SURFACE VEHICLE STANDARD

J2735™	MAR2016
Issued 2015-09 Revised 2016-03 Superseding J2735 JAN2016	

Dedicated Short Range Communications (DSRC) Message Set Dictionary

RATIONALE

This Standard is the fifth edition of the message set dictionary. The changes made from prior editions include revising the content to reflect a uniform use of unaligned packed coding rules, a common message framework, the further refinement of several existing messages due to deployment experience, and the addition of a preliminary Personal Safety Message for use with vulnerable road users. This amendment to the standard was issued in March of 2016 to clarify how positional offsets were calculated in some data frames. Two typographical errors were also corrected at that time.

The document areas affected by this limited scope revision are as follows:

Section 6.82 Data Frame: DF_PathHistory,	Page 79	In the Use section,
Section 6.84 Data Frame: DF_PathHistoryPoint,	Page 80	In the Use section
Section 6.84 Data Frame: DF_PathHistoryPoint,	Page 80	In the ASN.1 Representation section
Section 7.127 Data Element: DE_OffsetLL-B18,	Page 171	In the Use section,
Section 7.195 Data Element: DE_TimeOffset,	Page 202	In the Use section
Section 7.224 Data Element: DE_VertOffset-B12,	Page 214	In the Use section
Section 8.58 Data Element: EXT_ITIS_Codes [ITIS],	Page 240	In the ASN.1

Section 11.8 Lanes, Objects Defined in Intersections and Elsewhere, Page 263 In the last paragraph on this page.

DEDICATION

This standard is dedicated to the Memory of Broady Cash, who provided leadership and guidance in the evolution of the DSRC standards. His research led to work on the original ASTM DSRC standards, for which Broady pulled together a team of industry stakeholders and subject matter experts. The ASTM standard (E-2213) addressed all of the DSRC communications layers. Mr. Cash was also very active in helping support the establishment of the DSRC spectrum. When the DSRC standards expanded to IEEE and SAE, Broady continued his leadership role in ensuring that the 1609 and 802.11p standards continued to meet the original requirements, and that they would work together to meet the evolving ITS applications requirements. He was often the glue that kept the standards activities on track, as he mediated differences of opinion and personalities among the various contributors to the standards. Broady Cash was born on October 7, 1948, in Amherst, Virginia. He passed away after battling a long illness on November 3, 2008. He is survived by his wife and two children. Many thanks to Broady for his invaluable contributions to DSRC and to the foundation of Connected Vehicle technologies.

FOREWORD

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

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Create_time: 07:35:50 PM Tuesday, September 01, 2015
Extracted from:   J2735_r63.its       [Mod: 9/1/2015 7:30:56 PM]
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1. SCOPE

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

1.1 Purpose

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

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)

2.1.2 IEEE Publications

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

IEEE Std 1609.2™-2016 IEEE Standard for Wireless Access in Vehicular Environments—Security Services for Applications and Management Messages

IEEE Std 1609.3™-2016 IEEE Standard for Wireless Access in Vehicular Environments (WAVE)—Networking Services

IEEE Std 1609.4™-2016 IEEE Standard for Wireless Access in Vehicular Environments (WAVE)—Multi-channel Operation

2.1.3 ISO Publications

Copies of these documents are available online at http://webstore.ansi.org/

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

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

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

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

2.1.4 RTCM Publications

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

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

RTCM Standard 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

This standard is intended to be independent of the underlying lower layer protocols, though early deployments are expected to use the “DSRC-WAVE” technology operating at 5.9 GHz. 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 US 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 http://ntl.bts.gov/lib/38000/38600/38631/Appendix_G_CICAS-V_Task_10_Final_Report_4-29-10__FHWA-JPO-10-068_.pdf

2.2.3 US Dept. of Transportation, National ITS Architecture

Available on-line at http://www.iteris.com/itsarch/.

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 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

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

IEEE Std 802.11™-2012 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) – Identifier Allocations. December 9, 2015 (anticipated publication date)

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 Actors: An entity which has an active role or interest in a use case e.g., driver.

3.1.2 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.

3.1.3 Application-specific Data Dictionary: A data dictionary specific to a particular implementation of an ITS application. Local deployments which use DSRC may often select a subset of the defined messages meeting their specific needs and create an application-specific data dictionary for that deployment. This document is an example of an Application-specific Data Dictionary intended for DSRC applications.

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

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

3.1.6 Back Office (BO): A Back Office Infrastructure element which consumes data from, or provides data to, the roadside Infrastructure. Often used to communicate to the equipped vehicles using DSRC technology by transferring information to the roadside device (RD) for transmission to or from the HV.

3.1.7 Basic Encoding Rules: Rules laid out by the ASN.1 standard for encoding abstract information into a concrete data stream. The 2009 DSRC message set standard used DER, a variant of BER for its encoding. This is no longer used.

3.1.8 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.

3.1.9 Byte Type Encoding: A type of information encoding where units of information are handled in modular increments of 8 bits (an octet).

3.1.10 Certificate Authority (CA): A Back Office Infrastructure element which interacts with the HV and the RD 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 DSRC devices.

3.1.11 Commercial Motor Vehicle: Any self-propelled or towed vehicle used on public highways in interstate commerce to transport passengers or property when: 1) The vehicle has a gross vehicle weight rating or gross combination weight rating of 10,001 or more pounds; or 2) The vehicle is designed to transport more than 15 passengers, including the driver; or 3) The vehicle is used in the transportation of hazardous materials in a quantity requiring placarding under regulations issued by the Secretary of Transportation under the Hazardous Materials Transportation Act (49 U.S.C. App. 1801-1813). (49CFR350) (49CFR390)

3.1.12 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.

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

3.1.14 Control Channel (CCH): The DSRC radio channel typically used in IEEE 1609 for transmitting service annoucements and other control information in WAVE protocol.

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

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

3.1.17 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.

3.1.18 Cycle: One complete sequence of signal indications.

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

3.1.20 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).

3.1.21 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.

3.1.22 Data Consumer: Any entity in the ITS environment which consumes data.

3.1.23 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.

3.1.24 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.

3.1.25 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.

3.1.26 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.

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

3.1.28 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.

3.1.29 Disabled Vehicle: An equipped vehicle that has self-declared that it is not performing all designed/intended functions and/or operations. Such a vehicle may be moving or may be stationary.

3.1.30 Distinguished Encoding Rules: A variant of ASN BER encoding used by the 2009 edition of this standard.

3.1.31 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.

3.1.32 Dual-Arrow Signal Section: A type of signal section designed to include both a yellow arrow and a green arrow.

3.1.33 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.

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

3.1.35 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).

3.1.36 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.

3.1.37 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, see 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.

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

3.1.39 Full-Actuated Operation: A type of traffic control signal operation in which all signal phases function on the basis of actuation.

3.1.40 Functional-area Data Dictionary (FADD): A data dictionary that is intended to standardize data element syntax, and semantics, within and among application areas within the same functional area. This DSRC Standard is a FADD.

3.1.41 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.

3.1.42 Infrastructure: Any roadside device which supports V2V/V2I communications flows (message exchanges), including but not limited to DSRC RSU devices. At this time, the primary V2V uses cases and data flows require only moderate interaction with the Infrastructure for activities such as security.

3.1.43 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.

3.1.44 Intelligent Transportation Systems (ITS): Systems that apply information technology to transportation challenges. Another meaning of the ITS acronym is integrated transportation systems, which stress that ITS systems 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: http://www.its.dot.gov/faqs.htm#what

3.1.45 Interoperability: The ability to share information among heterogeneous applications and systems.

3.1.46 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."

3.1.47 Intersection Control Beacon: A beacon used only at an intersection to control two or more directions of travel.

3.1.48 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.

3.1.49 Interval Sequence: The order of appearance of signal indications during successive intervals of a signal cycle.

3.1.50 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.

3.1.51 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 DSRC 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.

3.1.52 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.

3.1.53 Link (RF): A communications channel being used in support of application data transfer needs.

3.1.54 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.

3.1.55 Local Deployment: A local deployment is an embodiment of the DSRC message set within a region that implements one or more of the DSRC application groups defined in one or more other standards. 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.

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

3.1.57 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. 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.

3.1.58 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.

3.1.59 Nearby Vehicle (NV): Those vehicles within the transmission range of the Host Vehicle and Receiving Vehicle(s), and which can therefore monitor and react to the exchange of DSRC messages between the HV and RV. Such vehicles are considered situationally aware of the use case exchange under consideration. The NV determines whether to address or ignore the primary use case based on its own positional trajectory with respect to the event and/or other data.

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

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

3.1.62 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.

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

3.1.64 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.

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

3.1.66 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 messages indicates a don’t walk state for that pedestrian lane (along with an optional period of time remaining for this state).

3.1.67 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 meters per second.

3.1.68 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.

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

3.1.70 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.

3.1.71 Preemption Control: The transfer of normal operation of a traffic control signal to a special control mode of operation.

3.1.72 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.

3.1.73 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.

3.1.74 Provider Service Context (PSC): A field associated with a PSID containing supplementary information related to the service. PSC is defined in IEEE Std 1609.3.

3.1.75 Provider Service Identifier (PSID): A number that identifies a service provided by an application. PSID is defined in IEEE Std 1609.12.

3.1.76 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.

3.1.77 Receiving Vehicle (RV): An equipped vehicle receiving DSRC messages from other nearby vehicles or from nearby infrastructure (e.g., an RSU).

3.1.78 Red Clearance Interval: An optional interval that follows a yellow change interval and precedes the next conflicting green interval.

3.1.79 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.

3.1.80 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.

3.1.81 Remote Vehicle (RV): The equipped vehicle (or vehicles) which play supporting roles in the use case by interacting with the Host Vehicle in some way. Each Remote Vehicle (RV) can be a transmitting vehicle, or a receiving vehicle, or both – this distinction is made clear in the use case description. There is typically more than one Remote Vehicle in any use case.

3.1.82 Reporting Vehicle: An equipped vehicle which is providing some form of additional data to other Remote Vehicles or to the roadside Infrastructure.

3.1.83 Reversing Vehicle: An equipped vehicle in which the transmission is engaged to propel the vehicle backwards.

3.1.84 Roadside Device (RD): Any Roadside Infrastructure device which is equipped with an RSU and which is used to communicate with equipped vehicles. Further distinctions among RDs may be made for devices which are co-located or in close communion with other roadside devices (such as an advanced signal controller) for some use cases.

3.1.85 Roadside Unit: A RoadSide Unit (RSU) is a DSRC device used to transmit to, and receive from, DSRC equipped moving vehicles (OBUs). The RSU transmits from a fixed position on the roadside (which may 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. An RSU contains a station (STA).

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

3.1.87 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.

3.1.88 Service Channel: A DSRC channel used for exchange of information relevant for ITS applications, in contrast to CCH, which carries control information."

3.1.89 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.

3.1.90 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).

3.1.91 Signal Section: Two or more traffic control signals operating in signal coordination. Also called a signal system.

3.1.92 Signal Timing: The amount of time allocated for the display of a signal indication, slang.

3.1.93 Slow Moving Vehicle: A vehicle engaged in movement that is slower than the surrounding flow of traffic and thereby presents a hazard, e.g. a tow truck with a load. The SMV can be equipped with an OBE or not, and there may be more than one SMV in a given use case.

3.1.94 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.

3.1.95 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.

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

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

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

3.1.99 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.

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

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

3.1.102 Towing Vehicle: An equipped light passenger vehicle which is towing a trailer.

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

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

3.1.105 Unaligned Packed Encoding Rules: The variant of ASN PER encoding which is used in this edition of the standard.

3.1.106 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.

