique RequestID with each). When such a request is processed and reflected in the signal status messages, the original sender and the specific request can both be determined.

ASN.1 Representation:

```
RequestID ::= INTEGER (0..255)
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_SignalRequest](#) [<ASN>](#), and

DF [DF_SignalRequesterInfo](#) [<ASN>](#).

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

Remarks: In typical use, this value is simply incremented in a modulo fashion to ensure a unique stream of values for the device creating it. Any needs for uniqueness across multiple dialogs to one or more parties shall be the responsibility of the device to manage. There are often normative restrictions on the device changing its [TemporaryID](#) during various dialogs when this data element is used. Further details of these operational concepts can be found in the relevant standards.

7.163 Data Element: DE_RequestImportanceLevel

Use: The RequestImportanceLevel data element is used to state what type of signal request is being made to a signal controller by a V2X device in a defined role (such as a police vehicle). The levels of the request typically convey a sense of urgency or importance with respect to other demands to allow the controller to use predefined business rules to determine how to respond. These rules will vary in terms of how details of overall importance and urgency are to be ranked, so they are to be implemented locally. As a result of this regional process, the list below should be assigned well-defined meanings by the local deployment. These meaning will typically result in assigning a set of values to list for each vehicle role type that is to be supported.

ASN.1 Representation:

```
RequestImportanceLevel ::= ENUMERATED {
    requestImportanceLevelUnknown (0),
    requestImportanceLevel1       (1), -- The least important request
    requestImportanceLevel2       (2), -- The values here shall be assigned
    requestImportanceLevel3       (3), -- Meanings based on regional needs
    requestImportanceLevel4       (4), -- for each of the basic roles which
    requestImportanceLevel5       (5), -- are defined elsewhere
    requestImportanceLevel6       (6),
    requestImportanceLevel7       (7),
    requestImportanceLevel8       (8),
    requestImportanceLevel9       (9),
    requestImportanceLevel10      (10),
    requestImportanceLevel11      (11),
    requestImportanceLevel12      (12),
    requestImportanceLevel13      (13),
    requestImportanceLevel14      (14), -- The most important request
    requestImportanceReserved     (15)  -- Reserved for future use
}
```

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

7.164 Data Element: DE_RequestSubRole

Use: The RequestSubRole data element is used to further define the details of the role which any V2X device might play when making a request to a signal controller. This value is not always needed. For example, perhaps in a deployment all police vehicles are to be treated equally. The taxonomy of what details are selected to be entered into the list is a regional choice but should be devised to allow the controller to use predefined business rules to respond using the data. As another example, perhaps in a regional deployment a cross-city express type of transit vehicle is given a different service response for the same request than another type of transit vehicle making an otherwise similar request. As a result of this regional process, the list below should be assigned well-defined meanings by the local deployment. These meanings will typically result in assigning a set of values to list for each vehicle role type that is to be supported.

ASN.1 Representation:

```
RequestSubRole ::= ENUMERATED {
    requestSubRoleUnknown      (0),
    requestSubRole1            (1), -- The first type of sub role
    requestSubRole2            (2), -- The values here shall be assigned
    requestSubRole3            (3), -- Meanings based on regional needs
    requestSubRole4            (4), -- to refine and expand the basic
    requestSubRole5            (5), -- roles which are defined elsewhere
    requestSubRole6            (6),
    requestSubRole7            (7),
    requestSubRole8            (8),
    requestSubRole9            (9),
    requestSubRole10           (10),
    requestSubRole11           (11),
    requestSubRole12           (12),
    requestSubRole13           (13),
    requestSubRole14           (14), -- The last type of sub role
    requestSubRoleReserved     (15) -- Reserved for future use
}
```

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

7.165 Data Element: DE_ResponseType

Use: The response type and general driving behavior which this vehicle is engaged in at the time the message is being sent. This is the type of response (driving behavior) which a public safety, or other type of authorized vehicle, is engaged in when transmitting alerts. These are used as part of the V2X safety message content for public safety vehicles operating in the area.

ASN.1 Representation:

```
ResponseType ::= ENUMERATED {
    notInUseOrNotEquipped      (0),
    emergency                  (1), -- active service call at emergency level
    nonEmergency                (2), -- also used when returning from service call
    pursuit                    (3), -- sender driving may be erratic
    stationary                  (4), -- sender is not moving, stopped along roadside
    slowMoving                  (5), -- such as mowers, litter trucks, etc.
    stopAndGoMovement          (6), -- such as school bus or garbage truck
    ...
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_EmergencyDetails](#) [<ASN>](#), and

MSG [MSG_EmergencyVehicleAlert \(EVA\)](#) [<ASN>](#).

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

7.166 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 serviced by the infrastructure
    -- These end users (which are not vehicles) are 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.

7.167 Data Element: DE_RestrictionClassID

Use: The DE_RestrictionClass data element defines an intersection-unique value to convey data about classes of users. The mapping used varies with each intersection 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 three other data structures in this standard:

| | | |
|----|---|-----------------------------------|
| 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.

7.168 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. These assignments are presumed to be permanent.

ASN.1 Representation:

```
RoadRegulatorID ::= INTEGER (0..65535)
-- The value zero shall be used for testing only
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_IntersectionReferenceID | <ASN> , and |
| DF | DF_RoadSegmentReferenceID | <ASN> . |

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

7.169 Data Element: DE_RoadSegmentID

Use: The RoadSegmentID is used to uniquely define a 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. Within the region the policies used to ensure an assigned value's uniqueness before that value is reused is the responsibility of that region. Such reuse is expected to occur, but over somewhat lengthy epoch (months).

ASN.1 Representation:

```
RoadSegmentID ::= INTEGER (0..65535)
-- The values zero to 255 shall be used for testing only
-- Note that the value assigned 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.

7.170 Data Element: DE_RoadSurfaceCondition

Use: Indicates the surface of the road surface condition for use in friction estimation. This DF may be extended in the future to support more specific characteristics. .

ASN.1 Representation:

```
RoadSurfaceCondition ::= ENUMERATED { dry, wet, ... }
```

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

7.171 Data Element: DE_RoadwayCrownAngle

Use: The RoadwayCrownAngle data element relates the gross tangential angle of the roadway surface with respect to the local horizontal 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 in which the measurement is taken.

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.

7.172 Data Element: DE_RockType

Use: Indicates the type of rock. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```
RockType ::= ENUMERATED {
    crushed,
    ...
}
```

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

7.173 Data Element: DE_RTCM_Revision

Use: The RTCM-Revision data element provides the specific revision of the RTCM standard which is being used. This is helpful to know precisely the mapping of the message types to their definitions, as well as some minor transport layer ordering details when received in the mobile unit. All RTCM SC-104 messages follow a common message numbering method (wherein all defined messages are given unique values) which can be decoded from the initial octets of the message. This operation is typically performed by the GNSS rover that consumes the messages, so it is transparent at the V2X message set level.

ASN.1 Representation:

```
RTCM-Revision ::= ENUMERATED {
    unknown          (0),
    rtcMRev2         (1), -- Std 10402.x et al
    rtcMRev3         (2), -- Std 10403.x et al
    reserved         (3),
    ...
}
```

Used By: This entry is used directly by one other data structure in this standard, a MSG called [MSG_RTCMcorrections \(RTCM\) <ASN>](#). 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 as they do today. It should also be noted that RTCM standards use the term “byte” for an 8-bit value, while in this standard the term “octet” is used.

7.174 Data Element: DE_RTCMmessage

Use: The RTCMmessage data element contains the stream of octets of the actual RTCM message that is being sent. The message's contents are defined in RTCM Standard 10403.1 and in RTCM Standard 10402.1 and its successors. Note that most RTCM messages are considerably smaller than the size limit defined here, but that some messages may need to be broken into smaller messages (as per the rules defined in the RTCM work) in order to be transmitted using V2X communications.

ASN.1 Representation:

```
RTCMmessage ::= OCTET STRING (SIZE(1..1023))
```

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

7.175 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 element, the value zero is taken to represent a value of one (scale 1:1). 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. The smallest valid value allowed is -1999 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 <ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.176 Data Element: DE_SecondOfTime

Use: The DE_SecondOfTime data element defines the time interval between actions or events over a 60 second span. This is used, for example, to define the interval between transmissions of probe messages. It is not normally used for clock seconds.

ASN.1 Representation:

```
SecondOfTime ::= INTEGER (0..61) -- units of seconds
-- The value 60 shall be used for leap seconds
-- or to indicate a full minute.
-- The value 61 indicates that the value is unavailable
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_SnapshotTime | <ASN> , and |
| MSG | MSG_ProbeDataManagement (PDM) | <ASN> . |

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

7.177 Data Element: DE_SegmentAttributeLL

Use: The DE_SegmentAttributeLL data element 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 attribute to persist for more than 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:

```

SegmentAttributeLL ::= ENUMERATED {
  -- Various values which can be Enabled and Disabled for a lane segment

  -- General Items
  reserved                ,
  doNotBlock              , -- segment where a vehicle
                           -- may not come to a stop
  whiteLine               , -- segment where lane crossing is not allowed
                           -- such as the final few meters of a lane

  -- 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 where parking has a cost
midBlockCurbPresent    , -- a protruding curb near lane edge
unEvenPavementPresent  , -- a disjoint height at lane edge
...
}

```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_SegmentAttributeLLLList<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. This entry is expected to be developed further.

7.178 Data Element: DE_SegmentAttributeXY

Use: The DE_SegmentAttributeXY data element 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 attribute to persist for more than 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:

```

SegmentAttributeXY ::= ENUMERATED {
  -- Various values which can be Enabled and Disabled for a lane segment

  -- 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

  -- 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 where parking has a cost
midBlockCurbPresent , -- a protruding curb near lane edge
unEvenPavementPresent , -- a disjoint height at lane edge
...
}

```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_SegmentAttributeXYList](#) [<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.

7.179 Data Element: DE_SemiMajorAxisAccuracy

Use: The DE_SemiMajorAxisAccuracy data element is used to express the radius (length) of the semi-major axis of an ellipsoid representing the accuracy which can be expected from a GNSS system in 5 cm steps, typically at a one sigma level of confidence.

ASN.1 Representation:

```
SemiMajorAxisAccuracy ::= INTEGER (0..255)
-- semi-major axis accuracy at one standard dev
-- range 0-12.7 meter, LSB = .05m
-- 254 = any value equal or greater than 12.70 meter
-- 255 = unavailable semi-major axis value
```

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

7.180 Data Element: DE_SemiMajorAxisOrientation

Use: The DE_SemiMajorAxisOrientation data element is used to orientate the angle of the semi-major axis of an ellipsoid representing the accuracy which can be expected from a GNSS system with respect to the coordinate system.

ASN.1 Representation:

```
SemiMajorAxisOrientation ::= INTEGER (0..65535)
-- orientation of semi-major axis
-- relative to true north (0~359.9945078786 degrees)
-- LSB units of 360/65535 deg = 0.0054932479
-- a value of 0 shall be 0 degrees
-- a value of 1 shall be 0.0054932479 degrees
-- a value of 65534 shall be 359.9945078786 deg
-- a value of 65535 shall be used for orientation unavailable
```

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

7.181 Data Element: DE_SemiMinorAxisAccuracy

Use: The DE_SemiMinorAxisAccuracy data element is used to express the radius of the semi-minor axis of an ellipsoid representing the accuracy which can be expected from a GNSS system in 5 cm steps, typically at a one sigma level of confidence.

ASN.1 Representation:

```
SemiMinorAxisAccuracy ::= INTEGER (0..255)
-- semi-minor axis accuracy at one standard dev
-- range 0-12.7 meter, LSB = .05m
-- 254 = any value equal or greater than 12.70 meter
-- 255 = unavailable semi-minor axis value
```

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

7.182 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 U.S. 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 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 represents a protected-Movement-Allowed or permissive-Movement-Allowed condition that exists at all times. This value is applied to lanes, with or without traffic control devices, that operate as free-flow lanes. Typically referred to as channelized right/left turn lanes (in right/left-hand drive countries).

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 four other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_Connection | <ASN> , and |
| DF | DF_MovementState | <ASN> , and |
| DF | DF_PrioritizationResponse_EU | <ASN> , and |
| DF | DF_SignalHeadLocation_EU | <ASN> . |

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

7.183 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 most significant bit 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'0000' 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 preempt,
-- 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.
```

Remarks: In use, the vehicle must determine which preempt number or priority number to request by analyzing its location relative to the map layer information.

7.184 Data Element: DE_SignPriority

Use: The relative importance of the sign, on a scale from zero (least important) to seven (most important).

ASN.1 Representation:

```
SignPriority ::= INTEGER (0..7)
-- 0 as least, 7 as most
```

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

7.185 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 beepers and other slow speed maneuvering alerts.

Used to reflect any type or style of audio alerting when a vehicle is progressing and transmitting V2X messages to others about its path. Intended to be used as part of the V2X safety message for public safety vehicles (and others which alert during maneuvers) operating in the area.

ASN.1 Representation:

```
SirenInUse ::= ENUMERATED {
    unavailable (0), -- Not Equipped or unavailable
    notInUse (1),
    inUse (2),
    reserved (3) -- for future use
}
```

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

7.186 Data Element: DE_SnowType

Use: Indicates the type of snow. This DF may be extended in the future to support more specific characteristics.

ASN.1 Representation:

```
SnowType ::= ENUMERATED {
    packed,
    loose,
    ...
}
```

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

7.187 Data Element: DE_SpeedAdvice

Use: This data element represents the recommended velocity of an object, typically a vehicle speed along a roadway, expressed in unsigned units of 0.1 m/s.

ASN.1 Representation:

```
SpeedAdvice ::= INTEGER (0..500)
-- LSB units are 0.1 m/s^2
-- the value 499 shall be used for values at or greater than 49.9 m/s
-- the value 500 shall be used to indicate 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: Note the conversion guidance provided in 11.5 for situations in which units of mph and m/s are mixed.

7.188 Data Element: DE_SpeedConfidence

Use: The DE_SpeedConfidence data element is used to provide 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 reference and axis of rotation used shall be in accordance with that defined Section 11.

ASN.1 Representation:

```
SpeedConfidence ::= ENUMERATED {
    unavailable (0), -- Not Equipped or unavailable
    prec100ms   (1), -- 100 meters/sec
    prec10ms    (2), -- 10 meters/sec
    prec5ms     (3), -- 5 meters/sec
    prec1ms     (4), -- 1 meters/sec
    prec0-1ms   (5), -- 0.1 meters/sec
    prec0-05ms  (6), -- 0.05 meters/sec
    prec0-01ms  (7)  -- 0.01 meters/sec
}
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_AdvisorySpeed | <ASN> , and |
| DF | DF_Speed_Heading_Throttle_Confidence | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> . |

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

7.189 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,
    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.

7.190 Data Element: DE_SpeedProfileMeasurement

Use: The DE_SpeedProfileMeasurement data element represents the average measured or reported speed of a series of objects traveling in the same direction over a period of time.

ASN.1 Representation:

```
SpeedProfileMeasurement ::= GrossSpeed
```

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

Remarks: Note the conversion guidance provided in 11.5 for situations in which units of mph and m/s are mixed.

7.191 Data Element: DE_Speed

Use: This data element represents the vehicle speed expressed in unsigned units of 0.02 m/s. 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
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_BSMcoreData](#) <ASN>, and

DF [DF_PathHistoryPoint](#) <ASN>.

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

Remarks: This element has been maintained for use by the BSM message. For all new work, the entry DE_Velocity shall be used.

7.192 Data Element: DE_SSPIndex

Use: The SSP index is included in this document to maintain backward compatibility. It is always set to zero and ignored upon reception.

ASN.1 Representation:

```
SSPIndex ::= INTEGER (0..31)
```

Used By: This element is included in the following four data structures in this standard:

DF [DF_EmergencyDetails](#) <ASN>, and

DF [DF_PrivilegedEvents](#) <ASN>, and

DF [DF_TrailerData](#) <ASN>, and

DF [DF_TravelerDataFrame](#) <ASN>.

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

7.193 Data Element: DE_StabilityControlStatus

Use: The DE_StabilityControlStatus data element reflects the current state of the stability control system. The element can inform others that the vehicle is not equipped with stability control or, if equipped, if the stability control status is unavailable. If the vehicle is equipped with stability control and the status is available, the element reports whether the system is in an off, on, or engaged 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 (but not engaged)
    engaged      (3)  -- B'11  stability control is Engaged
}
```

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

Remarks: 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 vectors. 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.

