SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

J2735

ISSUED DEC2006

Issued 2006-12

Dedicated Short Range Communications (DSRC) Message Set Dictionary

RATIONALE

Not applicable.

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1. SCOPE

This SAE Recommended Practice is intended as a guide toward standard practice and is subject to change to keep pace with experience and technical advances. This SAE Recommended Practice specifies standard message sets, data frames and data elements 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. The scope is limited to specifying initial representative message structure and providing sufficient background information to allow readers to properly interpret the DSRC standards and message definitions from the point of view of an application developer.

1.1 Purpose

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

2. REFERENCES

2.1 Applicable Publications

The following documents shall be used, when applicable, in the process of populating and developing the message sets of this standard. The specific revision and issued date stated below shall be used for each document. When the following documents are superseded by an approved revision, the revised version shall be reviewed for applicability.

The references cited below shall be included in the references of the other companion volumes of this standard unless specifically excluded.

2.1.1 SAE Publications

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.SAE J670Vehicle Dynamics Terminology, Issued 1976-07 and its successors

SAE J2540 Messages for Handling Strings and Look-Up Tables in ATIS Standards, July 2002 and its successors

SAE J2540-2 ITIS Phrase Lists (International Traveler Information Systems), Revision 3, November 2006 and its successors

SAE J2630 Converting ATIS Message Standards from ASN.1 to XML (XML Translation Rules), December 2003

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

2.1.2 ASTM Publications

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

ASTM E 2158-01 Standard Specification for Dedicated Short Range Communication (DSRC) Physical Layer Using Microwave in the 902 to 928 MHz Band

ASTM E 2213-03 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

2.1.3 IEEE Publications

Available from IEEE, 445 Hoes Lane, Piscataway, NJ 08854-1331, Tel: 732-981-0060, www.ieee.org.

IEEE Std 1488-2000	IEEE Trial-Use Standard for Message Set Template for Intelligent Transportation Systems
IEEE Std 1489-1999	IEEE Standard for Data Dictionaries for Intelligent Transportation Systems
IEEE Std P1609.1	(VT/ITS) Standard for Wireless Access in Vehicular Environments (WAVE)—Resource Manager
IEEE Std P1609.2	(VT/ITS) Standard for Wireless Access in Vehicular Environments—Security Services for Applications and Management Messages
IEEE Std P1609.3	(VT/ITS) Standard for Wireless Access in Vehicular Environments (WAVE)—Networking Services
IEEE Std P1609.4	(VT/ITS) Standard for Wireless Access in Vehicular Environments (WAVE)—Multi-Channel Operations
IEEE Std P802.11p (C/LM)	Amendment to Standard [for] Information Technology—Telecommunications and Information Exchange Between Systems—Local and Metropolitan Networks—Specific Requirements—Part II: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Wireless Access in Vehicular Environments

2.1.4 ISO Publications

Available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse, www.iso.ch/. ISO publications are also available in the United States from the Sales Department, American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO/IEC 8824-1:1998	Information technology—Abstract syntax notation one (ASN.1): Specification of basic notation
ISO/IEC 8824-2:1998	Information technology—Abstract syntax notation one (ASN.1): Information object specification
ISO/IEC 8824-3:1998	Information technology—Abstract syntax notation one (ASN.1): Constraint specification
ISO/IEC 8824-4:1998	Information technology—Abstract syntax notation one (ASN.1): Parameterization of ASN.1 specifications

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 Airlink

A radio frequency communication interface, such as that defined by WAVE.

3.1.2 Application Class Identifier (ACID)

A code that identifies a class of application, as defined by the IEEE.

3.1.3 Application Context Mark (ACM)

A code identifying a specific instance of an application (as defined in IEEE documents).

3.1.4 Application-Specific Data Dictionary

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

3.1.5 Byte Type Encoding

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

3.1.6 Control Channel (CCH)

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

3.1.7 Data

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

3.1.8 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.

3.1.9 Data Consumer

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

3.1.10 Data Dictionary

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

3.1.11 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.

3.1.12 Data Frame

(formerly: Data Structure, which appears in the early ITS efforts, is now more commonly called a Data Frame. The definition and meaning, which follows, remains the same.): Any construct used to represent the contents of a Data Dictionary. From a computer science perspective, data frames are viewed as logical groupings of other data frames and of data elements to describe "structures" or parts of messages used in this and other standards. A data frame is a collection of one or more other data concepts in a known ordering. These data concepts may be simple (data elements) or complex (data frames).