3.1.107 Un-equipped Vehicle: A vehicle which is not equipped with an OBU device.

3.1.108 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.

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

3.1.110 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."

3.1.111 Warning Beacon: A beacon used only to supplement an appropriate warning or regulatory sign or marker.

3.1.112 WAVE device: A Device which is conformant to Wireless Access for Vehicular Environment communication protocol.

3.1.113 WAVE management entity (WME): The set of management functions, as defined in IEEE Std 1609 documents.

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

3.1.115 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
CCH	Control Channel
CER	Canonical Encoding Rules
CICAS-V	Cooperative Intersection Collision Avoidance System – Violation
CLW	Control Loss Warning
CRC	Cyclic Redundancy Code
CSR	Common Safety Request Message
DE	Data Element
DER	Distinguished Encoding Rules
DF	Data Frame
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
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
OBE	On-Board Equipment
OBU	On-Board Unit
OEM	Original Equipment Manufacturer
OTA	Over-The-Air
PDM	Probe Data Management Message
PDU	Protocol Data Unit
PER	Packed Encoding Rules
PH	Path History
PHY	Physical Layer
PP	Path Prediction

PSC	Provider Service Context
PSID	Provider Service Identifier
PSN	Probe Segment Number
PVD	Probe Vehicle Data Message
RSA	RoadSide Alert Message
RSU	RoadSide Unit
RTCM	Radio Technical Commission For Maritime Services or RTCM Corrections Message
RTK	Real Time Kinematics
SAE	Society of Automotive Engineers
SAP	Service Access Point
SC-104	Sub-Committee 104 of the RTCM
SCH	Service Channel
SDH	Sensor Data Handler
SDN	Service Delivery Node
SDO	Standards Developing Organizations or Standards Development Organization
SPAT	Signal Phase And Timing Message
SRM	Signal Request Message
SRS	Safety Restraint System *or* Supplemental Restraint System
SSM	Signal Status Message
SSP	Service Specific Permissions
STA	Station
TA	Threat Arbitration
TC	Traction Control or Target Classification
TCIP	Transit Communications Interface Profiles
TCP	Transmission Control Protocol
TCS	Traction Control System
TIM	Traveler Information Message
TMDD	Traffic Management Data Dictionary
UDP	User Datagram Protocol
UML	Unified Modeling Language
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 any DSRC equipped object
VIN	Vehicle Identification Number
VSC	Vehicle Safety Communications

VSC-2	Vehicle Safety Communications 2
WAVE	Wireless Access in Vehicular Environments
WME	WAVE Management Entity
WMH	Wireless Message Handler
WSM	WAVE Short Message
WSMP	WSM Protocol
XML	eXtensible Markup Language

4. THE USE OF DSRC 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 DSRC Goals and Objectives (Informative)

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

1. Safety

2. Mobility

3. Commercial (or Private)

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

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

The following subsection provides an overview of the DSRC architecture and protocol stack. 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.

4.2 DSRC Overview (Informative)

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

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

The IEEE 1609 family of standards is used along with the IEEE 802.11 medium access control (MAC) and physical (PHY) layer standard 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 and includes specifications for channel coordination (1609.4), network and transport layers (1609.3), and data security (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. IEEE 1609.4 specifies channel coordination options that can be used in conjunction with IEEE 1609.3.

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.

4.3 Philosophy of Message Design (Informative)

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

This dense encoding uses a three-way approach:

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

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

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

The above data concepts are all described in Abstract Syntax Notation revision One (ASN.1, referred to as ASN hereafter). This process follows the typical style used for message sets defined in ITS standards by SAE and the other SDOs engaged in ITS development. The complete ASN specification of the Standard is available to developers to download at the SAE DSRC support site, see Annex A.

4.4 Message Encoding (Normative)

The ASN specified by this Standard is encoded for transport by the lower layers (the encoded stream of octets becomes the payload of that lower layer). The encoding style required to be used to conform with this Standard when used with the WSMP method of sending shall be UPER. In former editions of the Standard the DER encoding style, which follows an octet-aligned Tag-Length-Value format of BER for ASN, was used. The DER encoding style is no longer used when WSMP is used.

The UPER ASN encoding method is superseded in a few selected places where the normative use case does not involve ASN encoding. In such cases the ASN syntax of this Standard is typically encoded and sent "over the wire" with implicit encoding. In the production of ASN found in this Standard there are OCTET STRING segments defined which are made up of inner content constructed as outlined in ASN comments which are part of the definition. In such cases the OCTET STRING shall be encoded to match the described inner content found in the ASN comments and using the bit and octet numbering and packing order as defined by ASN. When the inner content of a defined OCTET STRING refers to another data frame or data element found in this Standard for its construction the definition of that element shall be used in the place it is referred to. The resulting content of that portion of the OCTET STRING shall be conformant to the definition of the referenced data frame or data element.

4.5 Additional Data Dictionary Constraints (Informative)

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 J2945/1.

5. MESSAGE SET

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

All text in this clause is considered normative unless expressly marked otherwise. The definitions for each data concept in this dictionary set are 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.1 is presented in a section titled ASN.1 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 productions of ASN.1 which follow shall be considered normative in nature. While the majority of the normative content is reflected in the actual syntax of the ASN.1, some entries also have additional statements in the ASN.1 comments which shall be considered normative as well. In addition, the textual commentary provided with each entry (in sections marked "use" and "remarks") may also provide additional normative restrictions on the proper use of the entry being described. Users of this Standard seeking to be in conformance with it shall follow the normative text outlined here.

In this SAE data dictionary all concepts are formally named by combining the basic type (data element (DE), data frame (DF), or message (MSG) and the ASN type definition name. This is the name which appears in the title of the section where the concept is defined. When citing entries for use by other standards the data concepts which follow 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. As an example, the ASN type definition which is called DSRCmsgID (which is a data element) should be referred to by its formal name which is: DE_DSRC_MessageID.

It should be observed that the MessageFrame entry represents the top most entry of the data dictionary and that all other messages (as well as data frame and data elements) are only sent by being enclosed within that message. The terminology of some protocols, the MessageFrame is the PDU that is exchanged.

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 Section 11.2. The provided set of test messages are intended for testing use only. The message encoding used shall be UPER, however other encoding styles (typically due to reuse from other standards) are encapsulated and supported in various places.

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 } |
   { 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 J2735 DSRC 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} )
   }
```

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 frequently 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 {{REGION.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 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 {{REGION.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_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      ITIS.VehicleGroupAffected      OPTIONAL,
   responseEquip    ITIS.IncidentResponseEquipment OPTIONAL,
   responderType    ITIS.ResponderGroupAffected    OPTIONAL,
   regional         SEQUENCE (SIZE(1..4)) OF
                    RegionalExtension {{REGION.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.

Note: Deployers are cautioned that it is expected the key content of this message will be placed into BSM Part II to support standards which are now under development.

5.5 Message: MSG_IntersectionCollisionAvoidance (ICA)

Use: This message is intended to be used to broadcast to other DSRC devces 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 {{REGION.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.

5.6 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 {{REGION.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.

5.7 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. Here, in the work of the SAE DSRC Technical Committee, these messages are "wrapped" for transport on the DSRC media, and then can be re-constructed back into the final expected formats defined by the NMEA standard and used directly by GNSS to increase the absolute and relative accuracy estimates produced.

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-MsgType       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 {{REGION.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 DSRC 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.

5.8 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.

This message is under development, and is included in this standard to support field trials. Changes in the specification of the message and/or its constituent elements may occur in the future.

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 {{REGION.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.

5.9 Message: MSG_ProbeDataManagement (PDM)

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

ASN.1 Representation:

```
 ProbeDataManagement ::= SEQUENCE {
    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 {{REGION.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.

5.10 Message: MSG_ProbeVehicleData (PVD)

Use: The probe vehicle message frame is defined below. The probe vehicle message is used to exchange status about a vehicle with other (typically RSU) DSRC devices to allow the collection of information about typical 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 messages is defined elsewhere. In typical use the reporting vehicle has collected one or more snapshots which it will send to receiving RSUs along with information (the vector) about the point in time and space when the snapshot event occurred. Because any sequence of snapshots is related within a limited range of time and space, some data compression is used in the message to reduce redundant information.

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

5.11 Message: MSG_RoadSideAlert (RSA)

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

This message is for 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 this is not a requirement to receive and understand these messages, nor is having a local base map.

The position section of the message gives a simple (and optional) vector for where the hazard is located (fixed or moving) and can be used to filter some messages as being not applicable. Consider a "train approaching" message which indicates the train is in fact traveling away from the receiver. The basic 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 will also be explained in the other supporting ATIS messages (available on DSRC service channels), and a linkage value is given in those cases when such data is available.

ASN.1 Representation:

```
RoadSideAlert ::= SEQUENCE {
   msgCnt          MsgCount,
   timeStamp       MinuteOfTheYear  OPTIONAL,
   typeEvent       ITIS.ITIScodes,
                   -- a category and an item from that category
                   -- all ITS stds use the same types here
                   -- to explain the type of  the
                   -- alert / danger / hazard involved
   description     SEQUENCE (SIZE(1..8)) OF ITIS.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 {{REGION.Reg-RoadSideAlert}} OPTIONAL,
   ...
   }
```

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

MSG MSG_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 DSRC messages. When used in other public safety messages, additional elements may be appended to form new message types.

5.12 Message: MSG_RTCMcorrections (RTCM)

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

ASN.1 Representation:
```
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
   rtcmHeader  RTCMheader OPTIONAL,

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

5.13 Message: MSG_SignalPhaseAndTiming Message (SPAT)

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

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

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

ASN.1 Representation:

```
SPAT ::= SEQUENCE {
   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 {{REGION.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.

5.14 Message: MSG_SignalRequestMessage (SRM)

Use: The Signal Request Message is a message sent by a DSRC 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 {{REGION.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.

5.15 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 {{REGION.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.

5.16 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 {{REGION.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.

5.17 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 exhanges of their own within the common framework of the overall DSRC Message set and this data dictionary. A few common data elements are provided for consistency, while the reminder 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,
      -- All content is added in below data frame
      regional  RegionalExtension {{REGION.Reg-TestMessage00}} OPTIONAL,
      ...
      }
   TestMessage01 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.Reg-TestMessage01}} OPTIONAL,
      ...
      }
   TestMessage02 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.Reg-TestMessage02}} OPTIONAL,
      ...
      }
   TestMessage03 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.Reg-TestMessage03}} OPTIONAL,
      ...
      }
   TestMessage04 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.Reg-TestMessage04}} OPTIONAL,
      ...
      }
   TestMessage05 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.Reg-TestMessage05}} OPTIONAL,
      ...
      }
   TestMessage06 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.Reg-TestMessage06}} OPTIONAL,
      ...
      }
   TestMessage07 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.Reg-TestMessage07}} OPTIONAL,
      ...
      }
   TestMessage08 ::= SEQUENCE {
      header    Header   OPTIONAL,
```

```
      regional  RegionalExtension {{REGION.Reg-TestMessage08}} OPTIONAL,
      ...
      }
   TestMessage09 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.Reg-TestMessage09}} OPTIONAL,
      ...
      }
   TestMessage10 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.Reg-TestMessage10}} OPTIONAL,
      ...
      }
   TestMessage11 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.Reg-TestMessage11}} OPTIONAL,
      ...
      }
   TestMessage12 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.Reg-TestMessage12}} OPTIONAL,
      ...
      }
   TestMessage13 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.Reg-TestMessage13}} OPTIONAL,
      ...
      }
   TestMessage14 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.Reg-TestMessage14}} OPTIONAL,
      ...
      }
   TestMessage15 ::= SEQUENCE {
      header    Header   OPTIONAL,
      regional  RegionalExtension {{REGION.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 certain data concepts defined by this standard.