7.194 Data Element: DE_StationID

Use: The DE_StationID has been included into SAE J2735 to support the optional European data element "PrioritizationResponse."

ASN.1 Representation:

```
StationID ::= INTEGER (0..4294967295)
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_VehicleID | <ASN> , and |
| 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.

7.195 Data Element: DE_SteeringWheelAngleConfidence

Use: The DE_SteeringWheelAngleConfidence data element is used to provide 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 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 reference and axis of rotation used shall be in accordance with that defined in Section 11.

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
}
```

Used By: This entry is directly used by the following three other data structures in this standard:

DF [DF_AccelSteerYawRateConfidence](#) [<ASN>](#), and

DF [DF_ConfidenceSet](#) [<ASN>](#), and

DF [DF_VehicleStatus](#) [<ASN>](#).

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

7.196 Data Element: DE_SteeringWheelAngleRateOfChange

Use: The rate of change of the angle of the steering wheel, expressed in signed units of 3 degree/s over a range of 381 degree/s 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
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_VehicleStatus](#) [<ASN>](#). 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 the presence of an obstruction or pothole in the roadway.

7.197 Data Element: DE_SteeringWheelAngle

Use: The angle of the driver's steering wheel, expressed in a signed (to the right being positive) value with LSB units of 1.5 degrees.

ASN.1 Representation:

```
SteeringWheelAngle ::= INTEGER (-126..127)
-- LSB units of 1.5 degrees, a range of -189 to +189 degrees
-- +001 = +1.5 deg
-- -126 = -189 deg and beyond
-- +126 = +189 deg and beyond
-- +127 to be used for unavailable
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_BSMcoreData](#) [<ASN>](#), and

DF [DF_VehicleStatus](#) [<ASN>](#).

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

Remarks: In the prior editions of the standard (pre-2015), this was constructed as a BLOB. It has now been converted for UPER use.

7.198 Data Element: DE_SunSensor

Use: The DE_SunSensor data element is intended to inform others as to the level of sunlight in the area the vehicle was traveling at the time a Probe Data snapshot was taken. The value of the sun sensor data element ranges from 0 to 2000, with zero indicating “complete darkness,” and 2000 indicating “maximum sunlight.” This information can be sent to vehicles approaching the area to tell drivers to be prepared for sunny/clouding/cloudy conditions ahead or to a weather server for monitoring weather conditions in the area.

ASN.1 Representation:

```
SunSensor ::= INTEGER (0..1000)
-- units of watts/m2
```

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

7.199 Data Element: DE_TemporaryID

Use: This is the 4 octet random device identifier, called the TemporaryID. When used for a mobile OBU device, this value will change periodically to ensure the overall anonymity of the vehicle, unlike a typical wireless or wired 802 device ID. 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. Other devices, such as infrastructure (RSUs), may have a fixed value for the temporary ID value. See also DE_StationID which is used in other deployment regions.

ASN.1 Representation:

```
TemporaryID ::= OCTET STRING (SIZE(4))
```

Used By: This entry is directly used by the following six other data structures in this standard:

| | | |
|-----|--|-----------------------------------|
| DF | DF_BSMcoreData | <ASN> , and |
| DF | DF_VehicleID | <ASN> , and |
| MSG | MSG_CommonSafetyRequest (CSR) | <ASN> , and |
| MSG | MSG_EmergencyVehicleAlert (EVA) | <ASN> , and |
| MSG | MSG_IntersectionCollisionAvoidance (ICA) | <ASN> , and |
| MSG | MSG_PersonalSafetyMessage (PSM) | <ASN> . |

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

Remarks: The circumstances and times at which various V2X devices (notably OBUs) create and change their current temporary ID is a complex application level topic. It should be noted that the temporary ID is not the same as a device MAC value, although when used as a means to uniquely identify a device, both have many common properties. It should further be noted that the MAC value for a mobile OBU device (unlike a typical wireless or wired 802 device) will periodically change to a new random value to ensure the overall anonymity of the vehicle.

7.200 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
```

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

7.201 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
```

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

7.202 Data Element: DE_ThrottleConfidence

Use: The DE_ThrottleConfidence data element is used to provide 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 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
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_ConfidenceSet](#) [<ASN>](#), and

DF [DF_Speed_Heading_Throttle_Confidence](#) [<ASN>](#).

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

7.203 Data Element: DE_ThrottlePosition

Use: The position of the throttle in the vehicle, expressed in units of 0.5% of range of travel, unsigned.

ASN.1 Representation:

```
ThrottlePosition ::= INTEGER (0..200) -- LSB units are 0.5 percent
```

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

7.204 Data Element: DE_TimeConfidence

Use: The DE_TimeConfidence data element is used to provide 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 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 than 100 Seconds
    time-050-000               (2), -- Better than 50 Seconds
    time-020-000               (3), -- Better than 20 Seconds
    time-010-000               (4), -- Better than 10 Seconds
    time-002-000               (5), -- Better than 2 Seconds
    time-001-000               (6), -- Better than 1 Second
    time-000-500               (7), -- Better than 0.5 Seconds
    time-000-200               (8), -- Better than 0.2 Seconds
    time-000-100               (9), -- Better than 0.1 Seconds
    time-000-050               (10), -- Better than 0.05 Seconds
    time-000-020               (11), -- Better than 0.02 Seconds
    time-000-010               (12), -- Better than 0.01 Seconds
    time-000-005               (13), -- Better than 0.005 Seconds
    time-000-002               (14), -- Better than 0.002 Seconds
    time-000-001               (15), -- Better than 0.001 Seconds
                                -- Better 1 ms
    time-000-000-5             (16), -- Better than 0.000,5 Seconds
    time-000-000-2             (17), -- Better than 0.000,2 Seconds
    time-000-000-1             (18), -- Better than 0.000,1 Seconds
    time-000-000-05            (19), -- Better than 0.000,05 Seconds
    time-000-000-02            (20), -- Better than 0.000,02 Seconds
    time-000-000-01            (21), -- Better than 0.000,01 Seconds
    time-000-000-005           (22), -- Better than 0.000,005 Seconds
    time-000-000-002           (23), -- Better than 0.000,002 Seconds
    time-000-000-001           (24), -- Better than 0.000,001 Seconds
                                -- Better than 1 μs
    time-000-000-000-5         (25), -- Better than 0.000,000,5 Seconds
    time-000-000-000-2         (26), -- Better than 0.000,000,2 Seconds
    time-000-000-000-1         (27), -- Better than 0.000,000,1 Seconds
    time-000-000-000-05        (28), -- Better than 0.000,000,05 Seconds
    time-000-000-000-02        (29), -- Better than 0.000,000,02 Seconds
    time-000-000-000-01        (30), -- Better than 0.000,000,01 Seconds
    time-000-000-000-005       (31), -- Better than 0.000,000,005 Seconds
    time-000-000-000-002       (32), -- Better than 0.000,000,002 Seconds
    time-000-000-000-001       (33), -- Better than 0.000,000,001 Seconds
                                -- Better than 1 nanosecond
    time-000-000-000-000-5     (34), -- Better than 0.000,000,000,5 Seconds
    time-000-000-000-000-2     (35), -- Better than 0.000,000,000,2 Seconds
    time-000-000-000-000-1     (36), -- Better than 0.000,000,000,1 Seconds
    time-000-000-000-000-05    (37), -- Better than 0.000,000,000,05 Seconds
    time-000-000-000-000-02    (38), -- Better than 0.000,000,000,02 Seconds
    time-000-000-000-000-01    (39) -- Better than 0.000,000,000,01 Seconds
}

```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_ConfidenceSet](#) [<ASN>](#), and

DF [DF_FullPositionVector](#) [<ASN>](#).

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

7.205 Data Element: DE_TimeIntervalConfidence

Use: This is the statistical confidence for the predicted time of 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)
```

| <i>-- Value</i> | <i>Probability</i> |
|-----------------|--------------------|
| <i>-- 0</i> | <i>21%</i> |
| <i>-- 1</i> | <i>36%</i> |
| <i>-- 2</i> | <i>47%</i> |
| <i>-- 3</i> | <i>56%</i> |
| <i>-- 4</i> | <i>62%</i> |
| <i>-- 5</i> | <i>68%</i> |
| <i>-- 6</i> | <i>73%</i> |
| <i>-- 7</i> | <i>77%</i> |
| <i>-- 8</i> | <i>81%</i> |
| <i>-- 9</i> | <i>85%</i> |
| <i>-- 10</i> | <i>88%</i> |
| <i>-- 11</i> | <i>91%</i> |
| <i>-- 12</i> | <i>94%</i> |
| <i>-- 13</i> | <i>96%</i> |
| <i>-- 14</i> | <i>98%</i> |
| <i>-- 15</i> | <i>100%</i> |

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_TimeChangeDetails](#) [<ASN>](#), and

DF [DF_REG_MovementEvent_JPN](#) [<ASN>](#).

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

7.206 Data Element: DE_TimeMark

Use: The TimeMark data element is used to relate a moment in UTC (Coordinated Universal Time)-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 the value of TimeMark is greater than the current time, it applies in the current hour, and if it is less than the current time, it applies in the next hour. When the value to be used is undefined or unknown, a value of 36111 shall be sent. Note that leap seconds are also supported.

ASN.1 Representation:

```

TimeMark ::= INTEGER (0..36111)
-- In units of 1/10th second from UTC time in the current or next hour
-- A range of 0~35999 covers one hour
-- The values 36000..36009 are used when a leap second occurs
-- The values 36010..36110 are reserved for future use
-- 36111 is to be used when the value is 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](#) <ASN>. In addition, this item may be used by data structures in other ITS standards.

7.207 Data Element: DE_TimeOffset

Use: The DE_TimeOffset data element is used to convey an offset in time from a known point. It is typically used to relate a set of measurements made in the recent past, such as a set of path points.

The above methodology is used when the offset is incorporated in data frames other than DF_PathHistoryPoint. Refer to the Use paragraph of DF_PathHistory for the methodology to calculate this data element for use in DF_PathHistoryPoint.

ASN.1 Representation:

```

TimeOffset ::= INTEGER (1..65535)
-- LSB units of of 10 mSec,
-- with a range of 0.01 seconds to 10 minutes and 55.34 seconds
-- a value of 65534 to be used for 655.34 seconds or greater
-- a value of 65535 to be unavailable

```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_PathHistoryPoint | <ASN> , and |
| DF | DF_TrailerHistoryPoint | <ASN> . |

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

7.208 Data Element: DE_TractionControlStatus

Use: The DE_TractionControlStatus data element reflects the status of the vehicle traction control system. The element can inform others that the vehicle is not equipped with traction control or, if equipped, if the traction control status is unavailable. If the vehicle is equipped with traction control and the status is available, the element reports whether the system is in an off, on, or engaged state.

ASN.1 Representation:

```

TractionControlStatus ::= ENUMERATED {
    unavailable (0), -- B'00 Not Equipped with traction control
                    -- or traction control status is unavailable
    off          (1), -- B'01 traction control is Off
    on           (2), -- B'10 traction control is On (but not Engaged)
    engaged      (3) -- B'11 traction control is Engaged
}

```

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

7.209 Data Element: DE_TrailerMass

Use: The DE_TrailerMass data element is used to relate the current mass of a trailer.

ASN.1 Representation:

```
TrailerMass ::= INTEGER (0..255)
-- object mass with LSB steps of 500 kg (~1100 lbs)
-- the value zero shall be used for an unknown mass value
-- the value 255 shall be used any mass larger than 127,500kg
-- a useful range of 0~127.5 metric tons.
```

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

7.210 Data Element: DE_TransitStatus

Use: The TransitStatus data element is used to relate basic information about the transit bus 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, kneeling, etc.)
    aBikeLoad     (2), -- loading of a bicycle 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 condition
} (SIZE(6))
```

Remarks: Most of these values are used to detect that the transit vehicle is 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.

7.211 Data Element: DE_TransitVehicleOccupancy

Use: The TransitVehicleOccupancy data element is used to relate basic level of current ridership.

ASN.1 Representation:

```
TransitVehicleOccupancy ::= ENUMERATED {
    occupancyUnknown      (0),
    occupancyEmpty        (1),
    occupancyVeryLow      (2),
    occupancyLow          (3),
    occupancyMed          (4),
    occupancyHigh         (5),
    occupancyNearlyFull   (6),
    occupancyFull         (7)
}
```

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

7.212 Data Element: DE_TransitVehicleStatus

Use: The TransitVehicleStatus 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:

```
TransitVehicleStatus ::= BIT STRING {
    loading      (0), -- parking and unable to move at this time
    anADAuse     (1), -- an ADA access is in progress (wheelchairs, kneeling, etc.)
    aBikeLoad    (2), -- loading of a bicycle is in progress
    doorOpen     (3), -- a vehicle door is open for passenger access
    charging     (4), -- a vehicle is connected to charging point
    atStopLine   (5)  -- a vehicle is at the stop line for the lane it is in
} (SIZE(8))
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_RequestorDescription](#) [<ASN>](#). 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 is 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).

7.213 Data Element: DE_TransmissionState

Use: The DE_TransmissionState data element is used to provide the current state of the vehicle transmission.

ASN.1 Representation:

```
TransmissionState ::= ENUMERATED {
    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,
    -- Any related speed is relative to the vehicle reference frame used
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_BSMcoreData](#) [<ASN>](#), and

DF [DF_TransmissionAndSpeed](#) [<ASN>](#).

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

7.214 Data Element: DE_TravelerInfoType

Use: The DE_TravelerInfoType data element provides the type of message to follow in the rest of the message frame structure. It is 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),
    ...
}

```

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

7.215 Data Element: DE_UniqueMSG_ID

Use: The DE_UniqueMSG_ID data element provides a relatively unique value which can be used to connect to (link to) other supporting messages in other formats.

ASN.1 Representation:

```

UniqueMSGID ::= OCTET STRING (SIZE(9))

```

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

7.216 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. Lowercase is recommended. The protocol to be used (such as http) should be given in the string. The very last character 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 character is then used to differentiate which base a given short value is to be used with (a matching first character in the URL-short value is also used). These characters 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))

```

Used By: This entry is used directly by one other data structure in this standard, a MSG called [MSG_TravelerInformation Message \(TIM\)](#) [<ASN>](#). 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.

7.217 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))

```

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.

7.218 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 be 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))
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_TravelerDataFrame](#) [<ASN>](#). 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.

7.219 Data Element: DE_UserSizeAndBehaviour

Use: The DE_UserSizeAndBehaviour data element is used to describe the overall stature of a user and user behaviours which may be of special note.

ASN.1 Representation:

```
UserSizeAndBehaviour ::= BIT STRING {
    unavailable                (0),
    smallStature                (1), -- less than 150 cm high
    largeStature                (2),
    erraticMoving               (3),
    slowMoving                  (4) -- those who move a bit slowly
} (SIZE (5, ...))
```

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

7.220 Data Element: DE_VariationStdDev

Use: The standard deviation of variation of measured mean of the vertical or horizontal road roughness.

ASN.1 Representation:

```
VariationStdDev ::= INTEGER (0..2500)
    -- Standard deviation in microns
```

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

7.221 Data Element: DE_VehicleEventFlags

Use: The vehicle 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 one 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 message unless at least one vehicle event flag is set to one. When one or more criteria associated with an event are no longer satisfied, the sender shall set the flag to zero in any vehicle event flag data element it sends. The presence of the vehicle 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 vehicle event flag element. When a given event flag is set to one the message might include related optional data as well. Further details of these operational concepts can be found in the relevant standards.

If no further normative requirements are provided, the below flags shall be used as given below.

- Hazard Lights: The hazard lights are active.
- Stop Line Violation: The vehicle anticipates that it will pass the stop line without coming to a full stop before reaching it.
- ABS: System activated exceeding 100 ms in length and active.
- Traction Control: System activated exceeding 100 ms in length and active.
- Stability Control: System activated exceeding 100 ms in length and active.
- Hazardous Materials: The vehicle is known to be carrying hazardous material and is placarded as such.
- Hard Braking: A Class 7 to 13 or a Class 4 vehicle is decelerating at a level greater than 0.2 g. For all other classes the vehicle is decelerating at a level of greater than 0.4 g.
- Lights Changed: The status of the external lighting of the vehicle has changed within the last 2 seconds. (The new state of the lights is presented in another element.)
- Wipers Changed: The status of wipers (front or rear) of the vehicle has changed within the last 2 seconds. (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.
- Jack Knife: One or more trailers connected to a vehicle have jack knifed.