3.1.13 Data Plane

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

3.1.14 Data Registry

An advanced data dictionary that contains not only data about data elements in terms of their names, representational forms and usage in applications, but also substantial data about the semantics or meaning associated with the data elements as concepts that describe or provide information about real or abstract entities. A data registry may contain abstract data concepts that do not get directly represented as data elements in any application system, but which help in information interchange and reuse both from the perspective of human users and for machine-interpretation of data elements. Within the ITS industry, there is a data registry established and run by the IEEE which contains the contents of this standard. SAE and the ATIS committee have also developed tools to access and use the data found in the registry as an aid to deployments.

3.1.15 Data Structure

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

3.1.16 Data Type

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

3.1.17 Dialog

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

3.1.18 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.

3.1.19 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).

3.1.20 Entity Type

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

3.1.21 EtherType

The Ethernet Type field, as defined in RFC 1042, used to indicate the higher layer protocol above Logical Link Control.

3.1.22 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.

3.1.23 Initialization

One of three modes, or states, of operation known as Registration, Initialization, and Operations which DSRC systems operate in. The Initialization mode is used to establish a direct connection (link) between two DSRC devices. It is comparable to, but not equivalent to, an IEEE 802.11 association.

3.1.24 Intelligent Transportation Systems (ITS)

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

3.1.25 Interoperability

The ability to share information between heterogeneous applications and systems.

3.1.26 ITIS

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

3.1.27 Link

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

3.1.28 Management Plane

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

3.1.29 Message

A well structured set of data elements and data frame that can be sent as a unit between devices to convey some semantic meaning in the context of the applications about which this standard deals.

3.1.30 Message Set

A collection of messages based on the ITS functional-area they pertain to. This DSRC standard is also a message set.

3.1.31 Message Set Extender

The concept of a message set extender refers to the process of adding additional data elements to a common (non-changing) core message in order to extend the basic core message structure to create messages for specific applications needs.

3.1.32 Metadata

Data that defines and describes other data.

3.1.33 Networking Services

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

3.1.34 Notification

An indication of an event of interest, sent to an application.

3.1.35 OBU to Vehicle Host Interface (OVHI)

Interface on the OBU offering access to WAVE capabilities by other vehicle-based devices.

3.1.36 On-Board Unit

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

3.1.37 Operations

One of three modes, or states, of operation known as Registration, Initialization, and Operations which DSRC systems operate in. In the Operations mode a link has been established, the link will have an open socket with which it can conduct operations in the same manner as with any other 802.11 communications session. The lower layers will be managing the switching between the Control Channel and the Service Channel. When the radio has switched to another channel, it would appear to the application as a temporary loss of communications.

3.1.38 Provider Service Table

The collection of data describing the applications that are registered with a WAVE device.

3.1.39 Registration

One of three modes, or states, of operation known as Registration, Initialization, and Operations which DSRC systems operate in. The Registration mode is the process by which critical parameters pertaining to the device and applications using it are entered into the device's Management Information Base (MIB). Registration must be completed before a DSRC device can be ready for operations. The registration process is defined in IEEE P1609.3 and is controlled by the WAVE Management Entity (WME).

3.1.40 Road Side Unit

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

3.1.41 Service Channel

Secondary channels used for application-specific information exchanges.

3.1.42 Service Table

A data store containing the pertinent information about applications available through the WAVE device.

3.1.43 Stability Control

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

3.1.44 Station

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

3.1.45 Syntax

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

3.1.46 Transactions

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

3.1.47 Value Domain

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

3.1.48 Vehicle Host

A device connecting to the WAVE system through the OBU vehicle host interface.

3.1.49 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.

3.1.50 WAVE Device

A device that contains a WAVE-conformant medium access control (MAC) and physical layer (PHY) interface to the wireless medium. (See IEEE 802.11 and IEEE 1609.4)

3.1.51 WAVE Management Entity (WME)

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

3.1.52 WAVE Service Information Element (WSIE)

A collection of configuration data transmitted by either OBU or RSU, which includes the Provider Service Table, and in the case of the RSU the WAVE Routing Advertisement, as well as security credentials.

3.1.53 Wireline

Connected via a traditional communications interface; not the wireless interface specified here.