All text in this clause is considered normative unless expressly marked otherwise. The definitions for each data concept in this dictionary set are 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.1 is presented in a section titled ASN.1 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 productions of ASN.1 which follow shall be considered normative in nature. While the majority of the normative content is reflected in the actual syntax of the ASN.1, some entries also have additional statements in the ASN.1 comments which shall be considered normative as well. In addition, the textual commentary provided with each entry (in sections marked "use" and "remarks") may also provide additional normative restrictions on the proper use of the entry being described. Users of this Standard seeking to be in conformance with it shall follow the normative text outlined here.

In this SAE data dictionary all concepts are formally named by combining the basic type (data element (DE), data frame (DF), or message (MSG) and the ASN type definition name. This is the name which appears in the title of the section where the concept is defined. When citing entries for use by other standards the data concepts which follow 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. As an example, the ASN type definition which is called DSRCmsgID (which is a data element) should be referred to by its formal name which is: DE_DSRC_MessageID.

6.1 Data Frame: DF_AccelerationSet4Way

Use: This data frame is a set of acceleration values in 3 orthogonal directions of the vehicle and with yaw rotation rates, expressed as 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

Remarks: In the prior editions of the standard (pre 2015) this was constructed as a BLOB, it has now been converted for UPER use, in the prior editions of the standard, SAE J670 was used to define the frame of reference system.

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 {{REGION.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 section 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 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 DSRC 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_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 consist 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.8 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

MSG MSG_BasicSafetyMessage (BSM) <ASN>, and

MSG MSG_IntersectionCollisionAvoidance (ICA) <ASN>.

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

6.9 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.10 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.11 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 {{REGION.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.

6.12 Data Frame: DF_ConfidenceSet

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

6.13 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.

6.14 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.

6.15 Data Frame: DF_ConnectionManeuverAssist

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

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 {{REGION.Reg-ConnectionManeuverAssist}} OPTIONAL,
   ...
   }
```

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

6.16 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.

6.17 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.

6.18 Data Frame: DF_DDate

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

ASN.1 Representation:

```
DDate ::= SEQUENCE {
   year    DYear,
   month   DMonth,
   day     DDay
   }
```

6.19 Data Frame: DF_DDateTime

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

ASN.1 Representation:

```
DDateTime ::= SEQUENCE {
   year     DYear     OPTIONAL,
   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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.20 Data Frame: DF_DFullTime

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

ASN.1 Representation:

```
DFullTime ::= SEQUENCE {
   year     DYear,
   month    DMonth,
   day      DDay,
   hour     DHour,
   minute   DMinute
   }
```

6.21 Data Frame: DF_DMonthDay

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

ASN.1 Representation:

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

6.22 Data Frame: DF_DTime

Use: The DSRC style time is a compound value consisting of finite-length sequences of integers (not characters) of the form: "hh, mm, ss (sss+) (offset)" - as defined below. In DSRC applications there is no need to send the offset representing the local time zone, so the most common representation for the data frame occupies 4 payload octets and provides a resolution of one millisecond over a range of one day.

ASN.1 Representation:

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

6.23 Data Frame: DF_DYearMonth

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

ASN.1 Representation:

```
DYearMonth ::= SEQUENCE {
   year     DYear,
   month    DMonth
   }
```

6.24 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      ITIS.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    ITIS.GenericLocations   OPTIONAL,
   ...
   }
```

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

6.25 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 {
   -- CERT SSP Privilege Details
   sspRights    SSPindex, -- index set by CERT
   sirenUse     SirenInUse,
   lightsUse    LightbarInUse,
   multi        MultiVehicleResponse,
   events       PrivilegedEvents OPTIONAL,
   responseType ResponseType OPTIONAL,
   ...
   }
```

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

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

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

6.26 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.

6.27 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     ITIS.ITIScodes,
                 -- A category and an item from that category
                 -- all ITS stds use the same types here
                 -- to explain the type of  the
                 -- alert / danger / hazard involved
   description   SEQUENCE (SIZE(1..8)) OF ITIS.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 {{REGION.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.

6.28 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 6 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.29 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
   regional  SEQUENCE (SIZE(1..4)) OF
             RegionalExtension {{REGION.Reg-GenericLane}} OPTIONAL,
   ...
   }
```

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

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

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

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

6.30 Data Frame: DF_GeographicalPath

Use: The DF_GeographicalPath data frame is used to support the cross-cutting need in many DSRC 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 {{REGION.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.

6.31 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 {{REGION.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.

6.32 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.

6.33 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.34 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 Additonal data may be added in the next release of the
   -- standard at this point to handle this concept
   preemptPriorityData PreemptPriorityList OPTIONAL,
                            -- data about one or more regional
                            -- preempt or priority zones

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

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

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

6.35 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.

6.36 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 6 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_Connection	<ASN>, and
DF	DF_IntersectionGeometry	<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.

6.37 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 {{REGION.Reg-IntersectionState}} OPTIONAL,
   ...
   }
```

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.

6.38 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.

6.39 Data Frame: DF_ITIS_Phrase_ExitService

Use: A data frame to allow sequences of ITIS codes, short text strings, and numerical values to be expressed in the normal ITIS vocabulary method and pattern. Note that the allowed text strings are more limited 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 then their full text equivalents.

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

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.

6.40 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   ITIS.ITIScodes,
       text   ITIStextPhrase
       }
  }
```

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.

6.41 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   ITIS.ITIScodes,
       text   ITIStextPhrase
       }
  }
```

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.

6.42 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 in a DER or UPER form, 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   ITIS.ITIScodes,
       text   ITIStextPhrase
       }
  }
```

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.

6.43 Data Frame: DF_J1939-Data Items

Use: This data frame used to sent various 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.

6.44 Data Frame: DF_LaneAttributes

Use: The DF_LaneAttributes data frame holds all of 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 {{REGION.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.

6.45 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 {{REGION.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.

6.46 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_NodeAttributeSetLL <ASN>, and

DF DF_NodeAttributeSetXY <ASN>.

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

6.47 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.

6.48 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.

6.49 Data Frame: DF_ManeuverAssistList

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

ASN.1 Representation:

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

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

DF DF_IntersectionState <ASN>, and

DF DF_MovementState <ASN>.

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

6.50 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.

6.51 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 {{REGION.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.

6.52 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.

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

In use, the 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 US deployments. Under such operating conditions, the unused phase states are simply skipped.

6.54 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.

6.55 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.

6.56 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.

6.57 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 Kmeters 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.

6.58 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 Kmeters 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.

6.59 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 Kmeters 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.

6.60 Data Frame: DF_Node_LLmD_64b

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

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

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

DF	DF_NodeOffsetPoint_LL	<ASN>, and
DF	DF_NodeOffsetPointXY	<ASN>.

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

6.61 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.

6.62 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.

6.63 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.64 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.

6.65 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.

6.66 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.

6.67 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.

6.68 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 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 {{REGION.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

6.69 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 {{REGION.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

6.70 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.

6.71 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. Refer to 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.

6.72 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. Refer to 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.73 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 an Lat and Lon 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.

6.74 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 {{REGION.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.

6.75 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 centimeter (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 {{REGION.Reg-NodeOffsetPointXY}}
                                     -- node which follows is of a
                                     -- regional definition type
   }
```

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

DF	DF_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.

6.76 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.

6.77 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.

6.78 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 a 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.

6.79 Data Frame: DF_ObstacleDetection

Use: The DF_ObstacleDetection data frame is used to relate basic location information about a detect obstacle or a road hazard in a vehicles path.

ASN.1 Representation:

```
ObstacleDetection ::= SEQUENCE {
   obDist          ObstacleDistance,         -- Obstacle Distance
   obDirect        ObstacleDirection,        -- Obstacle Direction
   description     ITIS.ITIScodes(523..541) OPTIONAL,
                                             -- Uses a limited set of ITIS codes
   locationDetails ITIS.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.

6.80 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 micro degree 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.

6.81 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.

6.82 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.83 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.

6.84 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 micro degrees of lat and long. The elevation offset units are in 10cm units. The time is expressed in units of 10 milliseconds. The PositionalAccuracy entry uses 3 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 of 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.

6.85 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.86 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 pivots (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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_TrailerData	<ASN>, and
DF	DF_TrailerUnitDescription	<ASN>.

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

6.87 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 micro degrees
   long        Longitude,               -- in 1/10th micro degrees
   elevation   Elevation  OPTIONAL,     -- in 10 cm units
   regional    SEQUENCE (SIZE(1..4)) OF
               RegionalExtension {{REGION.Reg-Position3D}} OPTIONAL,
   ...
   }
```

Used By: This entry is directly used by the following 9 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.88 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 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.89 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.90 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 {{REGION.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.

6.91 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 {
   -- CERT SSP Privilege Details
   sspRights   SSPindex,
   -- 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.

6.92 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.

6.93 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."

6.94 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 meter) of offset. When a value for zOffset is given, that value persists until changed again for additional nodes in the list.

6.95 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.

6.96 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.

6.97 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.

6.98 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 {{REGION.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 orginal request) are used.

6.99 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.

6.100 Data Frame: DF_RequestorType

Use: The DF_RequestorType data frame is used when a DSRC-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 {{REGION.Reg-RequestorType}} OPTIONAL,
    ...
    }
```

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

DF DF_RequestorDescription <ASN>, and

DF DF_SignalRequesterInfo <ASN>.

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

6.101 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.

6.102 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.

6.103 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.

6.104 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 {{REGION.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.

6.105 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.

6.106 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.

6.107 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.108 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 {{REGION.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.

6.109 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.

6.110 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 DSRC 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 millmeter-accurate values expressed in the current WGS-84 ECEF frame of reference.

6.111 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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

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

6.112 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 1st 2011 and its successors.

ASN.1 Representation:

```
RTCMPackage ::= SEQUENCE {
   -- precise antenna position and noise data for a rover
   rtcmHeader  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.

6.113 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 (2) values, then the Probe Data Management policy should be applied The numbers are inclusive: e.g., using 0x10 and 0x20 would provide a 1/16th sample, and the values 0x00 and 0x80 would provide a 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.

6.114 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.

6.115 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.

6.116 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.

6.117 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 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.

6.118 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.

6.119 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 {{REGION.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.

6.120 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 {{REGION.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.

6.121 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.

6.122 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.

6.123 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 {{REGION.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.

6.124 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 {{REGION.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.

6.125 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 ≤ Speed1, then distance to next snapshot is Distance1
- If speed is ≥ 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.

6.126 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.

6.127 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 ≤ Speed1, then time to next snapshot is Time1 with a default of 20 mph (8.9 m/s) and 6 secs
- If speed is ≥ Speed2, then time to next snapshot is Time2 with a default of 60 mph (26.8 m/s) and 20 secs
- 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.

6.128 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 content below requires SSP permissions to transmit

   -- 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
   trailers        TrailerData OPTIONAL,

   -- 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.

Remarks: Note that each of the items sent in this data frame uses one or more SSP index values to validate the message content against the message content rights and abilities reflected in the CERT used when signing it.

6.129 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.130 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.131 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.

6.132 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 meters. The BSM tempID 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°, 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.

6.133 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.