ASN.1 Representation:

```
VehicleEventFlags ::= BIT STRING {
    eventHazardLights           (0),
    eventStopLineViolation      (1), -- Intersection Violation
    eventABSActivated           (2),
    eventTractionControlLoss    (3),
    eventStabilityControlActivated (4),
    eventHazardousMaterials     (5),
    eventReserved1              (6),
    eventHardBraking            (7),
    eventLightsChanged          (8),
    eventWipersChanged          (9),
    eventFlatTire               (10),
    eventDisabledVehicle        (11), -- The DisabledVehicle DF may also be sent
    eventAirBagDeployment        (12),
    eventJackKnife              (13) -- Applies to vehicles with trailer(s)
} (SIZE (13, ..., 14) )
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_VehicleSafetyExtensions](#) [<ASN>](#), and

MSG [MSG_IntersectionCollisionAvoidance \(ICA\)](#) [<ASN>](#).

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 potentially dangerous events (such as hard braking) have been declared by the sender. Additional data elements in the message may provide more details on the cause of this event.

7.222 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. In the case of motorcycles, the height includes 1 m added to account for the rider.

ASN.1 Representation:

```
VehicleHeight ::= INTEGER (0..127)
-- the height of the vehicle
-- LSB units of 5 cm, range to 6.35 meters
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_TrailerUnitDescription | <ASN> , and |
| DF | DF_TrailerUnitDescJ2945Slash1B | <ASN> , and |
| DF | DF_VehicleData | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> . |

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

7.223 Data Element: DE_VehicleLength

Use: The length of the vehicle measured from the edge of the front bumper to the edge of the rear bumper expressed in centimeters, unsigned. It should be noted that this value is often combined with a vehicle width value to form a data frame. The value zero shall be sent when data is unavailable.

ASN.1 Representation:

```
VehicleLength ::= INTEGER (0.. 4095) -- LSB units of 1 cm with a range of >40 meters
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_TrailerUnitDescription | <ASN> , and |
| DF | DF_TrailerUnitDescJ2945Slash1B | <ASN> , and |
| DF | DF_VehicleSize | <ASN> . |

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

7.224 Data Element: DE_VehicleMass

Use: The DE_VehicleMass data element represents the estimated weight of the vehicle over a span of stepwise linear values. The least significant bit step size varies from 50, to 500, to 2000 kg, as noted in the ASN. This provides a value range from zero to in excess of 170000 kg. The weight should reflect the current gross mass of vehicle and contents if known. Otherwise, an average laden value should be established. In cases where the weight is greater than 170000 kg, the value of 254 shall be used.

ASN.1 Representation:

```

VehicleMass ::= INTEGER (0..255)
-- Values 000 to 080 in steps of 50kg
-- Values 081 to 200 in steps of 500kg
-- Values 201 to 253 in steps of 2000kg
-- The Value 254 shall be used for weights above 170000 kg
-- The Value 255 shall be used when the value is unknown or unavailable
-- Encoded such that the values:
-- 81 represents 4500 kg
-- 181 represents 54500 kg
-- 253 represents 170000 kg

```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_VehicleData | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> , and |
| MSG | MSG_EmergencyVehicleAlert (EVA) | <ASN> . |

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

Remarks: See also the DE_TrailerMass data element.

7.225 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) ,

...
}

```

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

7.226 Data Element: DE_VehicleType

Use: The DE_VehicleType data element is a type list (i.e., a classification list) of the vehicle in terms of overall size. The data element entries follow the definitions defined in the U.S. DOT Highway Performance Monitoring System (HPMS). Many infrastructure roadway operators collect and classify data according to this list for regulatory reporting needs. Within the ITS industry and within the V2X message set standards work, there are many similar lists of types for overlapping needs and uses.

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
    ...
}

```

Used By: This entry is directly used by the following five other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_RequestorType | <ASN> , and |
| DF | DF_VehicleClassification | <ASN> , and |
| DF | DF_VehicleIdent | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> , and |
| MSG | MSG_EmergencyVehicleAlert (EVA) | <ASN> . |

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

7.227 Data Element: DE_VehicleWidth

Use: The width of the vehicle expressed in centimeters, unsigned. 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 with a range of >10 meters
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_TrailerUnitDescription](#) [<ASN>](#), and

DF [DF_TrailerUnitDescJ2945Slash1B](#) [<ASN>](#), and

DF [DF_VehicleSize](#) [<ASN>](#).

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

Remarks: It should be noted that this data element is often combined with DE_VehicleLength when used.

7.228 Data Element: DE_Velocity

Use: This data element represents the velocity of an object, typically a vehicle speed or the recommended speed of travel along a roadway, expressed in unsigned units of 0.02 m/s. When used with motor vehicles it may be combined with the transmission state to form a data frame for use. A value of 8191 shall be used when the speed is unavailable. Note that Velocity as used here is intended to be a scalar value and not a vector.

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 directly used by the following three other data structures in this standard:

DF [DF_RegulatorySpeedLimit](#) [<ASN>](#), and

DF [DF_TransmissionAndSpeed](#) [<ASN>](#), and

MSG [MSG_PersonalSafetyMessage \(PSM\)](#) [<ASN>](#).

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

Remarks: Note the conversion guidance provided in 11.5 for situations in which units of mph and m/s are mixed.

7.229 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” 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 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 {
    notEquipped (0), -- Not equipped or off
    leftFront (1), -- Left Front Event
    leftRear (2), -- Left Rear Event
    rightFront (3), -- Right Front Event
    rightRear (4) -- Right Rear Event
} (SIZE(5))
```

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

7.230 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 m/s² is 1 G, i.e., 0.02 G = 0.1962 m/s²).

ASN.1 Representation:

```
VerticalAcceleration ::= INTEGER (-127..127)
-- LSB units of 0.02 G steps over -2.52 to +2.54 G
-- The value +127 shall be used for ranges >= 2.54 G
-- The value -126 shall be used for ranges <= 2.52 G
-- The value -127 shall be used for unavailable
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_AccelerationSet4Way](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

Remarks: Note: In the 2009 version of this standard, this data element was logarithmically encoded over a different range.

7.231 Data Element: DE_VertOffset-B07

Use: A 7-bit vertical delta offset in the Z direction from the last point. The offset is positive to the vertical (Z) direction. The most negative value shall be used to indicate an unknown value. Unlike similar horizontal offsets, the LSB used is 10 cm (not 1 cm).

ASN.1 Representation:

```
VertOffset-B07 ::= INTEGER (-64..63)
-- LSB units of of 10 cm
-- with a range of +- 6.3 meters vertical
-- value 63 to be used for 63 or greater
-- value -63 to be used for -63 or greater
-- value -64 to be unavailable
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|----|---|-----------------------------------|
| DF | DF_TrailerHistoryPoint | <ASN> , and |
| DF | DF_TrailerUnitDescription | <ASN> , and |
| DF | DF_VerticalOffset | <ASN> . |

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

7.232 Data Element: DE_VertOffset-B08

Use: An 8-bit vertical delta offset in the Z direction from the last point. The offset is positive to the vertical (Z) direction. The most negative value shall be used to indicate an unknown value. Unlike similar horizontal offsets, the LSB used is 10 cm (not 1 cm).

ASN.1 Representation:

```
VertOffset-B08 ::= INTEGER (-128..127)
-- LSB units of of 10 cm
-- with a range of +- 12.7 meters vertical
-- value 127 to be used for 127 or greater
-- value -127 to be used for -127 or greater
-- value -128 to be unavailable
```

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

7.233 Data Element: DE_VertOffset-B09

Use: A 9-bit vertical delta offset in the Z direction from the last point. The offset is positive to the vertical (Z) direction. The most negative value shall be used to indicate an unknown value. Unlike similar horizontal offsets, the LSB used is 10 cm (not 1 cm).

ASN.1 Representation:

```
VertOffset-B09 ::= INTEGER (-256..255)
-- LSB units of of 10 cm
-- with a range of +- 25.5 meters vertical
-- value 255 to be used for 255 or greater
-- value -255 to be used for -255 or greater
-- value -256 to be unavailable
```

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

7.234 Data Element: DE_VertOffset-B10

Use: A 10-bit vertical delta offset in the Z direction from the last point. The offset is positive to the vertical (Z) direction. The most negative value shall be used to indicate an unknown value. Unlike similar horizontal offsets, the LSB used is 10 cm (not 1 cm).

ASN.1 Representation:

```
VertOffset-B10 ::= INTEGER (-512..511)
-- LSB units of of 10 cm
-- with a range of +- 51.1 meters vertical
-- value 511 to be used for 511 or greater
-- value -511 to be used for -511 or greater
-- value -512 to be unavailable
```

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

7.235 Data Element: DE_VertOffset-B11

Use: An 11-bit vertical delta offset in the Z direction from the last point. The offset is positive to the vertical (Z) direction. The most negative value shall be used to indicate an unknown value. Unlike similar horizontal offsets, the LSB used is 10 cm (not 1 cm).

ASN.1 Representation:

```
VertOffset-B11 ::= INTEGER (-1024..1023)
-- LSB units of of 10 cm
-- with a range of +- 102.3 meters vertical
-- value 1023 to be used for 1023 or greater
-- value -1023 to be used for -1023 or greater
-- value -1024 to be unavailable
```

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

7.236 Data Element: DE_VertOffset-B12

Use: A 12-bit vertical delta offset in the Z direction from the last point. The most negative value shall be used to indicate an unknown value. Unlike similar horizontal offsets, the LSB used is 10 cm (not 1 cm).

The above methodology is used when the offset is incorporated in data frames other than DF_PathHistoryPoint. See the Use paragraph of DF_PathHistory for the methodology to calculate this data element for use in DF_PathHistoryPoint.

ASN.1 Representation:

```
VertOffset-B12 ::= INTEGER (-2048..2047)
-- LSB units of of 10 cm
-- with a range of +- 204.7 meters vertical
-- value 2047 to be used for 2047 or greater
-- value -2047 to be used for -2047 or greater
-- value -2048 to be unavailable
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|-------------------------------------|-----------------------------------|
| DF | DF_PathHistoryPoint | <ASN> , and |
| DF | DF_VerticalOffset | <ASN> . |

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

7.237 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 generally 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
```

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

7.238 Data Element: DE_WaitOnStopline

Use: The DE_WaitOnStopline data element is used to indicate to the vehicle that 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.

7.239 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. A value of one is used for any sweep rate with a period greater than 60 seconds.

ASN.1 Representation:

```
WiperRate ::= INTEGER (0..127) -- units of sweeps per minute
```

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

7.240 Data Element: DE_WiperStatus

Use: The current status of a wiper system on the subject vehicle.

The “Wiper Status” Probe Data Element is intended to inform other users whether or not it was raining/snowing at the vehicle’s location at the time it was taken (such as the Probe Data snapshot). 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:

```
WiperStatus ::= ENUMERATED {
    unavailable          (0), -- Not Equipped with wiper status
                           -- or wiper status is unavailable
    off                  (1),
    intermittent         (2),
    low                  (3),
    high                 (4),
    washerInUse          (5), -- washing solution being used
    automaticPresent     (6), -- Auto wiper equipped
    ...
}
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_WiperSet](#) [<ASN>](#). 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.

7.241 Data Element: DE_YawRateConfidence

Use: This DE is used to provide 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 reference and axis of rotation used shall be in accordance with that defined Section 11.

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
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_AccelSteerYawRateConfidence](#) [<ASN>](#), and

DF [DF_VehicleStatus](#) [<ASN>](#).

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

7.242 Data Element: DE_YawRate

Use: The DE_YawRate data element provides the yaw rate of the vehicle, a signed value (to the right being positive) expressed in 0.01 degrees per second. The element can be used to represent a vehicle's rotation about its vertical axis within a certain time period, often at the time a Probe Data snapshot was taken. Another element, the yaw rate confidence element provides 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)
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_AccelerationSet4Way](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

7.243 Data Element: DE_ZoneLength

Use: The DE_ZoneLength data element 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 ways to relate this distance value. When used with clearance zones, it represents the point at which 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 vehicle's 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 two other data structures in this standard:

DF [DF_AdvisorySpeed](#) [<ASN>](#), and

DF [DF_ConnectionManeuverAssist](#) [<ASN>](#).

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

7.244 Data Element: DE_Zoom

Use: The DE_Zoom data element is used to set a scaling factor for a region, a map fragment, or a sequence of offset points within a map, lane, or path. The scaling factor always reduces the precision of the offset steps while proportionally increasing the range (or span). The zoom value of zero implies a 1:1 scale, while a larger value implies an increase in the LSB step by a power of $X = 2^z$, where z is the zoom scale. By judicious use of the zoom element, a path can be described with the correct combination of suitable precision and the fewest data set points to meet different application needs.

ASN.1 Representation:

```
Zoom ::= INTEGER (0..15)
-- A zoom scale applied in units of 2^N
-- A value of 0 is a 1:1 zoom (no zoom)
-- A value of 1 is a 2:1 zoom
-- A value of 2 is a 4:1 zoom, etc.
-- The zoom value is applied to one or more offsets
-- increase the span or range while reducing its precision
-- The absence of a zoom, any offset element in a data
-- frame implies a 1:1 zoom
```

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

8. EXTERNAL DATA ENTRIES

This section defines the precise structure of certain data concepts defined by this standard. In general, these are data concepts found in other standards and reused here.

8.1 Data Element: DE_AltitudeConfidence_EU [ADDGRPC]

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 meters
    alt-005-00, -- accuracy within 5.00 meters
    alt-010-00, -- accuracy within 10.00 meters
    alt-020-00, -- accuracy within 20.00 meters
    alt-050-00, -- accuracy within 50.00 meters
    alt-100-00, -- accuracy within 100.00 meters
    alt-200-00, -- accuracy within 200.00 meters
    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 [ADDGRPC]

Use: The AltitudeValue data value is as defined in TS102894-2 data dictionary.

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 [ADDGRPB]

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 another 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 octet
-- 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 directly used by the following six other data structures in this standard:

| | | |
|----|--|-----------------------------------|
| DF | DF_ComputedLane | <ASN> , and |
| DF | DF_ObstacleDetection | <ASN> , and |
| DF | DF_PivotPointDescription | <ASN> , and |
| DF | DF_RequestorPositionVector | <ASN> , and |
| DF | DF_TrailerHistoryPoint | <ASN> , and |
| DF | DF_VehicleStatus | <ASN> . |

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

8.4 Data Element: DE_Day_JPN [ADDGRPB]

Use: The DE_Day data element is used to describe the day of the month using a single octet BCD coding format.

ASN.1 Representation:

```
Day ::= INTEGER (0..255)
-- BCD coding of Day of Month, in 1 octet
-- 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 [ADDGRPB]

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

```

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 [ADDGRPB]

Use: The DegreesJpn data element is used to describe signed units of degrees of latitude.

ASN.1 Representation:

```

DegreesLat ::= INTEGER (-90..90)
  -- Signed units of degrees, in 1 octets
  -- 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 [ADDGRPB]

Use: The DegreesJpn data element is used to describe signed units of degrees of longitude.