3.1.54 XML

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

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
ACID	Application Class Identifier
ASTM	American Society for Testing and Materials
ATIS	Advanced Traveler Information Systems
ATMS	Advanced Transportation Management Systems
C2C	Center to Center
CCC	Configuration Control Committee
CCH	Control Channel
CRC	Cyclic Redundancy Code
DE	Data Element
DF	Data Frame
DHCP	Dynamic Host Configuration Protocol
DSRC	Dedicated Short Range Communications
ESN	Electronic Serial Number
ESS	Environmental Sensors Stations
GMT	Greenwich Mean Time
ICC	Interstate Commerce Commission (now the Interstate Authority)
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IM	Incident Management or inter-modal
IP	Internet Protocol
IPv6	Internet Protocol version 6
ISO	International Standards Organization
ITE	Institute of Transportation Engineers
ITIS	International Traveler Information Systems
LLC	Logical Link Control
LSB	Least Significant Bit
MAC	Medium Access Control
MIB	Management Information Base
MIL	Malfunction Indicator Light (Check Engine Light)
MLME	MAC Layer Management Entity
MSB	Most Significant Bit
NTCIP	National Transportation Communications for ITS Protocols
OBU	On-Board Unit
OVHI	OBU to Vehicle Host Interface
PDU	Protocol Data Unit
PHY	Physical Layer
PLME	Physical Layer Management Entity
RFC	Request for Comments
RSU	Road Side Unit
SAE	Society of Automotive Engineers
SAP	Service Access Point
SCH	Service Channel
SDO	Standards Developing Organization
SME	Station Management Entity
SRS	Safety Restraint System
STA	Station
TC	Traction Control
TCIP	Transit Communications Interface Profiles
TCP	Transmission Control Protocol
TCS	Traction Control System
TMDD	Traffic Management Data Dictionary

UDP	User Datagram Protocol
UN	United Nations
UTC	Universal Coordinated Time (before you ask, see http://www.aldridge.com/utc.html)
WAVE	Wireless Access in Vehicular Environments
WME	WAVE Management Entity
WSIE	WAVE Service Information Element
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 the DSRC standard, background information on the rationale for the standard, and an introduction to the messages, which follow in Sections 5 to Section 9.

4.1 Introduction to DSRC Goals and Objectives

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

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

Safety applications, in particular, must be interoperable between vehicles from different manufacturers and between vehicles and roadway infrastructure within all the areas where the vehicle is likely to travel. This requirement for interoperability is also relevant to contemplated mobility applications. This SAE Standard specifies initial representative standard message sets, 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 standard message sets that can be universally generated and recognized by these proprietary applications.

The message sets specified in this SAE Standard depend upon the lower layers of the DSRC protocol stack to deliver the messages from applications at one end of the communication system (for example, in a vehicle) and 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 lower layers are addressed by IEEE P802.11p, and the upper layer protocols are covered in the IEEE P1609 series of standards. The DSRC family of standards developed by the various SDOs are meant to operate together in a harmonious fashion. The message sets specified in this SAE standard therefore define the message content delivered by the communication system at the application layer. This specification consequently defines the message payload at the physical layer. However, the operations at the physical layer, for example, are specified by IEEE P802.11p, and the actual content of over-the-air packets will be determined by layers below the applications layer, as specified in the IEEE standards.

The following subsection provides an overview of the DSRC architecture and protocol stack. A subsequent annex describes the concept of a Message Dispatcher function at the application layer, and the philosophy of the message design used to develop the message sets specified in this Recommended Practice. These message sets are presented in Section 5. The particular message design techniques described in this Recommended Practice have allowed for the construction of a dictionary of reusable, relevant data frames and data elements that are intended to expedite the development of future message sets. The standard data frames are presented in Section 6 of this Recommended Practice, and the data elements are specified in Section 7.

4.2 DSRC Overview

The 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 Section 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) of the WAVE system is defined in IEEE P802.11p. In general, the WAVE PHY provides a control channel (CCH) and multiple service channels (SCH). The range of this system is generally considered to be line-of-sight distances of less than 1000 meters. The PHY has been optimized to support usage by vehicles traveling at highway speeds.

IEEE P1609.4 provides enhancements to the IEEE 802.11 medium access control (MAC) that support WAVE safety, mobility and private applications in a multi-channel system by specifying mechanisms for prioritized access, channel routing, channel coordination and data transmission.

The upper layers of the network stack, up to the application layer, are defined in IEEE P1609.3. There are two pathways through the WAVE upper layers above the LLC layer: the Wave Short Message Protocol (WSMP) stack and the UDP/IP stack. IEEE 1609.3 describes networking services for applications running over either of these stacks, as well as describing the operation of the WSMP stack. Transmissions on the CCH are limited to WAVE Short Messages (WSM). Either WSMP stack or UDP/IP stack may be used for communications on SCHs. The WSMP stack is generally used for broadcast applications.