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
   weatherReport     WeatherReport             OPTIONAL,
   weatherProbe      WeatherProbe              OPTIONAL,

   -- Detected Obstacle data
   obstacle          ObstacleDetection         OPTIONAL,

   -- Disabled Vehicle Report
   status            DisabledVehicle           OPTIONAL,
```

```
   -- Oncoming lane speed reporting
   speedProfile     SpeedProfile             OPTIONAL,

   -- Raw GNSS measurements
   theRTCM          RTCMPackage              OPTIONAL,

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

   }
```

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.

6.134 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 itself started or is expected to start. This in turn allows the indication that a set of time change details refers to a future phase, rather than a currently active phase.

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 phase 1st started
   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 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.

6.135 Data Frame: DF_TrailerData

Use: The DF_TrailerData data frame provides a means to describe trailers pulled by a motor vehicle and/or other equipped devices. The span of use is intended to cover use cases from simple passenger vehicles with trailers to class 8 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. This data frame is typically used in the BSM Part II content.

ASN.1 Representation:

```
   TrailerData ::= SEQUENCE {
      -- CERT SSP Privilege Details
      sspRights     SSPindex, -- index to CERT rights

      -- 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.

6.136 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.

6.137 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.

6.138 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.

6.139 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.

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.

6.140 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_FullPositionVector <ASN>, and

DF DF_RequestorPositionVector <ASN>.

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

6.141 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.

6.142 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. The ability to send this message is controlled by the SSPIndex which links back to the sender's CERT.

ASN.1 Representation:

```
TravelerDataFrame ::= SEQUENCE {
   -- Part I, Frame header
   sspTimRights    SSPindex,
   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,
   duratonTime MinutesDuration,
   priority    SignPrority,

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

   -- Part III, Content
   sspMsgRights1    SSPindex,  -- allowed message types
   sspMsgRights2    SSPindex,  -- allowed message content
   content  CHOICE {
            advisory     ITIS.ITIScodesAndText,
                         -- typical ITIS warnings
            workZone     WorkZone,
                         -- work zone signs and directions
            genericSign  GenericSignage,
                         -- MUTCD signs and directions
            speedLimit   SpeedLimit,
                         -- speed limits and cautions
            exitService  ExitService
                         -- roadside avaiable services
            -- other types may be added in future revisions
            },
   url     URL-Short OPTIONAL,  -- May link to image or other content
   ...
   }
```

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.

6.143 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.

6.144 Data Frame: DF_VehicleClassification

Use: The DF_VehicleClassification data frame is a structure with a composite set of common classification systems used in ITS and DSRC work. 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' DSRC 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     ITIS.VehicleGroupAffected OPTIONAL,
   responseEquip   ITIS.IncidentResponseEquipment OPTIONAL,
   responderType   ITIS.ResponderGroupAffected OPTIONAL,

   -- Fuel types for vehicles
   fuelType        FuelType OPTIONAL,

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

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

DF DF_SupplementalVehicleExtensions <ASN>, and

MSG MSG_ProbeVehicleData (PVD) <ASN>.

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

6.145 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,
   bumpers       BumperHeights   OPTIONAL,
   mass          VehicleMass     OPTIONAL,
   trailerWeight TrailerWeight   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.

6.146 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   ITIS.VehicleGroupAffected,
                     rGroup   ITIS.ResponderGroupAffected,
                     rEquip   ITIS.IncidentResponseEquipment
                  } OPTIONAL,
   ...
   }
```

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

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

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

6.147 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 DSRC 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

6.148 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.

ASN.1 Representation:

```
VehicleSafetyExtensions ::= SEQUENCE {
   events            VehicleEventFlags OPTIONAL,
   pathHistory       PathHistory       OPTIONAL,
   pathPrediction    PathPrediction    OPTIONAL,
   lights            ExteriorLights    OPTIONAL,
   ...
   }
```

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

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

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

6.149 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.

6.150 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,
   sendOnLessThenValue  INTEGER (-32767..32767) OPTIONAL,
   sendOnMoreThenValue  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.

6.151 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.

6.152 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,
                                                             -- Braking Data
   brakePressure    BrakeAppliedPressure  OPTIONAL,          -- Braking Pressure
   roadFriction     CoefficientOfFriction OPTIONAL,          -- Roadway Friction


   sunData          SunSensor             OPTIONAL,          -- Sun Sensor
   rainData         RainSensor            OPTIONAL,          -- Rain Sensor
   airTemp          AmbientAirTemperature OPTIONAL,          -- Air Temperature
   airPres          AmbientAirPressure    OPTIONAL,          -- Air Pressure

   steering    SEQUENCE {
         angle      SteeringWheelAngle,
         confidence SteeringWheelAngleConfidence   OPTIONAL,
         rate       SteeringWheelAngleRateOfChange OPTIONAL,
         wheels     DrivingWheelAngle              OPTIONAL
         } OPTIONAL,                               -- steering data

   accelSets   SEQUENCE {
         accel4way      AccelerationSet4Way            OPTIONAL,
         vertAccelThres VerticalAccelerationThreshold OPTIONAL,
                                                   -- Wheel 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        NTCIP.EssPrecipYesNo,
          rainRate         NTCIP.EssPrecipRate       OPTIONAL,
          precipSituation  NTCIP.EssPrecipSituation  OPTIONAL,
          solarRadiation   NTCIP.EssSolarRadiation   OPTIONAL,
          friction         NTCIP.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.

6.153 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 {{REGION.Reg-VerticalOffset}}
                                     -- offset which follows is of a
                                     -- regional definition type
    }
```

6.154 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.

6.155 Data Frame: DF_WeatherReport

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

ASN.1 Representation:
```
WeatherReport ::= SEQUENCE {
   isRaining          NTCIP.EssPrecipYesNo,
   rainRate           NTCIP.EssPrecipRate         OPTIONAL,
   precipSituation    NTCIP.EssPrecipSituation    OPTIONAL,
   solarRadiation     NTCIP.EssSolarRadiation     OPTIONAL,
   friction           NTCIP.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.

6.156 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 concepts defined by this standard.

All text in this clause is considered normative unless expressly marked otherwise. The definitions for each data concept in this dictionary set are 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. The Use section may also provide illustrative use cases and 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 a given operational condition).

The ASN.1 is presented in a section titled *ASN.1 Representation* and is also available from SAE in a downloadable format. The ASN defines, at minimum, 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 productions of ASN.1 which follow shall be considered normative in nature. While the majority of the normative content is reflected in the actual syntax of the ASN.1, some entries also have additional statements in the ASN.1 comments which shall be considered normative as well. In addition, the textual commentary provided with each entry (in sections marked "use" and "remarks") may also provide additional normative restrictions on the proper use of the entry being described. Users of this Standard seeking to be in conformance with it shall follow the normative text outlined here.

In this SAE data dictionary all concepts are formally named by combining the basic type (data element (DE), data frame (DF), or message (MSG) and the ASN type definition name. This is the name which appears in the title of the section in which the concept is defined. When citing entries for use by other standards the data concepts which follow should be referred to only by their proper names and not by their numerical index, as that value will change over time as other entries are added or removed. As an example, the ASN type definition which is called DSRCmsgID (which is a data element) should be referred to by its formal name which is: DE_DSRC_MessageID.

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 meters per second squared. A range of over 2Gs is supported. The coordinate system is as defined in Section 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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: an permanent yellow condition)
     goWithHalt                   (9),
                                  -- after making a full stop, may proceed
     caution                      (10),
                                  -- proceed past stop line with caution
     reserved1                    (11)
                                  -- used to align to 12 Bit Field

    } (SIZE(12))
```

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

DF	DF_ConnectingLane	<ASN>, and
DF	DF_GenericLane	<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 5-legged intersection) but that to reach any given lane from the stop line of another lane is always a single maneuver item (hence the use of a list). Not all intersection 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 one bar, 100 kilopascals, or 14.7 psi (often rounded off to 15 psi) at sea level. Barometric pressure changes with the weather and with altitude. Since it affects the density of the air entering the engine and ultimately the air/fuel ratio, some computerized emissions control systems use a barometric pressure sensor so that the spark advance and 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 follows that defined by the relevant OBD-II standards. This provides for a precision of one degree Celsius and a range of -40 to +230 degrees. In this use we reduce the upper value allow to be +150 and to allow it to be encoded in a one octet value. The value of -40 deg C is encoded as zero and every degree above that increments the transmitted value by one, resulting in a transmission range of 0 to 191. Hence, a measurement value representing 25 degrees Celsius is transmitted as 40+25=65 or Hex 0x41.

ASN.1 Representation:

```
AmbientAirTemperature ::= INTEGER (0..191) -- in deg C with a -40 offset
     -- The value 191 shall indicate an unknown value
```

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

DF DF_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 6 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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_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.

7.13 Data Element: DE_AttachmentRadius

Use: The DE_AttachmentRadius data element is used to describe the radius of an attachment to another object which the (non motorized) 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.

7.14 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.

7.15 Data Element: DE_BasicVehicleClass

Use: The BasicVehicleClass data element is used to provide a common classification system to categorize DSRC-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 DSRC 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 DSRC 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 DSRC-equipped devices always have a DE_BasicVehicleClass which is typically a value fixed over the operational life of the device. By contrast, some DSRC-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.

7.16 Data Element: DE_BasicVehicleRole

Use: The BasicVehicleRole data element provides a means to indicate the current role that a DSRC device is playing. This is most commonly employed when a vehicle needs to take on another role in order to send certain DSRC 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 both the SRM message itself and also in the type of security CERT which is sent (the SSP in the CERT it used to identify the requester as being of type "police" and that they are allowed to send this message in this way). 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 us
    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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 DSRC 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 when in service, or a pedestrian may assume a cyclist role when using a bicycle). It should be observed that not all DSRC devices (or DSRC vehicles) can assume all roles, nor 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.

7.17 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.

7.18 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.

7.19 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.

7.20 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.

7.21 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_PathHistoryPoint	<ASN>, and
DF	DF_TrailerHistoryPoint	<ASN>.

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

7.22 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
```

7.23 Data Element: DE_CoefficientOfFriction

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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_VehicleStatus	<ASN>, and
DF	DF_WeatherReport	<ASN>.

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

7.24 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.

7.25 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)
```

7.26 Data Element: DE_DDay

Use: The DSRC style day is a simple value consisting of integer values from zero to 31. The value of zero shall represent an unknown value.

ASN.1 Representation:
```
DDay ::= INTEGER (0..31)  -- units of days
```

Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_DDate	<ASN>, 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.

7.27 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.

7.28 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.

7.29 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 9 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.30 Data Element: DE_DHour

Use: The DSRC 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.31 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_GeographicalPath <ASN>, and

DF DF_ShapePointSet <ASN>.

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

7.32 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.

7.33 Data Element: DE_DMinute

Use: The DSRC style minute is a simple value consisting of integer values from zero to 59 representing the minutes within an hour. The value of 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.34 Data Element: DE_DMonth

Use: The DSRC month consists of integer values from one to 12, representing the month within a year. The value of 0 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 5 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.35 Data Element: DE_DOffset

Use: The DSRC (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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_DDateTime	<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_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.

7.37 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

7.38 Data Element: DE_DrivingWheelAngle

Use: The angle of the front (steering) wheel, expressed in a signed (to the right being positive) value with units of 0.3333 degrees and a range of plus or minus 42.33 degrees. The value of zero shall be 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.

7.39 Data Element: DE_DSecond

Use: The DSRC 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 (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 DSRC system that is shared or understood by the user community. This point in time is typically the moment when the position determination was made for most messages (such as the BSM). Other measurements present in the same message (speed, heading etc.) should be aligned to that moment insofar as possible in the implementation.

The need for a leap second arises from the difference between solar time and UTC time. Here is a useful reference on this topic: <http://tycho.usno.navy.mil/leapsec.html>

7.40 Data Element: DE_DSRC_MessageID

Use: The DSRC 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

--
-- 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 in the event of revised message contents, is a process of the SAE DSRC Technical Committee alone. 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.