ASN.1 Representation:

```

DegreesLong ::= INTEGER (-180..180)
  -- Signed units of degrees, in 2 octets
  -- 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 [ADDGRPB]

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 octets
  -- the value 32767 (0x7FFF) shall indicate an invalid value

```

8.9 Data Element: DE_EmissionType_EU [ADDGRPC]

Use: The DE_EmissionType_EU data element allows selection of 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, --
    ...
}
```

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.

8.10 Data Element: DE_GenericLocations [ITIS]

Use: The ITIS enumeration list commonly referred to as “Generic Locations,” is assigned the upper byte value of [31] (which provides for value ranges from 7936 to 8191, inclusive). This list is formally called “GenericLocations” 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 96 different phrases, divided into five further sub-categories (the division into these sub-categories is informational only and other groupings may also be used). The remaining 31 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 8064).

ASN.1 Representation:

```
GenericLocations ::= ENUMERATED {
    -- Road Related
    on-bridges (7937), -- Not to be used as the default for this
    -- category
    in-tunnels (7938),
    entering-or-leaving-tunnels (7939),
    on-ramps (7940),
    in-road-construction-area (7941),
    around-a-curve (7942),
    on-curve (8026),
    on-tracks (8009),
    in-street (8025), -- As in in-street pad crossing
    shoulder (8027),
    on-minor-roads (7943),
    in-the-opposing-lanes (7944),
    adjacent-to-roadway (7945),
    across-tracks (8024),
    on-bend (7946),
    intersection (8032),
    entire-intersection (7947),
    in-the-median (7948),
    moved-to-side-of-road (7949),
    moved-to-shoulder (7950),
    on-the-roadway (7951), -- Use generic locations/groups affected to
    -- make other such phrases
    dip (8010),
    traffic-circle (8011), -- Used for W2-6 graphic as well. Alt term:
    -- roundabout
    crossover (8028),
    cross-road (8029), -- Also used for W2-1 Note that in some uses
    -- this is one word
    side-road (8030), -- Do not used for W2-2R and W2-2L
    to (8014),
    by (8015),
    through (8016),
```

| | | |
|--|---------|--|
| area-of | (8017), | -- Also area |
| under | (8018), | |
| over | (8019), | |
| from | (8020), | |
| approaching | (8021), | |
| entering-at | (8022), | -- Alt form: Entrance |
| exiting-at | (8023), | |
| -- Terrain & Geography | | |
| in-shaded-areas | (7952), | |
| in-low-lying-areas | (7953), | |
| in-the-downtown-area | (7954), | |
| in-the-inner-city-area | (7955), | |
| in-parts | (7956), | |
| in-some-places | (7957), | |
| in-the-ditch | (7958), | |
| in-the-valley | (7959), | |
| on-hill-top | (7960), | |
| near-the-foothills | (7961), | |
| at-high-altitudes | (7962), | |
| near-the-lake | (7963), | |
| near-the-shore | (7964), | |
| nearby-basin | (8008), | |
| over-the-crest-of-a-hill | (7965), | |
| other-than-on-the-roadway | (7966), | |
| near-the-beach | (7967), | |
| near-beach-access-point | (7968), | |
| mountain-pass | (8006), | |
| lower-level | (7969), | |
| upper-level | (7970), | |
| -- Transit Travel, Air Travel and Places | | |
| airport | (7971), | |
| concourse | (7972), | |
| gate | (7973), | |
| baggage-claim | (7974), | |
| customs-point | (7975), | |
| reservation-center | (8007), | |
| station | (7976), | |
| platform | (7977), | -- Alternative Rendering: track |
| dock | (7978), | |
| depot | (7979), | |
| ev-charging-point | (7980), | |
| information-welcome-point | (7981), | -- Use for Tourist Information as well (D9-10) |
| at-rest-area | (7982), | |
| at-service-area | (7983), | |
| at-weigh-station | (7984), | |
| roadside-park | (8033), | |
| picnic-areas | (7985), | |
| rest-area | (7986), | |
| service-stations | (7987), | |
| toilets | (7988), | -- Note also rest rooms in structures |
| bus-stop | (8031), | |
| park-and-ride-lot | (8012), | -- Not to be used as a mode of travel |
| -- Direction of Travel | | |
| on-the-right | (7989), | |
| on-the-left | (7990), | |
| in-the-center | (7991), | |
| in-the-opposite-direction | (7992), | |
| cross-traffic | (7993), | |
| northbound-traffic | (7994), | |
| eastbound-traffic | (7995), | |

```

southbound-traffic      (7996),
westbound-traffic       (7997),
-- Compass Points
north                   (7998),
south                   (7999),
east                    (8000),
west                    (8001),
northeast               (8002),
northwest               (8003),
southeast               (8004),
southwest               (8005),
... -- # LOCAL_CONTENT_ITIS
}

```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF ITIS-Codes And Text <ASN>](#). In addition, this item may be used by data structures in other ITS standards.

8.11 Data Element: DE_Holiday_JPN [ADDGRPB]

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).

8.12 Data Element: DE_Hour_JPN [ADDGRPB]

Use: The HourJpn data element is used to describe the hour using a single octet BCD coding format.

ASN.1 Representation:

```

Hour ::= INTEGER (0..255)
-- BCD coding of Hour of a Day, in 1 octet
-- 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.

8.13 Data Element: DE_Incident Response Equipment [ITIS]

Use: The ITIS enumeration list commonly referred to as “Incident Response Equipment” is assigned the upper octet 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 octet value of [127] are reserved for additional “national” phrases in this octet range. Local phrases may be added to the list starting with the lower octet value of 128 and proceeding upward from there; i.e., 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),
    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 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
}

```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_VehicleClassification | <ASN> , and |
| DF | DF_VehicleIdent | <ASN> , and |
| MSG | MSG_EmergencyVehicleAlert (EVA) | <ASN> . |

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

8.14 Data Element: DE_ITIS_Text [ITIS]

Use: Simple text used with ITIS codes. (Text taken from SAE J2540.)

ASN.1 Representation:

```
ITISText ::= IA5String (SIZE(1..500))
```

Used By: This entry is used directly by one other data structure in this standard, a DF called [DF_ITIS-Codes And Text](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

Remarks: It should be noted that the V2X standards using this entry will typically severely restrict the length that this data element can use to manage the bandwidth that a message can consume.

8.15 Data Element: DE_LatitudeDMS [ADDGRPBJ]

Use: The geographic latitude of an object, expressed in 1/100th of an integer second, where 60 seconds comprise 1 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 32400001 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 octet 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_LongitudeDMS [ADDGRPB]

Use: The geographic longitude of an object, expressed in 1/100th of an integer second, where 60 seconds comprise 1 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 64800001 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 octet 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.

8.17 Data Element: DE_MaxTimetoChange [ADDGRPB]

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 octets
-- 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.

8.18 Data Element: DE_MinTimetoChange [ADDGRPB]

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 octets
-- 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.

8.19 Data Element: DE_Minute_JPN [ADDGRPB]

Use: The MinuteJpn data element is used to describe a minute (of time) using a single octet BCD coding format.

ASN.1 Representation:

```
Minute ::= INTEGER (0..255)
-- BCD coding of Minute of an Hour, in 1 octet
-- 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.

8.20 Data Element: DE_MinutesAngle_JPN [ADDGRPB]

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 octet
-- 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 two other data structures in this standard:

DF [DF_LatitudeDMS2](#) [<ASN>](#), and
DF [DF_LongitudeDMS2](#) [<ASN>](#).

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

8.21 Data Element: DE_Month_JPN [ADDGRPB]

Use: The MonthJpn data element is used to describe the month using a single octet BCD coding format.

ASN.1 Representation:

```
Month ::= INTEGER (1..255)
-- BCD coding of Month of a year, in 1 octet
-- 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.

8.22 Data Element: DE_MsgCount_JPN [ADDGRPB]

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
```

8.23 Data Element: DE_Responder Group Affected [ITIS]

Use: The ITIS enumeration list commonly referred to as “Responder Group Affected” is assigned the upper octet 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 octet value of [127] are reserved for additional “national” phrases in this octet range. Local phrases may be added to the list starting with the lower octet value of 128 and proceeding upward from there; i.e., 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, 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)
```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_VehicleClassification | <ASN> , and |
| DF | DF_VehicleIdent | <ASN> , and |
| MSG | MSG_EmergencyVehicleAlert (EVA) | <ASN> . |

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

8.24 Data Element: DE_Second_JPN [ADDGRP]

Use: The SecondJpn data element is used to describe a second (of time) using a 1 octet BCD coding format.

ASN.1 Representation:

```
Second ::= INTEGER (0..60)
-- BCD coding of a second of time, in 1 octet
-- 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.

8.25 Data Element: DE_SecondsAngle_JPN [ADDGRPB]

Use: The Angle_JPN data element is used to describe the unsigned seconds of an angle in steps of 1/10th of a second.

ASN.1 Representation:

```
SecondsAngle ::= INTEGER (0..5999)
-- Unsigned units of 1/100th seconds of angle, in 2 octets
-- 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 two other data structures in this standard:

DF [DF LatitudeDMS2](#) [<ASN>](#), and
 DF [DF LongitudeDMS2](#) [<ASN>](#).

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

8.26 Data Element: DE_SummerTime_JPN [ADDGRPB]

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).

8.27 Data Element: DE_TenthSecond_JPN [ADDGRPB]

Use: The TenthSecond data element is used to describe a tenth of a second (of time) using a single octet BCD coding format.

ASN.1 Representation:

```
TenthSecond ::= INTEGER (0..9)
-- Unsigned units of 100 milliseconds, in 1 octet
-- 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.

8.28 Data Element: DE_TimeRemaining_JPN [ADDGRP]B

Use: The TimeRemaining data element is used to express the time remaining for a signal phase value in units of 0.1 seconds. 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 octets
    -- 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.

8.29 Data Element: DE_Vehicle Groups Affected [ITIS]

Use: The ITIS enumeration list commonly referred to as “Vehicle Groups Affected” is assigned the upper octet 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 octet value of [127] are reserved for additional “national” phrases in this octet range. Local phrases may be added to the list starting with the lower octet value of 128 and proceeding upward from there; i.e., 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),
    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),  -- The L is lower case here
military-convoys                 (9250),
military-vehicles                (9251),
... -- # LOCAL_CONTENT_ITIS
}
-- Classification of vehicles and types of transport

```

Used By: This entry is directly used by the following three other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_VehicleClassification | <ASN> , and |
| DF | DF_VehicleIdent | <ASN> , and |
| MSG | MSG_EmergencyVehicleAlert (EVA) | <ASN> . |

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

8.30 Data Element: DE_Year_JPN [ADDGRPB]

Use: The YearJpn data element is used to describe the year (of time) using a two octet BCD coding format.

ASN.1 Representation:

```

Year ::= INTEGER (1..65535)
-- BCD coding of four digits of the year A.D. in 2 octets
-- 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.

8.31 Data Frame: DF_Altitude_EU [ADDGRPC]

Use: The DF_Altitude data frame provides the altitude and confidence of the accuracy of that altitude from the reference ellipsoid, typically in the WGS-84 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.

8.32 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 SAE J2540 standard. This is a set of nearly 1500 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
}

```

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

Remarks: Refer to the SAE ITIS entry ITIScodes for the complete listing of these codes and for an XML rendering.

8.33 Data Frame: DF_LatitudeDMS2 [ADDGRPB]

Use: The geographic latitude of an object, expressed in 1/100th of an integer second, where 60 seconds comprise 1 minute and 60 minutes comprise a degree of latitude (often referred to as a DDMSS.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 32400001 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 octets (32 bits) when implicit encoding is used
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|---------------------------------------|-----------------------------------|
| 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_LongitudeDMS2 [ADDGRPB]

Use: The geographic longitude of an object, expressed in 1/100th of an integer second, where 60 seconds comprise 1 minute and 60 minutes comprise a degree of latitude (often referred to as a DDMSS.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 64800001 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 octets (40 bits) when implicit encoding is used
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|---------------------------------------|-----------------------------------|
| 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.

8.35 Data Frame: DF_Node_LLdms_48b [ADDGRPB]

Use: A 48-bit node type with lat-long values expressed in Japanese 0.01 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_NodeOffsetPointXY_JPN](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

8.36 Data Frame: DF_Node_LLdms_80b [ADDGRPB]

Use: An 80-bit node type with lat-long values expressed in Japanese 0.01 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_NodeOffsetPointXY_JPN](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

8.37 Data Frame: DF_PrioritizationResponse_EU [ADDGRPC]

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 prioritizationprocess
    priorState DSRC.PrioritizationResponseStatus,
    -- State of prioritization request
    signalGroup DSRC.SignalGroupID,
    -- id of prioritized LaneSet, which will
    -- be given free way
    ...
}
```

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.

8.38 Data Frame: DF_PrioritizationResponseList_EU [ADDGRPC]

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.

8.39 Data Frame: DF_REG_ConnectionManeuverAssist_EU [ADDGRPC]

Use: The regional definition of extensions to this data frame, for the EU region.

ASN.1 Representation:

```

ConnectionManeuverAssist-addGrpC ::= SEQUENCE {
    vehicleToLanePositions VehicleToLanePositionList,
    rsuDistanceFromAnchor DSRC.NodeOffsetPointXY OPTIONAL
}

```

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

8.40 Data Frame: DF_REG_IntersectionState_EU [ADDGRPC]

Use: The regional definition of extensions to this data frame, for the EU region.

ASN.1 Representation:

```

IntersectionState-addGrpC ::= SEQUENCE {
    activePrioritizations PrioritizationResponseList OPTIONAL,
    ... }

```

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

8.41 Data Frame: DF_REG_LaneDataAttribute_JPN [ADDGRPB]

Use: The regional definition of extensions to this data frame for the Japan region.

ASN.1 Representation:

```

LaneDataAttribute-addGrpB ::= SEQUENCE { ... }

```

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

8.42 Data Frame: DF_REG_MapData_Base_EU [ADDGRPC]

Use: The regional definition of extensions to this data frame for the EU region.

ASN.1 Representation:

```

MapData-addGrpC ::= SEQUENCE {
    signalHeadLocations SignalHeadLocationList OPTIONAL,
    ...
}

```

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

8.43 Data Frame: DF_REG_MovementEvent_JPN [ADDGRPB]

Use: The regional definition of extensions to this data frame for the Japan region.

ASN.1 Representation:

```

MovementEvent-addGrpB ::= SEQUENCE {
    -- A set of countdown style time-to-change values
    -- all in units of 0.1 seconds and following
    -- the naming of the base V2X standard

    startTime TimeRemaining OPTIONAL,
    -- When this phase 1st started
    minEndTime MinTimetoChange,
    -- Expected shortest end time
}

```

```

maxEndTime MaxTimetoChange OPTIONAL,
-- Expected longest 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_REG_DataFrames](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

8.44 Data Frame: DF_REG_NodeOffsetPointXY_JPN [ADDGRPB]

Use: The regional definition of extensions to this data frame for the Japan region.

ASN.1 Representation:

```

NodeOffsetPointXY-addGrpB ::= 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_REG_DataFrames](#) [<ASN>](#). In addition, this item may be used by data structures in other ITS standards.

8.45 Data Frame: DF_REG_Position3D_EU [ADDGRPC]

Use: The regional definition of extensions to this data frame for the EU region.

ASN.1 Representation:

```

Position3D-addGrpC ::= SEQUENCE {
  altitude Altitude,
  ...
}

```

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

8.46 Data Frame: DF_REG_Position3D_JPN [ADDGRPB]

Use: The DF_REG_Position3D_JPN data frame 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:

```

Position3D-addGrpB ::= 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_REG_DataFrames <ASN>](#). In addition, this item may be used by data structures in other ITS standards.

8.47 Data Frame: DF_REG_RestrictionUserType_EU [ADDGRPC]

Use: The regional definition of extensions to this data frame for the EU region.

ASN.1 Representation:

```
RestrictionUserType-addGrpC ::= SEQUENCE {
    emission EmissionType OPTIONAL,
    ...
}
```

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

8.48 Data Frame: DF_SignalHeadLocation_EU [ADDGRPC]

Use: The DF_SignalHeadLocation_EU 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.NodeOffsetPointXY, -- the location
    signalGroupID DSRC.SignalGroupID,
    ...
}
```

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

8.49 Data Frame: DF_SignalHeadLocationList_EU [ADDGRPC]

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 <ASN>](#). In addition, this item may be used by data structures in other ITS standards.

8.50 Data Frame: DF_TimeMark_JPN [ADDGRPB]

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, summertime or not, holiday or not, the 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 octets
    month Month, -- BCD coding of Month, 1 octet
    day Day, -- BCD coding of Day, 1 octet
    summerTime SummerTime,
    holiday Holiday,
    dayOfWeek DayOfWeek,
    hour Hour, -- BCD coding of Hour, 1 octet
    minute Minute, -- BCD coding of Minute, 1 octet
    second Second, -- BCD coding of Second, 1 octet
    tenthSecond TenthSecond -- units of 100 millisecond, 1 octet
```

}

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

8.51 Data Frame: DF_VehicleToLanePosition_EU [ADDGRPC]

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,
    ...
}
```

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.

8.52 Data Frame: DF_VehicleToLanePositionList_EU [ADDGRPC]

Use: The VehicleToLanePositionList data frame is a list of VehicleToLanePosition entries

ASN.1 Representation:

```
VehicleToLanePositionList ::= SEQUENCE SIZE(1..5) OF VehicleToLanePosition
```

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.

8.53 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)
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|----------------------------------|-----------------------------------|
| DF | DF_VehicleStatus | <ASN> , and |
| DF | DF_WeatherReport | <ASN> . |

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

8.54 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/h. A value of 65535 shall indicate an error condition or missing value.