IEEE P1609.2 defines secure message formats, and specifies how these secure messages are processed within the WAVE system. These security services are designed to protect messages from attacks such as eavesdropping, spoofing, alteration and replay, while respecting end users' rights to privacy. The messages covered in IEEE P1609.2 security procedures include WAVE management messages and application messages, but do not include vehicle-originating safety messages. Security services for vehicle-originating safety messages have not yet been specified in any standard, but will be required before vehicle safety applications can be deployed.

4.3 Philosophy of Message Design

The DSRC message sets which are the subject of this standard are transported over the protocol stack of the WAVE Short Message (WSM), a finite resource which must be conserved in order to promote the best operations for all vehicles. While other protocol stacks also exist over the DSRC media (and are in fact expected to simultaneously carry a variety of other ITS related information including such things as ATIS information encoded in XML forms), the WSM is characterized by short length packet message traffic, often broadcast to other vehicles in an un-acknowledged delivery mode. Dialogs and transactions do take place, and such transaction can leave the control channel in order to use a service channel as needed, but the general design goal is to maximize support for short broadcast style messages. To that end, a dense encoding of information is used in defining the message sets of this Standard. Several of the design aspects of this encoding are discussed below.

This dense encoding uses a three-way approach:

1) The smallest divisions of information content to be standardized are called Data Elements
2) Data Frames are the next, more complex data structures to be standardized in this dense encoding
3) The next level of complexity in the data structure standardization is called Messages

First and foremost, data elements and data frames are typically used in a known order and with a known element lengths and often appear without any form of element tagging info encoding because the specific data element in question (and hence its definitions) can be determined by inspection. This style of encoding provided a dense set of packed bytes where the decoding of any byte can be determined by the definitions. This style of encoding is used for many common messages (both complete messages and messages which begin with known elements). In these messages, other elements many be appended using a simple byte-long tag encoding to separate the elements which follow. The tag bytes relate to specific elements of known length, and therefore a length value is not needed. The range of tags in the two-byte case follows the ITS practices for enumerations wherein the (upper) first 127 values of a byte are used for national codes (in this case specific data elements and data frames) and the remaining 127 entries can be used for local codes as needed. Messages allow appending 2-byte tagged style to provide an open –ended means to convey elements that were unknown when the standard was adopted and which are defined and known only between local implementations. Further, a range of the 2-byte tags can be used to send variable length data elements (such as a string). In this usage the 2-byte tag is followed by a single byte representing the length of the data to follow. This allows sending octets or strings up to 255 bytes in length, and it allows receivers that do not comprehend the tag to calculate the word length and skip over it to the next tag in the sequence.

5. MESSAGE SETS

This section defines the structure of the DSRC message sets. Each message set shall be further divided into specific messages and elements as defined in this clause and those that follow. Typically, these messages are made up of message content internal to this document (made up of entries that are either atomic or complex) and message content external to this document (from other functional areas and companion volumes).

Definitions for these messages are presented in the following subclauses. The ASN is presented in a section called "ASN.1 Representation," formerly called "Format." In a similar manner, the equivalent XML expression is presented in a section called "XML Representation" which follows the translation rule set cited in Clause Two (SAE J2630).

Regarding equivalent entries to be placed into a data registry: The mapping between data elements and analogous meta data entries have been explained in other ITS stds. In addition, some meta information is constant in this entire standard and need not be repeated with each entry here. These include the sponsor and steward of the entries [SAE], the registration status [registered once the standard is adopted] and the revision date [the date of the standards adoption]. The class name is always ITS.

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 to be normative as well. In addition, the commentary provided with each entry may also provide additional normative restrictions on the proper use of the entry which shall be followed. The XML productions follow directly from the ASN.1 specifications and the same rules shall be applied.

5.1 Message: MSG_Ala Carte

Use: A message which is composed entirely of message elements determined by the sender for each message. The message is fundamentally composed of two sections, a single byte tagged section and a two-byte tagged section. Each may be used to create ala carte message contents as required. The single byte tagged section allows transmission of elements (both complex and simple) which are defined in the standard to be sent (the tag being used to inform the receiver what the next data element or data frame will be). The two-byte section expands on this by allowing the transmission of data concepts whose definition and length are outside this standard but which are known to both the sending and receiving entities. The elements valueCnt1 and valueCnt2 state how many items follow in the message. This message allows extreme flexibility in that any defined data element may be sent (in any order), followed by a section where additional data may be sent, whose definition is outside this document.