7.41 Data Element: DE_Duration

Use: The Duration data element provides a range of zero to 3600 seconds (one 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
```

7.42 Data Element: DE_DYear

Use: The DSRC 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 6 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.43 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.

7.44 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 meters is represented as +61439. Any elevation lower than -409.5 meters is represented as -4095. If the sending device does not know its elevation, it shall encode the Elevation data element with -4096.

ASN.1 Representation:
```
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 5 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.45 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 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.46 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_VehicleSafetyExtensions <ASN>, and

DF DF_VehicleStatus <ASN>.

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

7.47 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.

7.48 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.49 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.50 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 meters.

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.

7.51 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 meters per second. 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_SnapshotDistance	<ASN>, and
DF	DF_SnapshotTime	<ASN>.

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

Remarks: Note the conversion guidance provided in Section 11.5 when units of mph and m/s are mixed.

7.52 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.53 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.54 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 7 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 DSRC message set.

7.55 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.

7.56 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.

7.57 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.

7.58 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.

7.59 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 US 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_RequestorType	<ASN>, and
DF	DF_VehicleClassification	<ASN>.

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

7.60 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 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_ITIS_Phrase_ExitService	<ASN>, 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.

7.61 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.

7.62 Data Element: DE_J1939-71-Axle Weight

Use: A data element re-used from the SAE J1939 standard and to be encoded as: 0.5kg/bit, 0 offset, Range: 0 to +32,127.5kg. 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.

7.63 Data Element: DE_J1939-71-Cargo Weight

Use: A data element re-used from the SAE J1939 standard and encoded as: 2kg/bit, 0 offset, Range: 0 to +128,510kg. 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.

7.64 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 +1000kPa. 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.

7.65 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.

7.66 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 +1000kPa. 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.

7.67 Data Element: DE_J1939-71-Drive Axle Temperature

Use: A data element re-used from the SAE J1939 standard and encoded as: 1 deg C/bit, -40 deg C offset, Range: -40 to +210 deg 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.

7.68 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 +1000kPa. 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.

7.69 Data Element: DE_J1939-71-Steering Axle Temperature

Use: A data element re-used from the SAE J1939 standard and encoded as: 1 deg C/bit, -40 deg C offset, Range: -40 to +210 deg 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.

7.70 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 Pa/s 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.

7.71 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: 0-255. 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.

7.72 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.

7.73 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 +1000kPa. 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.

7.74 Data Element: DE_J1939-71-Tire Temp

Use: A data element re-used from the SAE J1939 standard and encoded as: 0.03125 deg C/bit, -273 deg C offset, Range: -273 to +1734.96875 deg 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.

7.75 Data Element: DE_J1939-71-Trailer Weight

Use: A data element re-used from the SAE J1939 standard and encoded as: 2kg/bit, 0 deg offset, Range: 0 to +128,510kg. See SPN 180, PGN reference 65258.

ASN.1 Representation:
```
TrailerWeight ::= INTEGER (0..64255)
```

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

DF	DF_J1939-Data Items	<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.

Remarks: The term "weight" is used in J1939, while the term "mass" is used in J2735.

7.76 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.

7.77 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.

7.78 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.

7.79 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.

7.80 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
     bicyleUseAllowed         (1),
                              -- The path allows bicycle traffic,
                              -- if not set, this mode is prohibited
     isXwalkFlyOverLane       (2),
                              -- path of lane is not at grade
     fixedCycleTime           (3),
                              -- ped walk phases use preset times
                              -- i.e. there is not a 'push to cross' button
     biDirectionalCycleTimes (4),
                              -- ped walk phases use different SignalGroupID
                              -- for each direction. The first SignalGroupID
                              -- in the first Connection represents 'inbound'
                              -- flow (the direction of travel towards the first
                              -- node point) while second SignalGroupID in the
                              -- next Connection entry represents the 'outbound'
                              -- flow. And use of RestrictionClassID 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.

7.81 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.

7.82 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
   bicyleUseAllowed        (1),
                           -- The path allows bicycle traffic,
                           -- if not set, this mode is prohibited
   isSidewalkFlyOverLane   (2),
                           -- path of lane is not at grade
   walkBikes               (3)
                           -- bike traffic must dismount and walk
   -- Bits 4~15 reserved and set to zero
   } (SIZE (16))
```

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

7.83 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.

7.84 Data Element: DE_LaneAttributes-TrackedVehicle

Use: The LaneAttributes-Special data element relates specific properties found in a tracked vehicle lane types (trolley and train lanes). 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.

7.85 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.

7.86 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. The ConnectionID concept is not used (is not present) when dynamic clearance data is not provided in the SPAT.

ASN.1 Representation:

```
LaneConnectionID ::= INTEGER (0..255)
```

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

DF	DF_Connection	<ASN>, and
DF	DF_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.

7.87 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.

7.88 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 8 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.89 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),
    pedestrianTraffic                   (9)
    } (SIZE (10))
    -- All zeros would indicate 'not shared' and 'not overlapping'
```

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

7.90 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 meters in width

ASN.1 Representation:
```
LaneWidth ::= INTEGER (0..32767) -- units of 1 cm
```

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

DF DF_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.

7.91 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 micro degree
    -- Providing a range of plus-minus 90 degrees
```

Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_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.

7.92 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.

7.93 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.

7.94 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 DSRC messages to other nearby vehicles about its path.

ASN.1 Representation:

```
LightbarInUse ::= ENUMERATED {
     unavailable         (0),  -- Not Equipped or unavailable
     notInUse            (1),  -- none active
     inUse               (2),
     yellowCautionLights (3),
     schooldBusLights    (4),
     arrowSignsActive    (5),
     slowMovingVehicle   (6),
     freqStops           (7)
     }
```

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

DF	DF_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.

7.95 Data Element: DE_Longitude

Use: The geographic longitude of an object, expressed in 1/10th integer microdegrees, as a 32-bit value, and with reference to the horizontal datum then in use. The value 1800000001 shall be used when unavailable.

ASN.1 Representation:
```
Longitude ::= INTEGER (-1799999999..1800000001)
    -- LSB = 1/10 micro degree
    -- Providing a range of plus-minus 180 degrees
```

Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.96 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 J2313 Section 8.35 "Location-Quality." This element is used by the IEEE Incident Management standards effort relating to the accuracy of location information.

7.97 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 J2313 Section 8.15 "Location-Tech."

7.98 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.

7.99 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.

7.100 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 (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.101 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.

7.102 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.

7.103 Data Element: DE_MovementPhaseState

Use: The DE_MovementPhaseState data element provides the overall current 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.

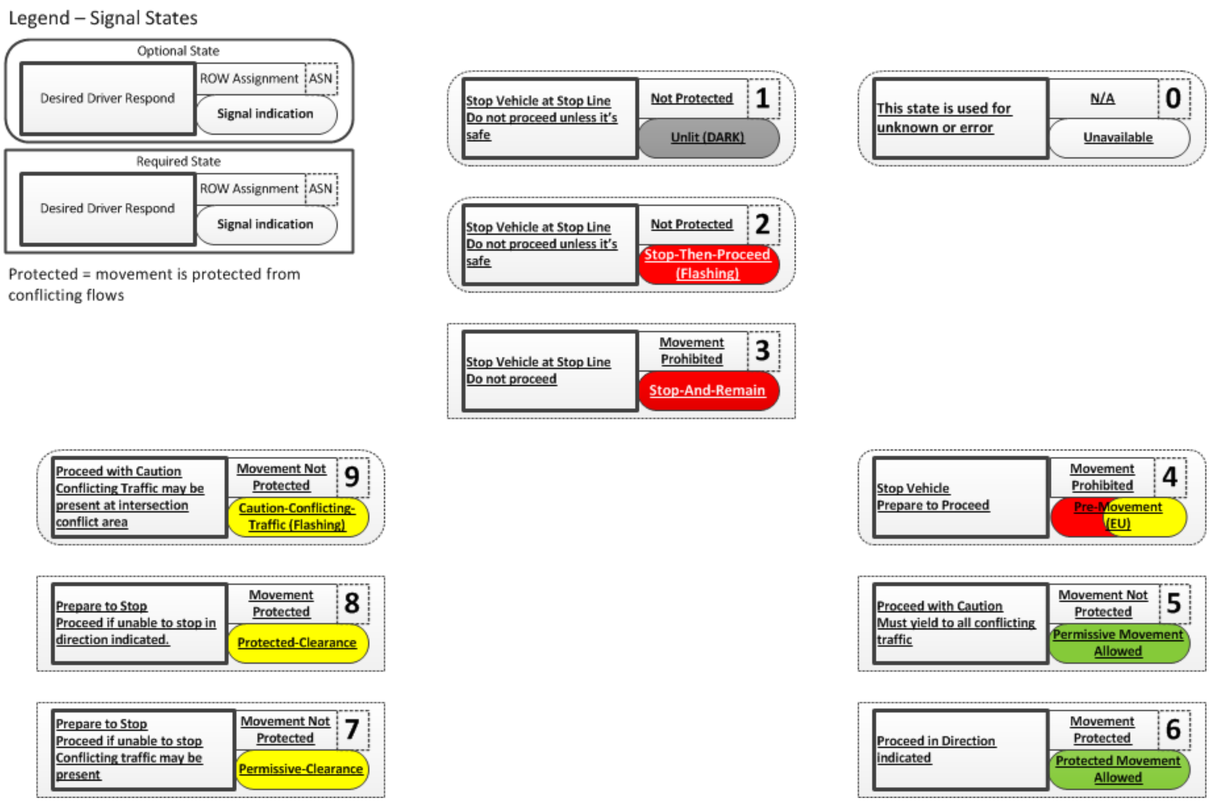

Figure 1 - State Diagram

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 US the MUTCD is used, as is indicated in the US regional variant of the above image. In various regions and modes of transportation, the visual expression of these states varies (the precise meaning of various color combinations, shapes, and/or flashing etc.). The below definition is designed to to be independent of these regional conventions.

In the US *permissive* is often referred to as a "round ball" while *protected* implies it has a directional arrow associated with it. The allowed single maneuver for a given *lane to lane* connection can be used to disambiguate this in the *ConnectsTo* data frame for that lane.

ASN.1 Representation:

```
MovementPhaseState ::= ENUMERATED {
    -- Note that based on the regions and the operating mode not every
    -- phase will be used in all transportation modes and that not
    -- every phase will be used in all transportation modes

    unavailable (0),
      -- This state is used for unknown or error
    dark (1),
      -- The signal head is dark (unlit)

   -- Reds
    stop-Then-Proceed (2),
      -- Often called 'flashing red' in US
      -- Driver Action:
      --   Stop vehicle at stop line.
      --   Do not proceed unless it is safe.
      -- Note that the right to proceed either right or left when
      -- it is safe may be contained in the lane description to
      -- handle what is called a 'right on red'
    stop-And-Remain (3),
      -- e.g. called 'red light' in US
      -- Driver Action:
      --   Stop vehicle at stop line.
      --   Do not proceed.
      -- Note that the right to proceed either right or left when
      -- it is safe may be contained in the lane description to
      -- handle what is called a 'right on red'

   -- Greens
    pre-Movement (4),
      -- Not used in the US, red+yellow partly in EU
      -- Driver Action:
      --   Stop vehicle.
      --   Prepare to proceed (pending green)
      --   (Prepare for transition to green/go)
    permissive-Movement-Allowed (5),
      -- Often called 'permissive green' in US
      -- Driver Action:
      --   Proceed with caution,
      --   must yield to all conflicting traffic
      -- Conflicting traffic may be present
      -- in the intersection conflict area
    protected-Movement-Allowed (6),
      -- Often called 'protected green' in US
      -- Driver Action:
      --   Proceed, tossing caution to the wind,
      --   in indicated (allowed) direction.