ASN.1 Representation:

```
EssPrecipRate ::= INTEGER (0..65535)
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_VehicleStatus](#) [<ASN>](#), and

DF [DF_WeatherReport](#) [<ASN>](#).

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

8.55 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)
}
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_VehicleStatus](#) [<ASN>](#), and

DF [DF_WeatherReport](#) [<ASN>](#).

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

8.56 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)}
```

Used By: This entry is directly used by the following two other data structures in this standard:

DF [DF_VehicleStatus](#) [<ASN>](#), and

DF [DF_WeatherReport](#) [<ASN>](#).

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

Remarks: Used in ATIS to provide gross (wide area) coverage area reports, not just point sensor measurements.

8.57 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)
```

Used By: This entry is directly used by the following two other data structures in this standard:

| | | |
|----|----------------------------------|-----------------------------------|
| DF | DF_VehicleStatus | <ASN> , and |
| DF | DF_WeatherReport | <ASN> . |

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

8.58 Data Element: EXT_ITIS_Codes [ITIS]

Use: The complete set of ITIS codes can be found in Volume Two of the SAE J2540 standard. This is a set of over 1000 items which are used to encode common events and list items in ITS.

ASN.1 Representation:

```
ITIScodes ::= INTEGER (0.. 65535)
-- 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 seven other data structures in this standard:

| | | |
|-----|---|-----------------------------------|
| DF | DF_EventDescription | <ASN> , and |
| DF | DF_ITIS_Phrase_ExitService | <ASN> , and |
| DF | DF_ITIS_Phrase_GenericSignage | <ASN> , and |
| DF | DF_ITIS_Phrase_SpeedLimit | <ASN> , and |
| DF | DF_ITIS_Phrase_WorkZone | <ASN> , and |
| MSG | MSG_RoadSideAlert (RSA) | <ASN> , and |
| DF | DF_ITIS-Codes_And_Text | <ASN> . |

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

Remarks: Refer to the SAE ITIS documents for the complete 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. The over the wire format is a numbered union of values and phrases in other systems such as XML.

9. REGIONAL DATA CONCEPTS

This section defines the precise structure of certain data concepts defined by this standard.

9.1 Data Frame: DF_REG_DataFrames [REGION]

Use: The regional definitions of any extensions to a set of data frames, if required. These extensions are 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 to augment the base standard. Each region will further define these data concepts, and the containing namespace, as it requires. It should be noted that these definitions all reside entirely in the REGION module but can (and are expected to) use the contents of this data dictionary and work residing in other modules. The provided content below can be used without further changes when no additional regional content is defined. It should be noted that over time, new regional content, in well-defined regions, is added to the data dictionary to promote harmonization and further message development.

A further description of a region and how content is added to messages or data frames can be found in 11.2.

ASN.1 Representation:

```
--
-- Regional data frames with no currently defined extensions
--
Reg-AdvisorySpeed          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-ComputedLane          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-EventDescription       DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-GenericLane           DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-GeographicalPath       DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-GeometricProjection    DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-IntersectionGeometry   DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-LaneAttributes         DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-MovementState         DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-NodeAttributeSetLL     DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-NodeAttributeSetXY     DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-NodeOffsetPointLL     DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-RequestorDescription   DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-RequestorType          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-RoadSegment           DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-SignalControlZone      DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-SignalRequest          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-SignalRequestPackage   DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-SignalStatus           DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-SignalStatusPackage    DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-SupplementalVehicleExtensions DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-VehicleClassification  DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-VerticalOffset         DSRC.REG-EXT-ID-AND-TYPE ::= { ... }

--
-- Data Frames with current adopted expansion point content
--
Reg-ConnectionManeuverAssist DSRC.REG-EXT-ID-AND-TYPE ::= {
    { AddGrpC.ConnectionManeuverAssist-addGrpC IDENTIFIED BY DSRC.addGrpC } ,
    ...
}

Reg-IntersectionState        DSRC.REG-EXT-ID-AND-TYPE ::= {
    { AddGrpC.IntersectionState-addGrpC IDENTIFIED BY DSRC.addGrpC } ,
    ...
}

Reg-LaneDataAttribute        DSRC.REG-EXT-ID-AND-TYPE ::= {
    { AddGrpB.LaneDataAttribute-addGrpB IDENTIFIED BY DSRC.addGrpB } ,
    ...
}

Reg-MovementEvent            DSRC.REG-EXT-ID-AND-TYPE ::= {
    { AddGrpB.MovementEvent-addGrpB IDENTIFIED BY DSRC.addGrpB } ,
```

```

...
}

Reg-NodeOffsetPointXY      DSRC.REG-EXT-ID-AND-TYPE ::= {
  { AddGrpB.NodeOffsetPointXY-addGrpB IDENTIFIED BY DSRC.addGrpB} ,
  ...
}

Reg-Position3D             DSRC.REG-EXT-ID-AND-TYPE ::= {
  { AddGrpB.Position3D-addGrpB IDENTIFIED BY DSRC.addGrpB} |
  { AddGrpC.Position3D-addGrpC IDENTIFIED BY DSRC.addGrpC} ,
  ...
}

Reg-RestrictionUserType    DSRC.REG-EXT-ID-AND-TYPE ::= {
  { AddGrpC.RestrictionUserType-addGrpC IDENTIFIED BY DSRC.addGrpC} ,
  ...
}

--
-- The pattern used for regional adaptations is shown below
-- Use:
-- the text 'XXX' below is used to represent the name of the entry
-- the region should replace 'xxx-RegionName' with its own Type Def
-- a name pattern such as 'DataFrameName-RegionName' is recommended
-- the 'regionName' value must be assigned from the RegionId element
-- this value would be defined in the REGION module, unless a well-known
-- region was being used (these IDs are defined in the V2X module)
-- refer to the full standard for additional details
--
--Reg-XXX DSRC.REG-EXT-ID-AND-TYPE ::= {
--  { XXX-RegionName IDENTIFIED BY regionName },
--  ...
--}
--regionName DSRC.RegionId ::= 128
--XXX-RegionName ::= SEQUENCE { ... }
--
-- End example pattern for regional use

```

9.2 Data Frame: DF_REG_MessageExpansionFramework [REGION]

Use: The regional definitions of all extensions to the set of defined messages, if required. These extensions are 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 to augment the base standard. Each region will further define these data concepts, and the containing namespace, as it requires. Note that these definitions all reside entirely in the REGION module but can (and are expected to) use the contents of this data dictionary and work residing in other modules. The provided content below can be used without further changes when no additional regional content is defined.

ASN.1 Representation:

```
-- Extension markers for operational messages in the standard
-- Messages with no currently defined extensions
Reg-BasicSafetyMessage      DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-CommonSafetyRequest     DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-EmergencyVehicleAlert   DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-IntersectionCollision    DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-NMEACorrections         DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-ProbeDataManagement     DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-ProbeVehicleData        DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-RoadSideAlert           DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-RTCMCorrections         DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-SignalRequestMessage    DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-SignalStatusMessage     DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-SPAT                    DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TravelerInformation     DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-PersonalSafetyMessage   DSRC.REG-EXT-ID-AND-TYPE ::= { ... }

-- Messages with current adopted extension marker content
Reg-MapData                  DSRC.REG-EXT-ID-AND-TYPE ::= {
    { AddGrpC.MapData-addGrpC IDENTIFIED BY DSRC.addGrpC },
    ...
}
```

9.3 Data Frame: DF_REG_TestMessageExpansionFramework [REGION]

Use: The regional definitions of all extensions to the set of defined test messages, if required. These extensions are used to allow each region to test and to develop additional messages and content within the overall framework of the V2X message set to suit regional needs. Each region will further define these data concepts, and the containing namespace, as it requires. Note that these definitions all reside entirely in the REGION module but can (and are expected to) use the contents of this data dictionary and work residing in other modules. The provided content below can be used without further changes when no additional regional content is defined.

ASN.1 Representation:

```
-- Test Messages
Reg-TestMessage00          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage01          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage02          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage03          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage04          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage05          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage06          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage07          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage08          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage09          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage10          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage11          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage12          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage13          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage14          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
Reg-TestMessage15          DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
```

10. CONFORMANCE

An implementation will be judged to be in conformance with this standard by demonstrating functional interoperability with other conformant implementations. The conformance interoperability in this standard shall be determined by effective encoding and/or decoding of the data concepts as defined by the message set, data frames and data elements specified herein. The regional extensions and their data frames and elements defined in this standard are given for information only and exempted from the conformance requirements. Any authoritative entity can issue a normative definition of regional extensions, which will then supersede the definitions in this standard. Implementations in conformance with standard shall be able to receive or to send at least one of the messages defined in standard.

In addition, an implementation is considered conformant 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 regional content.
- Data fields appear in the indicated order.
- Numerical values are within specified ranges, while using the proper units and definitions.
- And the resulting over the air encoding can be validated against the ASN specification of standard.

11. FUNDAMENTAL CONCEPTS USED IN V2X MESSAGES

This standard has been designed to solve a number of different application needs and requirements. As explained in Section 4, the resulting message set content has been developed for re-use such that any single V2X message, data frame, or data element may be used to meet multiple common needs. The message set content should be viewed as one possible embodiment of such a solution, although others could have been developed. As an outcome of developing this specific solution, many design choices were made regarding how the message set was to work as a whole. This section of the standard serves to further explain the resulting design and to provide additional informative and normative information needed for its correct use.

In the text which is found in this section, the term:

- SHALL means that the subject definition is an absolute requirement of conformance to the standard, just as it does in the rest of standard.
- SHOULD conveys a recommended best practice for deployments using standard.
- MAY conveys an optional choice that deployments may elect to follow or not as determined to best suit local needs.
- OPTIONAL, when used in the ASN specification, continues to have the same syntactical meaning regarding the presence or absence of a data element in a sequence of elements.

Regarding the ASN OPTIONAL keyword, any standard that makes use of a data concept may further constrain aspects of its use (for example, defining a minimum accuracy level under a given operational condition). Further details of these operational concepts can be found in the relevant standards.

11.1 The Use of ASN.1 Syntax and ASN.1 Encoding

This standard expresses its required information structure, ordering, and design concepts using the ASN syntax as defined by the ISO documents found in 2.1.3.

As noted elsewhere, the normative definition of each data concept is provided by a combination of the ASN, the comments found in the ASN, and by the normative statements made in the textual portions of that entry.

The ASN specification provided with standard shall be considered normative but does not reflect all normative content of the standard. Deployments are cautioned not to rely solely on the ASN specification for critical information.

If not otherwise specified (i.e., in an application specification), when encoding this ASN syntax for transmission, the Unaligned Packed Encoding Rules (UPER) shall be used.

The sole exception to this method of encoding shall be existing regional deployments which have historically not used any form of ASN encoding, preferring to use other means. The regional definition which do not use ASN encoding often also define various exception values as laying outside the range defined in the ASN, depending on a knowledge of local encoding methods.

11.2 Regional Extensions Used to Add Data Concepts

This standard has been designed first and foremost to ensure the correct exchange of selected messages (i.e., structured information commonly called data) between users to support a variety of V2X applications. The “rules” for these exchanges are anticipated to be standardized not only by this document and by application-level standards, but also by various local regulatory bodies in selected ways for deployment over very wide areas of use, often spanning national boundaries.

Within that framework, the standard has also been designed to support the needs of regional deployments (regardless of the geographic area which “regional” might encompass) to augment the message set for various emerging and local¹ needs. Often, such additional data needs are based on new research and additional field trials which the current adopted standard does not yet support. This section of the standard describes the process by which regional content (often called regional extensions) can be added to the message set to allow the development of local messages which still conform to the standard.

11.2.1 Goals and Objectives

The pattern used for regional extensions addresses a number of overall design goals in the standard. An informal partial list of these objectives includes:

1. The published ASN specification should not need to be edited by end deployments for use.
2. Provisions for adding regional extensions should be edited in a separate ASN module, placed in its own file, when needed.
3. Those deployments with no need for regional extensions should not have to edit anything.
4. The solution developed should not require any SAE coordination to be used.
5. Both well-known regional extensions (those regions with existing entries in the standard today or tomorrow) as well as local ad hoc extensions should be supported.
6. The solution developed should support the migration of regional concepts into the standard over time and with a configuration mechanism that is controlled.

Several related goals for the overall design of SAE J2735 also served to constrain this solution:

1. The standard shall provide a standardized “sand box” for experimental messages.
2. The solution developed must not break the ability of others to decode the standard message as per the current conformance statements of the standard.
3. The solution developed should allow anyone to decode any standard message that was modified by the addition of regional extensions, without necessarily being able to decode the extension themselves, but being able to recognize the presence of unknown extensions and to skip over them.

¹ For this discussion, *local* and *regional* have the same practical meaning.

4. ASN type extensibility, which is supported by the extension marker (...) present in an ASN type definition, must only be used by the owner of that ASN type definition to extend the definition (following standard ASN extensibility rules) in each new version of the specification, and must not be used as a way to support local variants.
5. In accordance with the previous item, the solution developed shall reserve the use of ASN type extensibility (denoted by the ASN extension marker) in the V2X module for the SAE V2X Core TC, and not for use by deployments.
6. Use of ASN type extensibility (denoted by the ASN extension marker) in the well-known regions shall be coordinated with the representatives of that regions and the SAE V2X Core TC.
7. Use of ASN type extensibility (denoted by the ASN extension marker) in a local ad hoc region is reserved to the entity that created that regional extension and need not be coordinated with others.

The solution in standard fully supports these goals.

11.2.2 Prior Solutions

In prior editions of the standard (notably 2015 and 2009) this topic was covered by two methods. First, in 2009, ASN type extensibility (denoted by the use of the extension marker "...") was used as the exclusive method. This led to problems when multiple parties edited the ASN for their own needs and then discovered they were not interoperable. This was largely mitigated by the use of the DER encoding at that time. In the 2009 edition of the standard, the conformance statement required a recipient of any V2X message to be able to accept (not to understand, or process, but simply to not "break") any V2X message regardless of it having additional element content not understood by the receiver.

In the 2015 edition of the standard, a two-part region module format was used. Specific places in each data structure where regional content could be added were defined. Those locations are referred to as regional extension points in the text. This was an improvement over the 2009 edition but allowed only one solution at a time and limited the defined solution to being contained in the REGION module for the most part. Deployments were also allowed to create and number top level messages, an ability which is prohibited in this updated edition of the standard and served by providing several pre-defined messages for such needs instead. In the 2015 edition, messages and selected data frame sequences were ended with lines like those shown below (using the MSG_SPAT message of that edition):

```
SPAT ::= SEQUENCE {
    msgID          DSRMsgID2,
    msgSubID       DSRMsgSubID OPTIONAL,
    name           DescriptiveName OPTIONAL,
    intersections   IntersectionStateList,
    regional       RegionalSPAT OPTIONAL, -- regional extensions
    ... -- # LOCAL_CONTENT
}
```

The regional extension point was named after the entity and preceded by the word Region, as in RegionalSPAT. This in turn (within the V2X module) was defined by an entry such as the one below, where the definition of Reg-SPAT in the REGION namespace provided the information content details.

```
RegionalSPAT ::= Reg-SPAT
```

In all but a few defined regional cases, this was an empty structure for future deployment use as shown below.

```
Reg-SPAT ::= SEQUENCE { ... }
```

From this starting point, any deployment could elect to revise the content in the REGION module to extend the message to contain additional content as they desire. Most deployments, not needing to make use of this feature, could use the content lines above "as is" without further modification.

The two levels of indirection (from RegionalSPAT in the V2X module to Reg-SPAT in the REGION module) were somewhat redundant but served to isolate the two content areas. This methodology, however, required the region definition to be present and only allowed one region to be supported at a time, an undue constraint on the requirements of some national deployments.

11.2.3 Regional Extension in the ASN Specification

NOTE: Use of regional extensions is discouraged for security reasons (refer to SAE J2945/5, 2.7.5).

This section defines how the regional extension process works in the ASN specification of the standard. Some understanding of the ASN syntax used is presumed. In developing the current solution, the basic parameterization process supported by ASN has been used along with more formal “information object classes.” In the U.S. development of ITS, the parameterization method has not generally been used, but it is widely adopted in ASN practices in general and in the ITS standards which have been developed for use in European regions.

At a high level, ASN parameterization in a message set allows the standard to establish key placeholders to which regional extensions can conform. These extensions can therefore be inserted into the standard after the standard is adopted. In essence, each extension can declare itself by providing a unique identifier value which is bound to the definition (the type) it provides. Sets of these combinations are declared and the ASN encoding can take place from there, enclosing the defined information as required for transport. The concept of ASN parameterization is in many ways similar to a C pre-processor in that functions with similar signatures can be later bound in the compiling process.

The formal definition used by each regional extension point follows the style of a unique indexing integer and a type definition bound into a set. Many ASN standards will often contain a section with a very similar pattern. The definition is as follows:

```
-- Regional extensions support
REG-EXT-ID-AND-TYPE ::= CLASS {
    &id      RegionId UNIQUE,
    &Type
} WITH SYNTAX {&Type IDENTIFIED BY &id}

RegionalExtension {REG-EXT-ID-AND-TYPE : Set} ::= SEQUENCE {
    regionId      REG-EXT-ID-AND-TYPE.&id( {Set} ),
    regExtValue   REG-EXT-ID-AND-TYPE.&Type( {Set}{@regionId} )
}
```

The second item forms the information object definition. It serves to bind the ID with the type content. In the case of standard, it binds the regional ID which is selected to the Type definition provided for that entry by that region. This is similar to an ASN CHOICE statement (or a C switch statement) because, regardless of the number of regions which are defined, only one is present in any given regional extension point within a message.

In the standard at this time there are entries which have none, one, and two such possible choices. Three examples show the pattern of the ASN when used in this way:

- Specification of the regional extensions of a data frame (DF_AdvisorySpeed) for which no regional extensions are currently defined:

```
Reg-AdvisorySpeed      DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
```

- Specification of the regional extensions of a data frame (DF_ConnectionManeuverAssist) that has a regional extension currently defined for one region:

```
Reg-ConnectionManeuverAssist DSRC.REG-EXT-ID-AND-TYPE ::= {
    { AddGrpC.ConnectionManeuverAssist-addGrpC IDENTIFIED BY DSRC.addGrpC} ,
    ...
}
```

- Specification of the regional extensions of a data frame (DF_Position3D) that has regional extensions currently defined for two regions:

```
Reg-Position3D          DSRC.REG-EXT-ID-AND-TYPE ::= {
  { AddGrpB.Position3D-addGrpB IDENTIFIED BY DSRC.addGrpB} |
  { AddGrpC.Position3D-addGrpC IDENTIFIED BY DSRC.addGrpC} ,
  ...
}
```

Any regional extension will simply add one more choice to the pattern where required. Note how the comma is replaced with “|” in the above when two or more items are present. As these definitions are placed into the file containing the REGION namespace, no editing will occur in the ASN specification file where the V2X module is found.

It should be pointed out that the standard now provides a number of test messages for regional use. Most regional extension points are intended to develop data frame content for a focused area of use. By contrast, these test messages are intended to allow the development of entirely new messages for serving use cases and applications not covered by the existing message set. The format of these messages is shown by the example below.

```
TestMessage01 ::= SEQUENCE {
  header      Header      OPTIONAL,
  regional    RegionalExtension {{Reg-TestMessage01}} OPTIONAL,
  ...
}
```

and

```
Reg-TestMessage01      DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
```

This message begins with a header which uses the same data element as the message frame found in other messages. Any party could add specific content to this message by using the regional extension mechanism. To do so, they would refine the Reg-TestMessage01 entry and add the information content required to suit their needs.

11.2.4 A Practical Example

As an example of these concepts, consider a use case which includes a need to have selected vehicles report the relative humidity that they observe by adding content to the Part II section of the BSM message. This example ignores the operational details, focusing only on the need to add this data element to the message set standard for regional use. The design requirement therefore reduces to how to add an integer with range (0..100) to the message set.

Several possible places in the BSM message structure could be used to fulfill this requirement, because regional extension points are found both at the message level and in data frames within the message. There are regional extension points present within several of the Part II content areas. The last three elements in the message specification might include (among others):

```
special      SpecialVehicleExtensions      OPTIONAL,
supplemental SupplementalVehicleExtensions OPTIONAL,
regional     RegionalExtension {{Reg-BasicSafetyMessage}} OPTIONAL,
```

The deployer could simply use the Reg-BasicSafetyMessage, but examining the elements above reveals that there are several with somewhat similar content.

The optimal organization of such data elements for a given set of needs is often a complex problem. For this case, it should be observed that because relative humidity is defined as the ratio of two vapor pressures at a given temperature, it would be useful (if not required) to always also send the ambient temperature when this data element was sent. This fact suggests that the deployer should use the DF_SupplementalVehicleExtensions regional extension point due to the optional DF_WeatherProbe element it contains. (The DF_WeatherProbe data frame itself does not have a regional extension point. The locations in which regional extensions exist are intentionally limited to preserve the integrity of the overall data dictionary.)

To use the DF_SupplementalVehicleExtensions point, the deployer will edit a small part of the ASN specification file within the REGION module. As defined in the prior overview text, it is necessary to establish a unique index number for the deployer's region, using the local region range allocated in the DE_RegionId for this purpose. This differentiates the deployer's region from any other regions and is required even if this is the only region present in the overall definition. This value can be created with a simple line of ASN like:

```
myRegion DSRC.RegionId ::= 150 -- any value from 128 to 255 could be used
```

In the V2X module provided by the standard, the SupplementalVehicleExtensions data frame has a typical extension point which is defined as the last entry of its definition as follows:

```
regional RegionalExtension {{Reg-SupplementalVehicleExtensions}} OPTIONAL,
...
}
```

This in turn leads the “empty” definition in the REGION module file of:

```
Reg-SupplementalVehicleExtensions DSRC.REG-EXT-ID-AND-TYPE ::= { ... }
```

This entry must be edited in order to add the deployer's region, and the name of the structure to be defined. In the example below, it should be noted that:

- The recommended ASN type naming of the SAE J2735 style is used.
- Specific capitalization is used, both to define an ASN type and as a recommended pattern that should be followed.
- “Reg-” is removed, the regional ID string “myRegion” is appended as a naming convention, and the string “MyRegion” is used as the module name.

```
Reg-SupplementalVehicleExtensions DSRC.REG-EXT-ID-AND-TYPE ::= {
  {MyRegion.SupplementalVehicleExtensions-myRegion IDENTIFIED BY DSRC.addGrpC} ,
  ...
}
```

If developers edit all of the regional content to be added within the file with REGION, they do not need to add a named module of their own devising. This is of value when only small changes need to be made. The resulting entry would be the same, except for the lack of the module name:

```
Reg-SupplementalVehicleExtensions DSRC.REG-EXT-ID-AND-TYPE ::= {
  { SupplementalVehicleExtensions-myRegion IDENTIFIED BY DSRC.addGrpC} ,
  ...
}
```

Finally, the developer must create the structure for SupplementalVehicleExtensions-myRegion that defines the additional information elements required. In this case, the structure requires only one item which is defined in-line² for this example.

```
SupplementalVehicleExtensions-myRegion ::= SEQUENCE {
  relativeHumidity INTEGER(0..100), -- In LSB units of 1%
  -- airTemp DSRC.AmbientAirTemperature OPTIONAL,
  ...
}
```

² As a style rule, SAE J2735 defines a proper ASN type for every entry and avoids the use of ASN built-in data types as in-line primitives. This promotes the goal of data concept reuse.

Observe that the temperature could have been added here (shown as a comment), but in this example it is presumed that the value is extracted from the DF_WeatherProbe data frame. As a broad rule, it is preferable to assemble the data elements from across a V2X message for a given application rather than to create a data frame for each application need at the risk of duplicating elements and causing message payload bloat. The final choice here would likely depend on determining if the DF_WeatherProbe data frame was also to be sent as part of the operational concepts supported by the application.

The above example has served to illustrate the principles of extending the message sets to support the needs of a deployment region. It is expected that over time, as such regional work is developed and tested further, it will become the basis for further revision to the SAE J2735 standard itself. Selected regional extensions are expected to migrate into the adopted standard for use by a wider deployment community.

11.3 Time Formats Used in Applications

This standard defines several data concepts that deal with time. This section explains how the various date and time elements of the standard relate to each other and to other well-known time frames.

In standard, time representations break into two general areas: absolute points of time (i.e., 10 o'clock UTC) and time durations (i.e., 10 minutes). Each is discussed in turn.

The only system of absolute time in the V2X standard is aligned to UTC time. The representation of absolute time in the V2X standard follows the methodology defined in the ISO 8601 standard 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:

- The resolution of time in V2X is universally kept and expressed with a precision of 1 ms. This value (and its modulo derivatives) is commonly used in many V2X applications and forms the basis of many “short” forms of time. Time within the current UTC minute is therefore expressed by the DE_DSecond in a 2 byte octet value (with a commonly used range 0 to 59999 ms for most of the time) in many messages.
- The occasional leap second in UTC time is represented in the DE_DSecond by the range 60000 to 60999, but that concept of 60 seconds of duration is represented by the value 60000. Consult the entry for DE_DSecond for normative details.
- The collection of elements of time (minutes, hours, days, months, years, etc.) are expressed in the normative definition provided by ISO 8601 including a local time zone, although the time zones are not used in most V2X messages.
- Leap-seconds and other periodic aberrations are handled in the normal ISO 8601 way.
- In many V2X messages, there is only a need to send a part of the current time (such as the current minute or second) and the full (absolute) moment of time is only sent once or periodically when actually needed.
- In many V2X messages, time is sent using a count representing the current number of whole minutes in the current year (again aligned with UTC time). Conversions from the minute of year (MOY) value to more human-readable Month/Date/Hour are easily developed.
- In many V2X messages, the current year of time is only set as an optional element. Years are sent using the current number of whole years in the common era. As a rule, only long-term message recoding systems require the year, so it is not sent in most V2X messages.
- There is a general presumption in V2X that all parties know UTC time to within the same accuracy as the precision of 1 ms. When there is a requirement to deal with unaligned clocks found in legacy systems, other methods are provided to detect relevant time offsets.
- Component elements of the time in V2X 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 both as a legal value of time and as an unknown value. As a rule, this type of information overloading is not used in the V2X standard.

It is the responsibility of each V2X device to convert between any GNSS time system which it uses (such as GPS which counts but does not accumulate leap seconds) and the UTC time system used in standard. This includes the timely and correct insertion or removal of leap seconds when such events occur.

The standard also provides several data concepts to provide durations or intervals of time. Time ranges from 1 minute (DE_SecondOfTime) to a span of many days (DE_MinutesDuration) are supported. Signed time offsets (such as DE_DeltaTime) are used to represent concepts such as gross schedule adherence for transit systems. Generally, these data concepts are used in the messages to measure or report values that are not extremely precise.

These duration times should not be confused with absolute times that are simply truncated to some agreed upon modulo range limit. Duration elements are not used as countdown timers in standard. The standard does not ever express the concept “the light will change in 3-1/2 seconds from now”; rather, it provides the precise time at which this will occur (“the light will change at the time point 15 minutes and 23-1/2 seconds in the current hour”). In this example, the point in time at which a signal light will change is conveyed by the DE_TimeMark data element which provides a precision of 0.1 second over a range of 1 hour. In using this element, it is presumed by all parties that a common alignment to UTC time is shared.

11.4 Frames of Reference Between the Vehicles and the Roadway

This section of the document explains the coordinate system between a V2X-equipped platform (often a vehicle) and the ground. The position reported shall be a point (latitude, longitude, and elevation) projected onto the surface of the roadway (road plane) with reference to the WGS-84 coordinate system and its reference ellipsoid. This point is the center of the rectangle projected on to the road plane, oriented about the V2X-equipped platform (often a vehicle) that encompasses the farthest forward, rearward, and side-to-side points on the platform, including original equipment such as outside side view mirrors (see Figure 2). Positive directions for each axis are as shown in the image below.

NOTE: The GNSS subsystem (shown as GPS in Figure 2) antenna reference position is not the same as the position reference. The incline of the road surface results in changes in pitch, roll, and yaw. The projection of the GNSS positional estimate to that of the equipped platform can be offset in position by 25 cm or more from these factors. The impact of this on minimum performance standards is handled in the relevant application standards. It is expected that often conformance testing can be done using a flat ground plane.

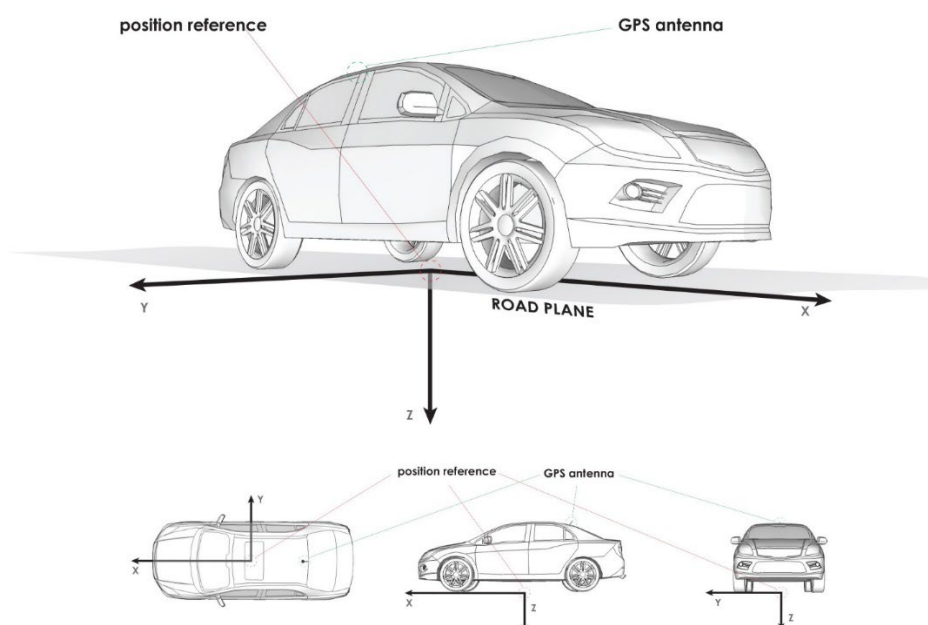


Figure 2 - V2X-equipped platform position reference

11.5 Position, Velocity, and Acceleration of Vehicles

Many of the data elements in standard use near real-time estimates of the vehicle motion state to express the current position of an equipped device. In addition, other data elements provide various derivatives of the position state estimate such as a vehicle's speed and acceleration expressed in component vectors. Typically, the estimate of position is determined using a GNSS device, while speeds, headings, accelerations, and yaw rates may be measured by a variety of methods with differing degrees of integrated or independent sensors. At this time, data elements for measurements of jerk, pitch, and roll are not provided by the standard. A limited number of quality elements, reflecting the current estimate of positional error as an ellipse and reporting the GNSS error estimate as a scalar value, are provided.

As a result of the multiplicity of the sensor sources, the precise moment in time when each of these values is determined is not likely to be aligned in most V2X devices. Developers are cautioned not to presume that data such as that found in the BSM reflects a common measurement epoch. As a broad summary of the current industry practices, sensor data such as the yaw rate is collected by means of the vehicle CAN bus and arrives over a ~30 ms period before being assembled with other data for transmission into a BSM message. The lack of a precisely known time relationship between each measurement type, or of any platform motion model used by individual message senders, has a direct effect on the predictive value of the measurement when used by other parties. Minimum performance requirements for this topic for specific applications can be found in the relevant standards.

Multiple coordinate frames of reference are used in this process, requiring the normal translations between the V2X-equipped platform and the external frame of reference to be employed. The coordinate frames used are:

- All expressions of latitude, longitude, and height above the reference ellipsoid are with respect to the current WGS-84 coordinate system.
- Speed or velocity is expressed using units of m/s, with various least significant bit (LSB) steps according to the data element used. It should be noted that the ITIS codes (which are part of standard by reference) do allow both m/s and mph, but that their use is limited to various traveler advisories.
- All heading or angular values (including bearing) are expressed either with respect to the north axis in the case of the WGS-84 coordinate system, to "the front" in the case of some vehicle use cases, or with respect to the current path/line for certain use cases concerned with maps and graphical line segments. Heading is always presumed to be tangential to the surface of the WGS coordinate system.
- All accelerations are expressed in three orthogonal axes with respect to the V2X platforms (i.e., in an equipped vehicle in most cases), and not to the local ground surface or WGS coordinate system.
- Yaw is expressed about the horizontal plane formed by the orthogonal axis used for X-Y accelerations.

The sign conventions used in the above are as defined in 11.4. Developers are advised to review these two sections thoroughly. Developers are further advised to recall that the position provided by a GNSS system will be with respect to the phase center of its antenna location and that this value must be correctly translated (both vertically and horizontally) to reflect the center point of a vehicle's outline when used with V2X-equipped vehicles.