   -- 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).

7.104 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 0-127 when sending the first message with a given DSRCmsgID, or if the sender has changed identity (e.g. by changing its TemporaryID) since sending the most recent message with that DSRCmsgID. 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 (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.105 Data Element: DE_MsgCRC

Use: The DE_MsgCRC data element is a two 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 two 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 DSRC message (including its last two 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.

7.106 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 that one vehicle is responding and traveling in a closely aligned fashion (one after the other in a loose platoon formation). This DE is intended to be used with the DSRC "public safety vehicle operating in the area" use case.

ASN.1 Representation:
```
MultiVehicleResponse ::= ENUMERATED {
     unavailable   (0), -- Not Equipped or unavailable
     singleVehicle (1),
     multiVehicle  (2),
     reserved      (3)  -- for future use
     }
```

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.

7.107 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.

7.108 Data Element: DE_NMEA_MsgType

Use: The NMEA-MsgType 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-MsgType ::= 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.

7.109 Data Element: DE_NMEA_Payload

Use: The NMEA Payload data element contains the stream of octets in the actual NEMA 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.

7.110 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.

7.111 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.

7.112 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.

7.113 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.

7.114 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.

7.115 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
```

7.116 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_ObstacleDetection	<ASN>, and
DF	DF_VehicleStatus	<ASN>.

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

7.117 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.

7.118 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 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.119 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.120 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.121 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.

7.122 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.

7.123 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 +- 327.68 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.

7.124 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.

7.125 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.

7.126 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.127 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.128 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.

7.129 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.

7.130 Data Element: DE_PayloadData

Use: A stream of octets to be exchanged.

ASN.1 Representation:

```
PayloadData ::= OCTET STRING (SIZE(1..2048))
```

7.131 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.

7.132 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.

7.133 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.

7.134 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.

7.135 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.

7.136 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.

7.137 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.

7.138 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.

7.139 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.

7.140 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.141 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 111xxxxx 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 6 levels shall be used as determined by local conventions.

ASN.1 Representation:

```
Priority ::= OCTET STRING (SIZE(1))
    -- Follow definition notes on setting these bits
```

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

DF	DF_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.

7.142 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.

7.143 Data Element: DE_PrivilegedEventFlags

Use: The PrivilegedEventFlags data element conveys various states of the sender (typically a DSRC-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. This data element (more correctly the data frame in which it is used) required the presence of an SSP index element to confirm the sender's right to use it. The SSP index element matches to a bit sequence in the SSP of the CERT used in sending the message to confirm the privilege of sending this data.

ASN.1 Representation:

```
PrivilegedEventFlags ::= BIT STRING {
   -- These values require a suitable SSP to be sent
   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.

7.144 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 1km, whichever comes last. The interval between PSN changes is a random number of seconds between 0 and 10s or a random distance between 0 and 200m, whichever comes last. When sending messages containing a PSN, each message must contain a single PSN.

For example, when using the PSN in a Probe Data snapshot, all snapshots contained within a single message must contain the same PSN. All remaining Snapshots with a PSN that has already been sent to an RSU will be purged when the RSU communication link is broken. Event based Snapshots will not contain a PSN.

ASN.1 Representation:

```
ProbeSegmentNumber ::= INTEGER (0..32767)
    -- value determined by local device
    -- as per standard
```

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.

7.145 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.

7.146 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.

7.147 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),
   towOperater                 (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.

7.148 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.

7.149 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.

7.150 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 0-7, 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 8 resistance ranges corresponding to the above scale. For Example: a sensor that has a resistance range from 12K Ohms (Max Rain Fall) to 250 Ohms (No Rain Fall) will have the following resistance value ranges:

0=250 to 1749 Ohms

1=1750 to 3249 Ohms

2=3250 to 4749 Ohms

3=4750 to 6249 Ohms

4=6250 to 7749 Ohms

5=7750 to 9249 Ohms

6=9250 to 10749 Ohms

7=10501 to 12000 Ohms

7.151 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 DSRC ASN specification of the standard. This process is further described in Section 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.

7.152 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.

7.153 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 TempID 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 TempID during various dialogs when this data element is used. Further details of these operational concepts can be found in the relevant standards.

7.154 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 DSRC 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.

7.155 Data Element: DE_RequestSubRole

Use: The RequestSubRole data element is used to further define the details of the role which any DSRC 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.

7.156 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 th 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 DSRC 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 a mowers, litter trucks, etc.
   stopAndGoMovement          (6),  -- such as school bus or garbage truck
   ...
   }
```

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

DF DF_EmergencyDetails <ASN>, and

MSG MSG_EmergencyVehicleAlert (EVA) <ASN>.

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

7.157 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.

7.158 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_AdvisorySpeed	<ASN>, and
DF	DF_Connection	<ASN>, and
DF	DF_RestrictionClassAssignment	<ASN>.

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

7.159 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_IntersectionReferenceID	<ASN>, and
DF	DF_RoadSegmentReferenceID	<ASN>.

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

7.160 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.

7.161 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.

7.162 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 DSRC 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.

7.163 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 over DSRC.

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.

7.164 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.

7.165 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_SnapshotTime	<ASN>, and
MSG	MSG_ProbeDataManagement (PDM)	<ASN>.

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

7.166 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 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_SegmentAttributeLLList <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.

7.167 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.

7.168 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 5cm 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.

7.169 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.

7.170 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 5cm 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.

7.171 Data Element: DE_SignalGroupID

Use: The SignalGroupID is an index used to map between the internal state machine of one or more signal controllers (or other types of traffic flow devices) and a common numbering system that can represent all possible combinations of active states (*movements* and *phases* in US traffic terminology). All possible movement variations are assigned a unique value within the intersection. Conceptually, the ID represents a means to provide a list of lanes in a set which would otherwise need to be 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 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_Connection	<ASN>, and
DF	DF_MovementState	<ASN>, and
DF	DF_PrioritizationResponse_EU	<ASN>, and
DF	DF_SignalHeadLocation_EU	<ASN>.

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

7.172 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 prempt,
    -- while the value of 0 is reserved.

   -- lower nibble:  Strategy #:
    -- Range is 0..15 and is used to specify a desired
    -- strategy (if available).
    -- Currently no strategies are defined and this
    -- should be zero.
```

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.

7.173 Data Element: DE_SignPrority

Use: The relative importance of the sign, on a scale from zero (least important) to seven (most important).

ASN.1 Representation:
```
SignPrority ::= 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.

7.174 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 DSRC messages to others about its path. Intended to be used as part of the DSRC 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.

7.175 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 meters per second.

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 Section 11.5 for situations in which units of mph and m/e are mixed.

7.176 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_AdvisorySpeed	<ASN>, and
DF	DF_Speed_Heading_Throttle_Confidence	<ASN>, and
DF	DF_VehicleStatus	<ASN>.

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

7.177 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.

7.178 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 Section 11.5 for situations in which units of mph and m/s are mixed.

7.179 Data Element: DE_Speed

Use: This data element represents the vehicle speed expressed in unsigned units of 0.02 meters per second. 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.180 Data Element: DE_SSPindex

Use: The SSP index is used to control the data elements that follow the occurrence of the index. The index relates back to the SSP contents in the CERT used to declare what content is allowed by that CERT. In the absence of a matching index in the message sender's CERT, the message contents are not valid.

ASN.1 Representation:

```
SSPindex ::= INTEGER (0..31)
```

Used By: This entry is directly used by the following 4 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_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.

7.181 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.

7.182 Data Element: DE_StationID

Use: The DE_StationID has been included into SAEJ2735 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.183 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.184 Data Element: DE_SteeringWheelAngleRateOfChange

Use: The rate of change of the angle of the steering wheel, expressed in signed units of 3 degrees/second over a range of 381 degrees/second 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.

7.185 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.186 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 0-2000, with 0 indicating "Complete Darkness", and 2000 indicating "Maximum Sun Light". 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.

7.187 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 6 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 DSRC 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.

7.188 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.

7.189 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.

7.190 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.191 Data Element: DE_ThrottlePosition

Use: The position of the throttle in the vehicle, expressed in units of 0.5 percent of range of travel, unsigned.

ASN.1 Representation:
```
ThrottlePosition ::= INTEGER (0..200) -- LSB units are 0.5 percent
```

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.

7.192 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 than  one millisecond
    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  one micro second
    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  one nano second
    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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_ConfidenceSet <ASN>, and

DF DF_FullPositionVector <ASN>.

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

7.193 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)
    -- Value   Probability
    --   0          21%
    --   1          36%
    --   2          47%
    --   3          56%
    --   4          62%
    --   5          68%
    --   6          73%
    --   7          77%
    --   8          81%
    --   9          85%
```

```
--   10         88%
--   11         91%
--   12         94%
--   13         96%
--   14         98%
--   15         100%
```

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

DF DF_TimeChangeDetails <ASN>, and

DF DF_REG_MovementEvent_JPN <ASN>.

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

7.194 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 there is a need to send a value greater than the range allowed by the data element (over one hour in the future), the value 36000 shall be sent and shall be interpreted to indicate an indefinite future time value. When the value to be used is undefined or unknown a value of 36001 shall be sent. Note that leap seconds are also supported.

ASN.1 Representation:

```
TimeMark ::= INTEGER (0..36001)
    -- Tenths of a second in the current or next hour
    -- In units of 1/10th second from UTC time
    -- A range of 0~36000 covers one hour
    -- The values 35991..35999 are used when a leap second occurs
    -- The value 36000 is used to indicate time >3600 seconds
    -- 36001 is to be used when value undefined or unknown
    -- Note that this is NOT expressed in GPS time
    -- or in local time
```

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

7.195 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_PathHistoryPoint <ASN>, and

DF DF_TrailerHistoryPoint <ASN>.

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

7.196 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.

Remarks:

7.197 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 uaed 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.

7.198 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 bicyle is in progress
    doorOpen     (3), -- a vehicle door is open for passenger access
    occM         (4),
    occL         (5)
    -- bits four and five are used to relate the
    -- the relative occupancy of the vehicle, with
```

```
    -- 00  as least full and 11 indicating a
    -- close-to or full conditon
    } (SIZE(6))
```

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.

7.199 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.

7.200 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 in not in a state where movement can occur (and that therefore any priority signal should be ignored until the vehicle is again ready to depart).

7.201 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_BSMcoreData	<ASN>, and
DF	DF_TransmissionAndSpeed	<ASN>.

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

7.202 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.

7.203 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.

7.204 Data Element: DE_URL_Base

Use: A valid internet style URI / URL in the form of a text string which will form the base of a compound string which, when combined with the URL-Short data element, will link to the designated resource. The string is to be interpreted as case-insensitive. Lower case is recommended. The protocol to be used (such as http) should be given in the string. The very last 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.

7.205 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.

7.206 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.

7.207 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.

7.208 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 1 if the stated criteria are met, but it is not required to do so. The set of event flags and their respective minimum criteria are listed below. These definitions and criteria are normative. The Event Flag data element should not be included in a message unless at least one vehicle event flag is set to 1. When one or more criteria associated with an event are no longer satisfied, the sender shall set the flag to zero in any 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 1 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 mSec in length and active
- Traction Control: System activated exceeding 100 mSec in length and active
- Stability Control: System activated exceeding 100 mSec in length and active
- Hazardous Materials: The vehicle is known to be carrying hazardous material and is placarded as such.
- Hard Braking: The vehicle is decelerating at a level of greater than 0.4g
- Lights Changed: The status of the external lighting of the vehicle has changed within the last two 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 two 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.

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)
   } (SIZE (13, ...))
```

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

DF	DF_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.