When converting or comparing the position between one or more vehicles and a map or other geometric object which is described by standard, it is often required to determine the precise scaling rate between local 1/10th microdegrees of latitude or longitude and 1 cm.³ This is typically done at the location where the "anchor point" used in that map is located. When performing this conversion, it is recommended that ellipsoidal projections, rather than spherical, be used to increase accuracy. The common Vincenty algorithm⁴ has been used in many V2X deployments for this purpose.

³ Latitude and longitude in this standard are expressed in 32 bit values where the LSB is 1/10th microdegree, and where the offsets used in the XYZ map system of the standard are all expressed in units of 1 cm unless the zoom feature has been used.

⁴ A useful summary of this method can be found at: <http://www.movable-type.co.uk/scripts/latlong-vincenty.html>.

Speed and velocity in standard are always expressed in units based on m/s. However, there is often a need to express m/s in units of mph or for consumption by human users. The driver of a vehicle is not likely to respond well to a speed limit of 11.176 m/s when used to seeing posted speed limits of 25 mph. This situation is further complicated by the different precisions used in various speed data elements of the standard. In the design of V2X devices, human-readable speed representation becomes part of the human-machine interface and may therefore be the topic of further requirements in the relevant performance standards.

The recommended conversion algorithm process is as follows: when a speed is provided in miles per hour (mph), convert the value to units of m/s with full precision, then translate to the system of units used by the data element to be used, rounding to the nearest integer unit.

For example, 30 mph is ~48.28 km/h or 13.4112 m/s. In the DE_GrossSpeed (where the LSB is 1 m/s), the value 13 would be sent. In the DE_Velocity (where the LSB is 0.02 m/s) the value 671 would be sent. A similar reverse process should be used when a speed expressed in m/s is to be displayed to an end user in units of mph.

The task of ensuring clear direction to the driver is enabled by first ensuring that the information to be sent is itself clear at the data level. In Table 1, recommended values to be transmitted for selected well-known speeds are provided for the different data elements concerned with speed. These values should be used by deployments seeking to express the given speeds. These values reflect the rounding process defined above.

Table 1 - Conversion of mph to m/s for selected data elements

| Precise mph | Precise m/s | DE_Velocity | DE_SpeedAdvice | DE_GrossSpeed |
|----------------|----------------|-----------------|----------------|----------------|
| | <i>LSB</i> | | | |
| | <i>units:</i> | <i>0.02 m/s</i> | <i>0.1 m/s</i> | <i>1.0 m/s</i> |
| 0 | 0 | 0 | 0 | 0 |
| 5 | 2.2352 | 112 | 22 | 2 |
| 10 | 4.4704 | 224 | 45 | 4 |
| 15 | 6.7056 | 335 | 67 | 7 |
| 20 | 8.9408 | 447 | 89 | 9 |
| 25 | 11.176 | 559 | 112 | 11 |
| 30 | 13.4112 | 671 | 134 | 13 |
| 35 | 15.6464 | 782 | 156 | 16 |
| 40 | 17.8816 | 894 | 179 | 18 |
| 45 | 20.1168 | 1006 | 201 | 20 |
| 50 | 22.3520 | 1118 | 224 | 22 |
| 55 | 24.5872 | 1229 | 246 | 25 |
| 60 | 26.8224 | 1341 | 268 | 27 |
| 65 | 29.0576 | 1453 | 291 | 29 |
| 70 | 31.2928 | 1565 | 313 | 30* |
| 75 | 33.5280 | 1676 | 335 | 30* |
| 80 | 35.7632 | 1788 | 358 | 30* |

* This data element cannot fully represent this value so the value indicating the maximum value or larger is sent.

11.6 Methods to Describe Roadway Geometry and Other Map-Like Features

In standard, it is often required to describe geometric aspects of the local roadway network (the location and bounds of its path and lanes in various degrees of detail and precision), as well as irregularly shaped polygons such as jurisdictional boundaries. These are described using the WGS-84 coordinate system in all cases. Various local coordinate systems such as state plane coordinates or NAD83/27 are translated into WGS-84 when used in standard. To the extent possible, coordinates in regional deployments should be translated at a common epoch to remove the effects of ground velocities being introduced into the final values.

In standard, values of latitude and longitude are always expressed in LSB units of 0.0000001 degree. In V2X and ITS, this value system is commonly referred to as V2X 1/10th microdegree units. Other common historical systems such as expressing latitude, longitude and height (LLH) values in forms with units divided into steps of degrees, minutes, seconds, fractions (DMS or DD:MM:SS.sss) are not used in the message set. The height above or below the reference ellipsoid is referred to as “elevation” (not height⁵) in standard.

Irregular polygons are used in several of the message types (notably MAP and TIM). Apart from the use case involving a simple circle (which is described by an anchor point and a radius distance), these irregular polygons are described by sequences of short straight segments to describe the desired path or to enclose a region of interest. The terminology used to describe this consists of three key terms: anchors, nodes, and segments. The concept is as follows:

- To align to the global WGS-84 coordinate system, each description is tied to an anchor point that aligns the path data which it provides.
- Each of the points used to describe any polygon path is referred to as a *node* (or node offset point).
- Each of the lines formed between the nodes is called a *segment*.
- The first node provides the offset *from* the anchor *to* the precise location where the object starts, resulting in the first node.
- The second node is offset from the first node in a similar way, resulting in the second node. This process repeats for each node. Note that offsets are cumulative, with each being added to the prior node point position.
- The described polygon path may be open (such as a description for a roadway lane) or may close back on the initial point (not the anchor) in the case when a closed polygon is described, such as an affected region.
- The node points are always scaled (multiplied) by the current zoom setting. In the absence of any expressed zoom setting, the setting is defined to be one (1:1, or no zoom used).
- Each node can contain optional attribute information which changes the meaning of the described object (typically to reflect changes in some feature of the environment⁶) over a portion of the path. Note that the effect of an attribute may be local to the node (or to subsequent segment) at which it is placed or may persist until changed by another attribute.

In the above, the vertical axis information is largely treated as an attribute which, once established, can be considered a constant and therefore not repeated. However, it can be changed with each node offset point when such a use case arises.

The number of node points which are used in any message instance is left to the application or application group to define and is typically based on the degree of accuracy required balanced against the increased size of the message entailed by adding node points.

⁵ The term *height* in this standard is used to refer to the distance from the local ground, as in *vehicle height*.

⁶ A typical use case would be to assert the attribute value “merging lane on right side” for a short distance or a few segments of a lane description.

Because the distances involved are typically quite short, the node offset data frames are defined as a small set of data elements to allow the message creator to select only the smallest offset size needed at any time. This provides a very large saving in the resulting payload size of the final message. In the two primary data frames (NodeOffsetPointLL and NodeOffsetPointXY), a choice with full 32 bit values for latitude and longitude are also provided. These are intended to assist the V2X developer and should not be used for over-the-air transmission when one of the smaller sizes could be used. The entries also have value when the resulting message is created only for internal or archival uses.

It should be noted in passing that the ITIS codes (SAE J2540) provide a number of “phrases” useful for relative geometric aspects and locations of events on or near the roadway. Concepts like “around the next bend,” “along the right shoulder,” “at the top of the hill,” or “in the valleys” are all handled by ITIS phases as part of the expressions for situational descriptions.

11.7 Using Relative Offset Positions and Absolute LLH Positions

In standard, two complementary systems of Node Offsets are provided to describe geometric features. One system provides a method of orthogonal XYZ offsets intended to describe geometric objects spanning only a few kilometers. The other provides a system of latitude and longitude offsets intended to be used for larger spans where the curvature of the earth must be considered. In both systems:

- There is an initial anchor point followed by a sequence of nodes with offset values as described in the previous section.
- The concept of zoom can be used to proportionally increase the range of a given offset element while decreasing its precision.

This section provides simple examples to explain how an anchor point and a set of offsets are used to describe a polygon region or a path such as a motor vehicle lane. Content in 11.8 explains how positions and offset are used in the standard to describe lanes and other objects. See the data concepts for normative details.

11.7.1 The XYZ Offset System

The XYZ offset system provides a set of X and Y orthogonal offsets in a plane which is tangential to the anchor point. Because the span of the objects to be described is typically within a few kilometers of the anchor point used, the divergence from the curvature of the earth can be ignored in such a system at the decimeter or greater accuracies found in the V2X applications. The practical use of this system is best explained with an example.

Consider a work zone extending in an 80 m² around a given LLH location. This work zone is a rectangle with 80 m sides. If the anchor is placed at the center of the work zone, then the first node point needs to contain offsets of ± 40 m in the X and Y directions, while the second through fourth node points need only to offset the last node point by 80 m. The final node point is presumed to close on the initial node point, forming a closed polygon. The order in which the nodes are described (clockwise in this case) is arbitrary. Graphically, this can be shown as:

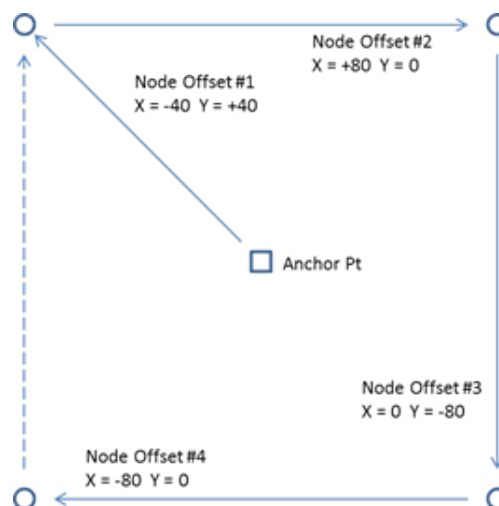


Figure 3 - An example of XYZ offsets describing a rectangular polygon

The offsets themselves are expressed in 1 cm steps, so 80 m becomes a value of 8000 cm. Looking at the range of values supported by the DF_NodeOffsetPointXY, it is clear that the entry DF_Node-XY-28b is the smallest⁷ which can be used to send a value of this size (and will require 28 bits in the message per point). This example requires four offset points, or 110 bits for this part of the message. (The last point is presumed to close on the first point, so it need not be repeated.)

On the use of zoom, implementing the description in this way provides a precision of $\sim \pm 1$ cm, which is likely to be an excessive level of precision for a common work zone. The values transmitted could therefore be scaled down and the overall payload reduced considerably. For example, a value of 2 m might be determined to be the largest allowable error (i.e., the inaccuracy of the described polygon could be ± 2 m). The zoom scale design works in multiples of two, so it is not possible to directly scale to down to 2 m. The values 1.28 m and 2.56 m are the closest supported. Selecting a precision value of 1.28 m represents a scale of seven (two to the seventh power). Using this scale, the prior value to transmit (8000) is now 63, a considerable saving in data size. In order to use this scale, the deployer must set the zoom, which will have a cost of 4 bits in the message.

Looking at the range of values supported by the DF_NodeOffsetPointXY again, the smallest entry, DF_Node-XY-20b, can be used to send a value of this size (the scaled value of 63, rather than 8000), and this will require 20 bits in the message per point. The revised example using scaling required four offset points of 20 bits plus the zoom value, or 84 bits for this part of the message. The >30% saving in message size can be considerably larger in more complex situations.

It should be noted that this example has described the bounds of the work zone, but not any information about it. That description is contained in the ITIS phases which are selected for use. Such a description lends itself to creating pre-defined TIM messages where only a few further details need to be added before use.

To continue the example, consider a hypothetical incident occurring at the corner of Big Beaver and Troy Center Drive in Troy, Michigan. By setting the anchor point values in the above example to be the middle of this intersection, the resulting polygon described would then be “localized” for use at that location. No further geometric changes would then be required.

11.7.2 The LLH Offset System

The LLH offset system provides a set of latitude and longitude offsets which follow the axis established for WGS-84. In this system, the distance between points at an equal longitude decreases as one moves closer to each pole. This system is suitable for describing longer spans than the XYZ offset, and especially well-suited to describe geo-political boundaries such as states. The practical use of this system is best explained with a short example: describing the idealized⁸ boundaries of the state of Colorado, which consists of four points taken from lines of latitude and longitude.

In this example, the state is deemed to be a latitude-longitude quadrangle which stretches from 37°N to 41°N latitude and from 102°03'W to 109°03'W longitude. The standard uses units of only degrees and decimal fractions of degrees, so these values become: 37.0, 41.0 and 102.05, 109.05, respectively. The shortening of the latitudes shown below is not to any scale.

⁷ The very first node, with a value to send of 40.00 m, would fit in the next smaller size, the Node-XY-26b element, requiring two fewer bits.

⁸ The actual state boundary is not a polygon consisting of four points. It does have some jogs in it due to both survey errors and from coordinate transformation issues over time.

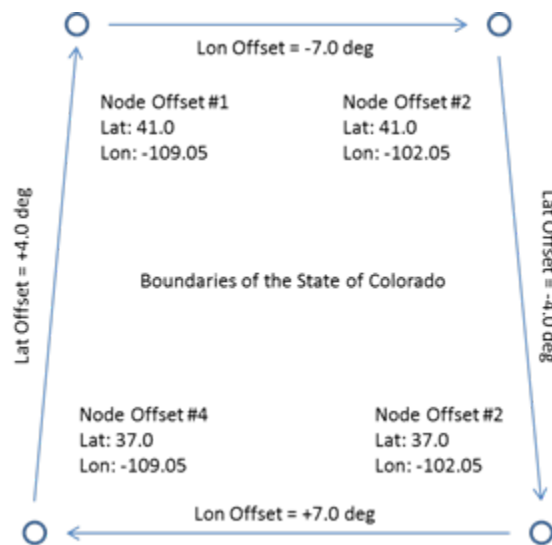


Figure 4 - An example of LLH offsets describing a quadrangle polygon

In the LLH systems, this is simply a rectangle with sides spanning 7 degrees and 4 degrees. It is, however, an unusually long span. The data dictionary entries are optimized for shorter lengths which occur more often. To handle this limitation, the anchor point can be made the first corner, using the normal 32 bit values of latitude and longitude to describe it with $\sim \pm 1$ cm accuracy. The problem then requires three node offsets to describe the polygon. However, the entries for DF_NodeOffsetPointLL show that the largest of these only allow steps of ± 0.8388607 degree (when the zoom is set at 1:1). Therefore, the full latitude and longitude values (the DF_Node-LLmD-64b element) must be used to describe the remaining three points.

This example requires four offset points (each with two 4 byte values), or 32 bytes for this part of the message. Implementing the description in this way again provides a precision of ± 1 cm (because 1/10th microdegrees steps are used), which may or may not be considered excessive precision for a given application.

To illustrate the use of zoom with this example, consider a revised use case where a resolution of ± 41 m is sufficient to meet the design needs (40.96 m, or a zoom scale of 12). This reduces the bits to be sent by the three offsets. The initial anchor point is still sent using the full precision. Scaling the largest offset range of 7 degrees by 4096 results in 0.001709 degree. This can be expressed in the DF_Node_LL_32B entry, which requires half the prior bit size (16 bits). The zoom element (a cost of 4 bits), as well as the offsets in their reduced size, must still be sent.

The revised example when using scaling still requires the anchor point (8 bytes) and the three offset points of 4 bytes, for a total cost of 20-1/2 bytes for this part of the message. There is a $\sim 60\%$ saving in message size in return for the reduced precision.

11.7.3 On the Use of Zoom and Scales

In the absence of an established zoom value, the zoom scale shall be 1:1; i.e., the LSB of the XYZ system is in units of a single centimeter, and the LSB of the LLH system is in units of 1/10th of a microdegree. The use of the zoom scale feature is not required.

The application of zoom to an offset scales both the range and precision of any given offset object by a power of two for each step of zoom. In other words, with each increase in zoom, the range of the object doubles and the LSB precision falls by half. When such offsets are applied to a point, the mathematical operation always starts with the resolution of the point and preserves that regardless of the zoom scale in use. In other words, if an anchor point were to provide some arbitrary value, and then an offset with a coarser zoomed value were applied to it, the sum of these operations would not lose any precision due to lack of precision in the zoomed elements.

The below table of zoom scales and the resulting LSB values for both the XYZ and LLH systems is provided as an aid to the reader.

Table 2 - Effect of zoom scale on LSB units of XYZ and LLH coordinates

| | Zoom Scale | Scaling Value | XYZ Span (meters) | LLH Span (degree) |
|----------|-----------------------|--------------------------|----------------------------------|----------------------------------|
| None/Min | 0 | 1 | 0.01 | 0.0000001 |
| | 1 | 2 | 0.02 | 0.0000002 |
| | 2 | 4 | 0.04 | 0.0000004 |
| | 3 | 8 | 0.08 | 0.0000008 |
| | 4 | 16 | 0.16 | 0.0000016 |
| | 5 | 32 | 0.32 | 0.0000032 |
| | 6 | 64 | 0.64 | 0.0000064 |
| | 7 | 128 | 1.28 | 0.0000128 |
| | 8 | 256 | 2.56 | 0.0000256 |
| | 9 | 512 | 5.12 | 0.0000512 |
| | 10 | 1024 | 10.24 | 0.0001024 |
| | 11 | 2048 | 20.48 | 0.0002048 |
| | 12 | 4096 | 40.96 | 0.0004096 |
| | 13 | 8192 | 81.92 | 0.0008192 |
| | 14 | 16384 | 163.84 | 0.0016384 |
| Max | 15 | 32768 | 327.68 | 0.0032768 |

11.7.4 On the Ordering of Offset Points and Lat-Lon Points

In standard, the ordering of element pairs describing latitude and longitude coordinates is normally expressed in that order followed by any elevation or height value when required. In a similar fashion, the ordering of element pairs describing X and Y coordinates are normally expressed in that order followed by any Z value when required. When expressing offsets in either the LLH or XYZ system described in this standard, the offset values are treated as X and Y elements and are ordered accordingly (the X element precedes the Y in the message definitions). There are also a few historical exceptions to this pattern found in the standard.

11.8 Lanes, Objects Defined in Intersections and Elsewhere

In standard, a number of core data concepts support the creation of various types of maps. These are often found in the MSG_MAP message (which contains descriptions such as an intersection's lanes), but are also used elsewhere, such as in the MSG_TIM message. These maps support describing both vehicle roadways and other geometric aspects of the transportation network topology, including sidewalks, bike lanes, pedestrian crosswalks, and various other objects such as barriers and medians. Temporary road work (as might be found in a work zone as part of responding to an incident event) is also supported in this way. To the various geometric aspects of an object, various additional data, such as the regulatory signage used by MUTCD, can also be assigned. This is how the ITIS phrases such "speed limit 35 except when children are present" or "no parking on the left side of street from 8 AM to 5 PM weekdays" are attached to an element of a map. The system is quite flexible but requires some explanation to understand core concepts.

One core concept is that maps are comprised of a set of common "lane object types" with sufficient detail to convey the required information. These lane types are described in this section, while 11.10 describes the indexing system used to construct physical and logical relationships between these lanes. The geometric aspects of the lane (its precise path and width over the earth's surface) are expressed using the relative offset and absolute position methods which were described in 11.6 and 11.7.

The term "lane object" is used in standard to refer to many spatial objects whose physical representation can be represented by a sequence of points along with the width of the object at that point. While this is used for many types of lanes (for both motor vehicle users and non-motor vehicle users), it is also used for other objects such as roadway medians.

The MAP messages in 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 normative assumptions made about it which reflect real world operational needs that 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, or an application group.

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 lane types and merging across such lanes does occur. 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 (an inbound 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) DF_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 crosswalk type lanes are not the same as sidewalk type lanes. Crosswalk lane paths cross over other lane paths and can be alongside other lane types. As a rule, merging of crosswalk lanes across other crosswalk lanes does not occur. That is, unlike in 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 assignments in each direction when different timing plans are required based on the direction of travel. In some use cases where routing directions must be conveyed for travelers, the DF_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 only for motor vehicle use only would not.

An alternative mechanism to relate the lane connectivity and signal groups used between sidewalks without using the crosswalk lane is also allowed and may be deployed in some European areas. In this embodiment, two sidewalk lane types are connected using the DF_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, it would be represented as a small additional sidewalk lane with suitable DF_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 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 needs 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 the end of the lane, passing the stop line, crossing to another lane as indicated by the DF_ConnectsTo data for this lane and the movement events, 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 typically occurs alongside of it. In the rare case that path information is required along with a DF_ConnectsTo structure, the ingress lane connects to the stripe lane which in turn connects to the egress lane. As a recommended practice, an additional offset point should be provided at least every 30 degrees of angular change to describe the path. 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 lane types and merging across such lanes does occur. 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.

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 centerline (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 lane 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 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 vehicles in those lanes 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 describing both lanes and then invoking the active one for the current time of day within the SPAT message. (The SPAT message deals with all time of day regulatory matters by design.) The parking lane type does not have stop lines and is not associated with a movement event.

11.9 Various Vehicle Taxonomies Used in V2X

This section provides an informative summary of the different vehicle taxonomies that are used to describe vehicles and how these are used in the V2X message sets to meet various design goals (requirements). A number of such taxonomies are supported to reflect the needs of different user communities. Most of these are formulated as enumerated lists allowing the selection of a single entry from a given list.

These vehicle taxonomies are selected as part of the standards consensus process and are provided here as advice for consideration by deployments which may need such lists for regional uses. This section is expected to evolve over time to track the evolving needs of relevant standards.

The table below shows the various taxonomy elements currently in the standard. It also shows the mapping between these existing vehicle taxonomies and the messages which appear in the standard.

The data frame DF_VehicleClassification also contains a number of the below items and can be suitable for use when a deployment is uncertain or unable to agree on the scope of the user need to be supported. Observe that this data frame also contains a regional expansion point where any regionally defined lists can be added.

Table 3 - Vehicle taxonomies used in V2X

| Vehicle Taxonomy | Description | Messages |
|---------------------------|--|--------------------|
| BasicVehicleType | Basic classification of a V2X device. A cross cutting list developed to be used in most general cases. | BSM |
| BasicVehicleRole | Basic role of this user at this time, used for security and elevated privilege applications. | BSM, SRM |
| RequestSubRole | A local list (a list with locally understood meanings) with local “role” based items. | SRM |
| RequestImportanceLevel | A locally defined list (a list with locally understood meanings) with local “type of request” items. | SRM |
| Iso3833VehicleType | Value domain provided by ISO 3833 for general vehicle types. | BSM, SRM |
| VehicleType | HPMS classification types used in the U.S. for reporting. | EVA, PVD, BSM, SRM |
| VehicleGroupAffected | ITIS enumeration list commonly referred to as “Vehicle Groups Affected.” | EVA, BSM |
| EmissionType | Allows selecting an emission type (typically for a road segment use restriction). | MAP |
| IncidentResponseEquipment | ITIS enumeration list commonly referred to as “Incident Response Equipment.” | EVA, BSM |
| ResponderGroupAffected | ITIS enumeration list commonly referred to as “Responder Group Affected.” | EVA, BSM |
| ResponseType | Type of response which a vehicle is engaged in when transmitting emergency alerts. | EVA |
| RestrictionAppliesTo | List of common vehicle types which may have one or more special movements at an intersection. | MAP |
| SpeedLimitType | The type of vehicle class to which a given speed limit applies. | MAP |

11.10 Object Indexing Methods Used in Maps and Elsewhere

The MAP, SPAT, and TIM messages in the SAE J2735 standard use a number of indexing systems to link between data objects found in the messages, which in turn describe the overall data model supported by the messages. The motivation for this was to create efficient message structures in small payloads. This section of the standard addresses how these indices are intended to work.

The SAE J2735 standard is intended as a means to exchange required data effectively (both uniformly and compactly). 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 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. As an example, a traffic flow monitoring application may desire lane information extending back 1000 m from the stop line, while the needs of a vehicle safety application may be served by a smaller span of perhaps 300 m.

A brief summary of the indexing process used from the bottom to the top is as follows. All lane objects are identified within the context of an intersection by a LaneID. Any lane object can be identified in a globally unique manner by concatenating its IntersectionReferenceID and its LaneID. 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 regional extension concept for adding additional ASN content is not the same as the roadway operator’s regional areas (denoted by the DE_RoadRegulator entry) over which a set of intersections enjoy a unique index assignment (the two separate systems coexist but have similar names).

The multiple part naming tree to uniquely describe a given intersection lane can be expressed as:

| | | | | |
|--|---|-----------------------|---|---|
| RoadRegulatorID | → | IntersectionID | → | LaneID |
| IntersectionReferenceID. RoadRegulatorID | | | | Road Owner/Operator Id |
| IntersectionReferenceID. IntersectionID | | | | Intersection Regional ID assignment |
| GenericLane. LaneID | | | | Lane ID assignment in this intersection |

While this clause covers indexing methods and systems used throughout the MAP and SPAT messages, most of the practical indexing occurs using only the DE_LaneID values, where the value assigned is unique. The DE_LaneID is used to express relationships between different lanes within a single intersection, the most typical use case. When combined with an optional DE_IntersectionReferenceID; however, this index can be used in places such as the DF_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 jurisdictional boundaries in the U.S.

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 standard. It is expected that the assignment of this value is permanent in nature. Every region is assigned a range of DE_IntersectionID values which it may manage and assign as it sees fit. The DE_RoadRegulatorID value of zero is assigned, by definition, for testing use. Both of these values are defined as INTEGER (0..65535); refer to the normative definitions for details. Every “intersection” in a given region is assigned such a unique IntersectionID value. The lane collection within an intersection is arbitrary by design (in the way that the numbering assignments have been selected for lanes and approaches). 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 2-byte fields (again, each an integer ranging from 0 to 65535) were allocated for this ID structure 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 deployment region to a U.S. state, an intersection located in Ann Arbor, Michigan, may be able to avoid sending the field `DE_RoadRegulatorID` indicating the broader geographical concept of Michigan in the U.S. In practical terms, an intersection may be referred to by its `DF_IntersectionID` over broad operational coverage areas, sending the `DE_RoadRegulatorID` only when required. The value range of `DE_IntersectionID` for 0x0001 to 0x00FF is specifically allocated in each region for its own deployment testing, and it is recommended that early adopters should select from that range for testing use. Note further that the data element `DE_Revision` in the `DF_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 four multiple lane approaches, complete with various medians, bike lanes, crosswalks, and sidewalks all modeled would require about 50 such indexes. The `DE_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 apply to which lanes, are found within that structure. When a `DE_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 `DF_ConnectsTo` data frames within a lane are an example of this. Within an intersection, the `DE_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 `MSG_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 (found in the `MAP` message). To recap, each lane object is assigned a unique lane ID, and this is how other lanes refer to it.

ApproachID: A `DF_GenericLane` data frame optionally includes a `DF_ApproachGroup` data frame that includes two `DF_ApproachIDs`, one for an ingress approach and one for an egress approach. When the `DF_ApproachGroup` is included in the `DF_GenericLane`, if the lane belongs to only an ingress approach, the egress `DE_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 will have two non-zero `DE_ApproachIDs` in an `DF_ApproachGroup`. The approach concept is sometimes of use when the precise lane of a moving vehicle cannot be determined.

LaneConnectionID: The `DE_LaneConnectionID` index is used to provide dynamic movement assist details for connecting to one or more outbound lanes. The `DE_LaneConnectionID` is (optionally) assigned to a lane in the `Connection` data structure of the map message. This allows an owning lane to learn what data values in the message would pertain to it. The `DE_LaneConnectionID` is used within the `SPAT` message in the `DF_IntersectionState` data frame in the `DF_ConnectionManeuverAssist` data frame where it is expressed. The `DF_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.

SignalGroupID: The `DE_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 U.S. 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 `DF_MovementState` data structure (which contains the `DE_SignalGroupID`) and list of `DF_MovementEvent` entries where the `DF_SignalPhaseState` (i.e., Red, yellow, green, etc. in the U.S.) and the `DF_TimeChangeDetails` (i.e., the time at which the state will change) are found. Note also that the `DF_MovementEvent` is presented as a list of such events, allowing the ability to express the time change points for multiple future state changes for eco driving and other needs. For non-adaptive signal systems, this can be used to advantage to express time change points for multiple future cycles.

DF_ConnectsTo and LaneIDs, SignalGroupIDs, and LaneConnectionIDs: While the DF_ConnectsTo data concept is not an index itself, it contains three index types of interest in this discussion. The DF_ConnectsTo data frame 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 DF_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 into other lanes) is provided by the connected DE_LaneID. The SPAT timing information is provided by the DE_SignalGroupID. Dynamic clearance advice is provided by the DE_LaneConnectionID. All of these are simple indexes to other lanes or to signal groups which are fully described in the map message for that intersection. 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 DF_ConnectsTo list are simply added to reflect each unique combination.

Other Intersections and Lane IDs: The DE_IntersectionReferenceID is (optionally) found in the Connection data frame (found in DF_ConnectsTo) when the lane index (DE_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 DE_IntersectionID and DE_LaneID assigned by the adjacent intersection (note that this allows crossing both to another intersection and another intersection located in another roadway owner/operator 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 lane's stop line. In this use case, the resulting intersections can be combined in a mosaic fashion. 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, 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.

12. COMMENTS ON THE 2022 REVISION OF SAE J2735 (INFORMATIVE)

This document added new ASN.1 modules for support of messages defined in other documents, such as SAE J2945/C. In the case of the J2945/C and J2945/3 ASN.1 modules, the modules have already been fully integrated with the ASN.1 corresponding to this revision. In cases where the message contents are not yet defined, placeholder modules were used, e.g., for PSM2. A placeholder module should be replaced by the module that fully defines the message when it becomes available.

13. NOTES

13.1 Revision Indicator

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 SAE V2X CORE TECHNICAL COMMITTEE

APPENDIX A - ASN SOURCE CODE

Starting from the 2020 edition of SAE J2735, the ASN.1 definitions of the messages, data frames, and data elements specified in this standard are published as a set of ASN.1 files and no longer as a single ASN.1 file. The set of ASN.1 files is referred to as the "V2X ASN.1 Module Collection" and may also include ASN.1 files containing messages, data frames, and data elements specified in other SAE standards and/or technical reports related to SAE J2735.

Each ASN.1 file in the V2X ASN.1 Module Collection contains one ASN.1 module. In most cases, a module contains a message definition and a number of data elements and data frames that are closely related to that message. However, some modules contain ASN.1 types that are common to multiple messages.

Each ASN.1 module is assigned an object identifier (OID) and each subsequent version of a module will be assigned a different OID. In addition, all the references from an ASN.1 type present in a module to an ASN.1 type defined in another module are qualified (via an IMPORTS clause) by the OID of the version of the module containing the referenced entity. Whenever the content of a module is modified, the OID of the module will also be changed. The new OID will refer to the new version of the module and the old OID will keep referring to the state of the module prior to the change. This mechanism ensures that any existing references to a module from another module will not be affected when a module is modified.

Some message modules that have not been fully developed are represented using placeholder module files. Placeholder modules contain an OID and a message definition that indicates NULL. This allows for message IDs (DSRCmsgID) to be defined and reserved, and it provides a well-defined path forward for inclusion once these messages are developed. Placeholder files should be replaced by the appropriate ASN.1 module files when the future message definitions become available.

The set of ASN.1 modules corresponding to this document are available for download from SAE (<https://www.sae.org/standards/>).

APPENDIX B - VARIOUS REGIONAL ID ASSIGNMENTS

NOTE: Use of regional extensions is discouraged for security reasons (refer to SAE J2945/5, 2.7.5).

Region ASN Extensions

The message set and message framework developed in standard provide for regional extensions to allow extending the contents of various messages. Deployment regions are identified by a unique numerical assignment. The assignment range provides for both uncoordinated ad hoc values in an assigned range and for registered range values assigned solely by standard. The data element DE_RegionId is used for this purpose. Refer to that entry for further normative information. At this time, the following registered range values have been assigned:

```
addGrpA      RegionId ::= 1  -- originally for use in a USA deployment
addGrpB      RegionId ::= 2  -- originally for use in a Japanese deployment
addGrpC      RegionId ::= 3  -- originally for use in a European deployment
```

The reader is directed to 11.2 for further information on the use of regional extension points.

Road Regulator Regional Index Assignments

In standard, an indexing system called the DE_RoadRegulatorID is used to denote one or more regions operated by a roadway owner/operator such as a state or province within a country. Note the spelling of the name, which is not to be confused with the RegionId values described above.

Within a given RoadRegulatorID value, the roadway owner/operator is responsible for the assignment of unique indexing values to roadway objects such as intersections and road segments.

At this time the following registered range values have been assigned:

```
regionalIDTesting  RoadRegulatorID ::= 0  -- assigned for deployment testing use
```

The reader is directed to 11.10 for further information on indexing and the use of regional IDs.