7.209 Data Element: DE_VehicleHeight

Use: The height of the vehicle, measured from the ground to the highest surface, excluding any antenna(s), and expressed in units of 5 cm. In cases of vehicles with adjustable ride heights, camper shells, and other devices which may cause the overall height to vary, the largest possible height will be used.

ASN.1 Representation:
```
VehicleHeight ::= INTEGER (0..127)
    -- the height of the vehicle
    -- LSB units of 5 cm, range to 6.35 meters
```

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

DF	DF_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.

7.210 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_TrailerUnitDescription	<ASN>, and
DF	DF_VehicleSize	<ASN>.

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

7.211 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 kg, to 500kg, to 2000kg 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.212 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.

7.213 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 US 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 DSRC 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 5 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.214

7.215 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_TrailerUnitDescription <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.

7.216 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 meters per second. 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 Section 11.5 for situations in which units of mph and m/s are mixed.

7.217 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.

7.218 Data Element: DE_VerticalAcceleration

Use: A data element representing the signed vertical acceleration of the vehicle along the vertical axis in units of 0.02 G (where 9.80665 meters per second squared is one G, i.e., 0.02 G = 0.1962 meters per second squared).

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..

7.219 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 centimeters (not one centimeter).

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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

7.220 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 centimeters (not one centimeter).

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.

7.221 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 centimeters (not one centimeter).

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.

7.222 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 centimeters (not one centimeter).

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.

7.223 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 centimeters (not one centimeter).

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.

7.224 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 centimeters (not one centimeter).

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:

```
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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_PathHistoryPoint	<ASN>, and
DF	DF_VerticalOffset	<ASN>.

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

7.225 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.

7.226 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.

7.227 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 1 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.

7.228 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.

7.229 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_AccelSteerYawRateConfidence <ASN>, and

DF DF_VehicleStatus <ASN>.

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

7.230 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 used 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.

7.231 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF DF_AdvisorySpeed <ASN>, and

DF DF_ConnectionManeuverAssist <ASN>.

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

7.232 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 concept taken from other efforts (other SDOs and/or other standards) and reused in DSRC here.

All text in this clause is considered normative unless expressly marked otherwise. The definitions for each data concept in this dictionary set are 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 a given operational conditions). The ASN.1 is presented in a section titled *ASN.1 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 productions of ASN.1 which follow shall be considered normative in nature. While the majority of the normative content is reflected in the actual syntax of the ASN.1, some entries also have additional statements in the ASN.1 comments which shall be considered normative as well. In addition, the textual commentary provided with each entry (in sections marked "use" and "remarks") may also provide additional normative restrictions on the proper use of the entry being described. Users of this Standard seeking to be in conformance with it shall follow the normative text outlined here.

In this SAE data dictionary all concepts are formally named by combining the basic type (data element (DE), data frame (DF), or message (MSG) and the ASN type definition name. This is the name which appears in the title of the section where the concept is defined. When citing entries for use by other standards, the data concepts which follow 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. As an example, the ASN type definition which is called DSRCmsgID (which is a data element) should be referred to by its formal name which is: DE_DSRC_MessageID.

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 meter
   alt-005-00,  -- accuracy within    5.00 meter
   alt-010-00,  -- accuracy within   10.00 meter
   alt-020-00,  -- accuracy within   20.00 meter
   alt-050-00,  -- accuracy within   50.00 meter
   alt-100-00,  -- accuracy within  100.00 meter
   alt-200-00,  -- accuracy within  200.00 meter
   outOfRange,  -- accuracy exceeds 200.00 meters
   unavailable  -- unavailable
}
```

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

8.2 Data Element: DE_AltitudeValue_EU [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 6 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 5 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 refered 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 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 DSRC 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 [ADDGRPB]

Use: The geographic latitude of an object, expressed in 1/100th of an integer second, where 60 seconds comprise one minute, and 60 minutes comprise a degree of latitude (often referred to as a DDMMSS.sss format). This format is used only in Japanese deployments. The finer precision offered by units in 1/10th integer microdegrees is used elsewhere (about ~28X more precise). In both cases, the data is with reference to the horizontal datum then in use. The value 32,400,001 shall be used when unavailable.

ASN.1 Representation:
```
LatitudeDMS ::= INTEGER (-32400000.. 32400000)
   -- Signed units of 0.01 seconds of a minute of a degree of Latitude
   -- Providing a range of plus-minus 90 degrees
   -- in a 4 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 one minute, and 60 minutes comprise a degree of longitude (often referred to as a DDMMSS.sss format). This format is used only in Japanese deployments. The finer precision offered by units in 1/10th integer microdegrees is used elsewhere (about ~28X more precise). In both cases the data is with reference to the horizontal datum then in use. The value 64,800,001 shall be used when unavailable.

ASN.1 Representation:
```
LongitudeDMS ::= INTEGER (-64800000.. 64800000)
   -- Signed units of 0.01 seconds of a minute of a degree of Longitude
   -- Providing a range of plus-minus 180 degrees
   -- in a 4 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_LatitudeDMS2	<ASN>, and
DF	DF_LongitudeDMS2	<ASN>.

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

8.21 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 refered 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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 [ADDGRPB]

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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_LatitudeDMS2	<ASN>, and
DF	DF_LongitudeDMS2	<ASN>.

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

8.26 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 [ADDGRPB]

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 3 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 2 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 J2540 Standard. This is a set of nearly 1,500 items which are used to encode common events and list items in ITS.

ASN.1 Representation:

```
ITIScodesAndText ::= SEQUENCE (SIZE(1..100)) OF SEQUENCE {
  item CHOICE    {
       itis ITIScodes,
       text ITIStext
       } -- # UNTAGGED
  }
```

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 one minute and 60 minutes comprise a degree of latitude (often referred to as a DDMMSS.sss format). This format is used only in Japanese deployments. The finer precision offered by units in 1/10th integer microdegrees is used elsewhere (about ~28X more precise). In both cases the data is expressed with reference to the horizontal datum then in use. The value 32,400,001 shall be used when unavailable.

ASN.1 Representation:
```
LatitudeDMS2 ::= SEQUENCE {
   d  DegreesLat,     -- units of degrees
   m  MinutesAngle,   -- units of minutes
   s  SecondsAngle    -- units of 1/100th seconds
   } -- total size of 4 octets (32 bits) when implicit encoding is used
```

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

DF DF_Node_LLdms_80b <ASN>, and

DF DF_REG_Position3D_JPN <ASN>.

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

8.34 Data Frame: DF_LongitudeDMS2 [ADDGRPB]

Use: The geographic longitude of an object, expressed in 1/100th of an integer second, where 60 seconds comprise one minute and 60 minutes comprise a degree of latitude (often referred to as a DDMMSS.sss format). This format is used only in Japanese deployments. The finer precision offered by units in 1/10th integer microdegrees is used elsewhere (about ~28X more precise). In both cases the data is expressed with reference to the horizontal datum then in use. The value 64,800,001 shall be used when unavailable.

ASN.1 Representation:
```
LongitudeDMS2 ::= SEQUENCE {
   d  DegreesLong,    -- units of degrees
   m  MinutesAngle,   -- units of minutes
   s  SecondsAngle    -- units of 1/100th seconds
   } -- total size of 5 octets (40 bits) when implicit encoding is used
```

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

DF DF_Node_LLdms_80b <ASN>, and

DF DF_REG_Position3D_JPN <ASN>.

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

8.35 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 DSRC 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, summer time 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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/hr. 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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 J2540 Standard. This is a set of over 1,000 items which are used to encode common events and list items in ITS.

ASN.1 Representation:
```
ITIScodes ::= INTEGER (0.. 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 7 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

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.

All text in this clause is considered normative unless expressly marked otherwise. The definitions for each data concept in this dictionary set are 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.1 is presented in a section titled *ASN.1 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 B*y 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 productions of ASN.1 which follow shall be considered normative in nature. While the majority of the normative content is reflected in the actual syntax of the ASN.1, some entries also have additional statements in the ASN.1 comments which shall be considered normative as well. In addition, the textual commentary provided with each entry (in sections marked "use" and "remarks") may also provide additional normative restrictions on the proper use of the entry being described. Users of this Standard seeking to be in conformance with it shall follow the normative text outlined here.

In this SAE data dictionary, all concepts are formally named by combining the basic type (data element (DE), data frame (DF), or message (MSG) and the ASN type definition name. This is the name which appears in the title of the section where the concept is defined. When citing entries for use by other standards the data concepts which follow 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. As an example, the ASN type definition which is called DSRCmsgID (which is a data element) should be referred to by its formal name, which is: DE_DSRC_MessageID.

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 section 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 DSRC 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 DSRC 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. Implementationsin conformance with this Standard shall be able to receive or to send at least one of the messages defined in this Standard.

In addition, an implementation is considered 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 this Standard.

11. FUNDAMENTAL CONCEPTS USED IN DSRC 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 DSRC 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 this Standard.
- SHOULD conveys a recommended best practice for deployments using this 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 Section 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 this 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.

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 ecoding 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 DSRC 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 local[1] 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 DSRC 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.

[1] For this discussion *local* and *regional* have the same practical meaning.

Several related goals for the overall design of 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.
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 DSRC module for the DSRC 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 DSRC 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 this 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 DSRC message to be able to accept (not to understand, or process, but simply to not “break”) any DSRC message regardless of its 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         DSRCmsgID2,
   msgSubID      DSRCmsgSubID 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 DSRC 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 ::=  REGION.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 DSRC 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

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 US 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 this 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 DSRC 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 {{REGION.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 REGION.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 {{REGION.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 DSRC 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 {{REGION.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 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-line[2] for this example.

```
SupplementalVehicleExtensions-myRegion ::= SEQUENCE {
     relativeHumidity   INTEGER(0..100), -- In LSB units of 1%
--   airTemp            DSRC.AmbientAirTemperature  OPTIONAL,
   ...
   }
```

[2] As a style rule, 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 DSRC 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 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 this 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 DSRC Standard is aligned to UTC time. The representation of absolute time in the DSRC 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 DSRC is universally kept and expressed with a precision of one millisecond. This value (and its modulo derivatives) is commonly used in many DSRC applications and forms the basis of many "short" forms of time. Time within the current UTC minute is therefore expressed by the DE_DSecond in a 2 byte octet value (with a commonly used range 0 to 59,999 milliseconds for most of the time) in many messages.

- The occasional leap second in UTC time is represented in the DE_DSecond by the range 60,000 to 60,999 but that concept of 60 seconds of duration is represented by the value 60,000. 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 DSRC messages.

- Leap-seconds and other periodic aberrations are handled in the normal ISO 8601 way.

- In many DSRC 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 DSRC 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 DSRC 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 DSRC messages.

- There is a general presumption in DSRC that all parties know UTC time to within the same accuracy as the precision of one millisecond. 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 DSRC are sent as integer values (i.e., Jan is sent as Hex 0x01) and not as ASCII strings as is found in some representations (for example, ISO 8601 expressed as XML where Jan is represented as the ASCII pattern for “01” or Hex 0x3031).

- In addition, some unknown values have been mapped to the last value in the range. This is at odds with some other standards that use zero 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 DSRC Standard.

It is the responsibility of each DSRC 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 this 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 one 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 this Standard. The Standard does not ever express the concept “the light will change in 3 ½ 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 and ½ 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 seconds over a range of one 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 DSRC 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 DSRC 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 below). Positive directions for each axis are as shown in the image below.

Note: The GNSS subsystem (shown as GPS in the below Figure) 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.

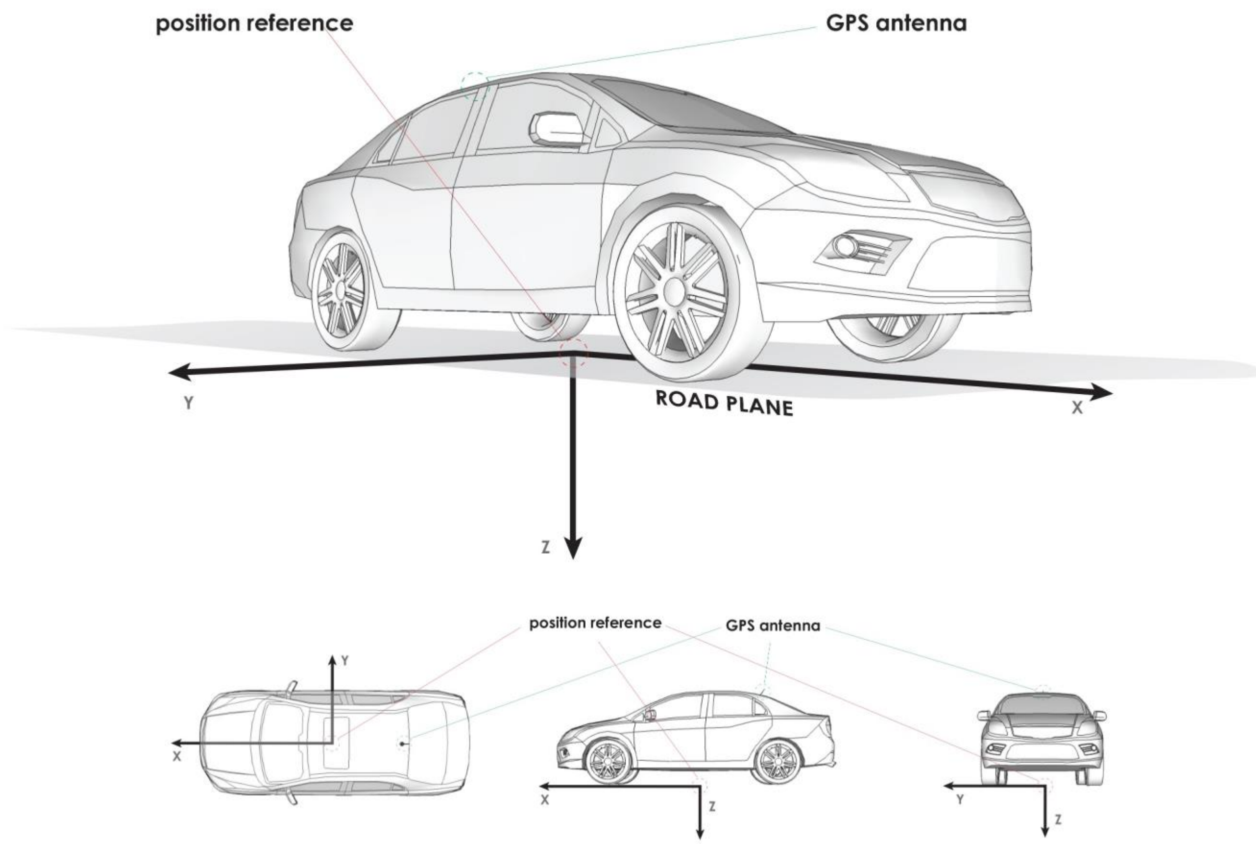

Figure 2 - DSRC equipped platform position reference

11.5 Position, Velocity, and Acceleration of Vehicles

Many of the data elements in this 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 DSRC 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 millisecond 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 DSRC-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 meters per second, 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 this 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 DSRC 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 Section 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 DSRC-equipped vehicles.

When converting or comparing the position between one or more vehicles and a map or other geometric object which is described by this Standard, it is often required to determine the precise scaling rate between local 1/10th micro degrees of Latitude or Longitude and one centimeter.[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 algorithm[4] has been used in many DSRC deployments for this purpose.

Speed and velocity in this 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 DSRC 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 kph 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 the table below, 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.

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[3] Latitude and longitude in this standard are expressed in 32 bit values where the LSB is 1/10th micro degree, 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

Table 1 - Conversion of mph to m/s for selected data elements

Precise mph	Precise m/s	DE_ Velocity	DE_ SpeedAdvice	DE_ GrossSpeed
	LSB units:	*0.02 m/s*	*0.1 m/s*	*1.0 m/s*
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 this 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 this 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 this Standard, values of latitude and longitude are always expressed in LSB units of 0.0000001 degrees. In DSRC and ITS, this value system is commonly referred to as DSRC 1/10th micro degree 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 episode is referred to as “elevation” (not height[5]) in this 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).

[5] The term *height* in this standard is used to refer to the distance from the local ground, as in *vehicle height*.

- 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 environment[6]) 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.

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 is also provided. These are intended to assist the DSRC 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 <u>relative</u> 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 this 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.

[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.

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 section 11.8 explains how positions and offset are used in the Standard to describe lanes and other objects. Refer to 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 DSRC applications. The practical use of this system is best explained with an example.

Consider a work zone extending in an 80 meter square around a given LLH location. This work zone is a rectangle with 80 meter sides. If the anchor is placed at the center of the work zone, then the first node point needs to contain offsets of ±40 meters in the X and Y directions, while the second through fourth node points need only to offset the last node point by 80 meters. 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:

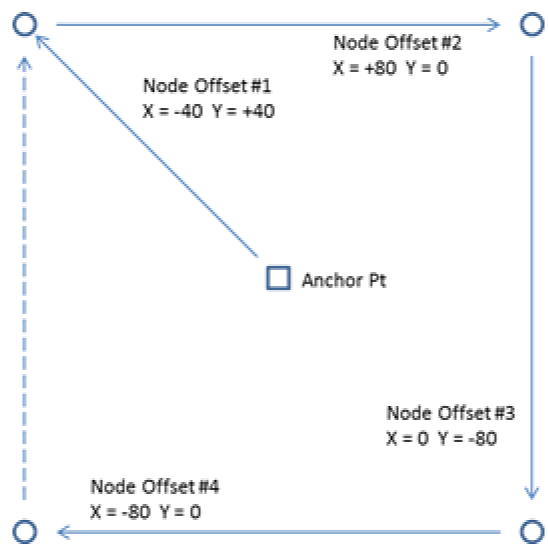

Figure 3 - An example of XYZ offsets describing a rectangular polygon

The offsets themselves are expressed in one centimeter steps, so 80 meters becomes a value of 8000 centimeters. Looking at the range of values supported by the DF_NodeOffsetPointXY, it is clear that the entry DF_Node-XY-28b is the smallest[7] 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 ~±1cm, 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 meters might be determined to be the largest allowable error (i.e., the inaccuracy of the described polygon could be ±2 meters). The zoom scale design works in multiples of two, so it is not possible to directly scale to down to 2 meters. The values 1.28 and 2.56 meters are the closest supported. Selecting a precision value of 1.28 meters represents a scale of 7 (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.

[7] The very first node, with a value to send of 40.00 meters, would fit in the next smaller size, the Node-XY-26b element, requiring two fewer bits.

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 be 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 idealized[8] 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.

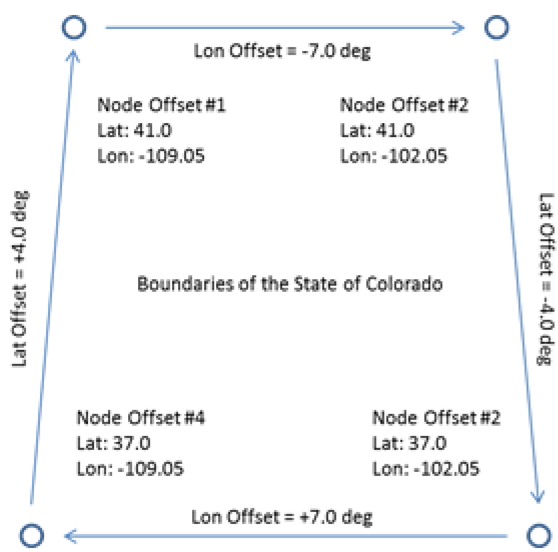

Figure 4 - An example of LLH offsets describing a quadrangle polygon

In the LLH systems, this is simply a rectangle with sides spanning 7 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 ~±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 degrees (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.

[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.

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 ±1cm (because 1/10th micro degrees 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 meters is sufficient to meet the design needs (40.96 meters, 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 degrees. 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 20½ bytes for this part of the message. There is a ~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 micro degree. 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 (degrees)**
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 this 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 this 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 8AM to 5PM 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 Section 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 Sections 11.6 and 11.7.

The term "lane object" is used in this 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 this Standard use a common format for all lane object types to improve code reuse. Each lane is defined to be one of these basic types, and each type has certain normative assumptions made about it which reflect real world operational needs that this Standard supports. This section describes the eight basic types of lane objects found in the Standard. It serves to document the basic assumptions and properties which each type of lane has in the MAP message. This in turn describes how different modes of travel use and interact with the lanes and with other travelers in a coordinated way to safely traverse the intersection based on the active movements in the SPAT. This information is necessary to understanding the intended data model, which the lanes then describe and which can be conveyed in the resulting message. A data model, in this context, refers to the internal representation of the MAP information content in a form suitable for use by an application, 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 DSRC

This section provides an informative summary of the different vehicle taxonomies that are used to describe vehicles and how these are used in the DSRC 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 DSRC

Vehicle Taxonomy	Description	Messages
BasicVehicleType	Basic classification of a DSRC 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 US 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 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 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 meters from the stop line, while the needs of a vehicle safety application may be served by a smaller span of perhaps 300 meters.

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 US.

IntersectionReferenceID At the highest level, all intersections have a globally unique ID which will require a registration process to manage. This process is outside the scope of this Standard. It is expected that the assignment of this value is permanent in nature. Every region is assigned a range of 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 two-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 US 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 USA.   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 4 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 US traffic terminology). All possible movement variations are assigned a unique value within the intersection. The values zero and 255 are reserved (with special meanings), so there may be up to 254 different signal group IDs within one single intersection. In practice, an intersection with one common eight phase signal control would have eight signal group IDs, likely numbered from hex 0x01 to 0x09. Note that the state of the movements for this is given in the 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 US) 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 / operators 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 2016 REVISION OF SAE J2735 [INFORMATIVE]

The 2016 revision of this Standard revises the ASN specification to use UPER encoding, establishes a uniform set of framework and regional extension concepts, revises the SRM and SSM message to align with the MAP and SPAT messages adopted in 2015, provides further explanatory and normative text, and inserts various improvements to the ASN specification driven by deployment experience. A variety of application-level content and performance requirements which appeared in the annexes of the 2015 edition of the Standard has been removed and placed into other SAE documents. Certain information pertaining to the use of the BSM messages in the scope of V2V safety applications has been moved to J2945/1, which also provides various minimum performance requirements needed for that application area.

13. NOTES

13.1 Revision Indicator

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY THE SAE DSRC (DEDICATED SHORT RANGE COMMUNICATION) TECHNICAL COMMITTEE

Annex A, ASN Source Code

Complete ASN.1 source code is provided in a downloadable format from the SAE web site at:

http://www.sae.org/Standardsdev/dsrc/

http://www.sae.org/Standardsdev/dsrc/usa/

Annex B, Various Regional ID Assigments

Region ASN Extensions

The message set and message framework developed in this 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 this 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 Section 11.2 for further information on the use of regional extension points.

Road Regulator Regional Index Assignments

In this Standard, an indexing system called the DE_RoadRegulatorIDis 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 the Section 11.10 for further information on indexing and the use of regional IDs.

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