ASN.1 Representation:

```
AlaCarte ::= SEQUENCE {
   -- each send as required with short tags
   valueCnt1    INTEGER (0..32),
   items1 SEQUENCE (SIZE(0..32)) OF SEQUENCE {
       tag      StdTagList,
       value    ValueList
       },
   -- Part II, the ad hoc data section
   valueCnt2    INTEGER (0..32),
   items2 SEQUENCE (SIZE(0..32)) OF SEQUENCE {
      tag       TwoByteTagList,
      data      CHOICE {
         payload   Payload,
         value     ValueList
         }
      },

   ... -- # LOCAL_CONTENT
```

XML Representation:

```
<xs:element name="alaCarte" type="AlaCarte"/>
<xs:complexType name="AlaCarte" >
      <xs:sequence>
         <!-- each send as required with short tags -->
         <xs:element name="valueCnt1"  minOccurs="1">
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte">
                  <xs:maxInclusive value="32"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="items1" >
            <xs:complexType>
               <xs:sequence minOccurs="0" maxOccurs="32">
                  <xs:element name="items1-item" >
                     <xs:complexType>
                        <xs:sequence>
                           <xs:element name="tag" type="StdTagList" />
                           <xs:element name="value" type="ValueList" />
                        </xs:sequence>
                     </xs:complexType>
                  </xs:element>
                  <!-- Part II,  the ad hoc data section -->
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <xs:element name="valueCnt2" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte">
                  <xs:maxInclusive value="32"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="items2" >
            <xs:complexType>
               <xs:sequence minOccurs="0" maxOccurs="32">
                  <xs:element name="items2-item" >
                     <xs:complexType>
                        <xs:sequence>
                           <xs:element name="tag" type="TwoByteTagList" />
                           <xs:element name="data" >
                              <xs:complexType>
                                 <xs:choice>
                                    <xs:element name="payload" type="Payload" />
                                    <xs:element name="value" type="ValueList" />
                                 </xs:choice>
                              </xs:complexType>
                           </xs:element>
                        </xs:sequence>
                     </xs:complexType>
                  </xs:element>
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <xs:element name="localAlaCarte" type="local:AlaCarte" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

5.2 Message: MSG_BasicSafetyMessage

Use: The basic safety message is defined here. This message is used in a variety of applications to exchange safety data regarding vehicle state. This message is broadcast to surrounding vehicles periodically with a variety of data content as required by different applications. Certain data is sent with every instance of the message. Other information is sent periodically or selectively based on the requests of other nearby vehicles. Refer to each safety application for specific details.

The combining of various data elements based on the demands of different active safety applications in the vehicle is the job of the message dispatcher, who manages the selection of what is to be sent. The specific encoding of those elements into the final transmitted message is defined by this structure. The message dispatcher is an abstract architectural concept from the perspective of the message set standard. It should be pointed out that the message dispatcher is expected to provide translation services from the received messages into various ordering and forms required by the application which it supports. This is outside the scope of this standard. Additional information on the use of message dispatcher in applications can be found in Appendix D.

Additional information on the use of this message in applications can be found in Appendix A.

ASN.1 Representation:

```
BasicSafetyMessage ::= SEQUENCE {
   -- Part I, sent at all times without any tagging
   msgID       DSRCmsgID,                  -- App ID value, 1 byte
   secMark     DSecond,                    -- 2 bytes
   id          TemporaryID,                -- 6 bytes

   -- pos      PositionLocal3D,
   lat         Latitude,                   -- 4 bytes (1/8th micro degrees)
   long        Longitude,                  -- 4 bytes
   elev        Elevation,                  -- 3 bytes

   -- motion   Motion,
   speed       Speed,                      -- 2 bytes
   heading     Heading,                    -- 2 byte
   accelSet    AccelerationSet4Way,        -- accel set (four way)

   -- control  Control,
   brakes      BrakeSystemStatus,          -- 1 byte
   steering    SteeringWheelAngle,         -- 2 bytes
   throttle    ThrottlePosition,           -- 1 byte
   lightSet    ExteriorLights,             -- 1 byte

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

   -- Part II, send as required with short tags
   valueCnt1    INTEGER (0..32), -- 1 byte
   items1 SEQUENCE (SIZE(0..32)) OF SEQUENCE {
       tag      StdTagList,                -- 1 byte
       value    ValueList
       },

   -- Part III, send as required with 2-byte tags
   valueCnt2    INTEGER (0..32),
   items2 SEQUENCE (SIZE(0..32)) OF SEQUENCE {
      tag       TwoByteTagList,
      data      CHOICE {
         payload   Payload,
         value     ValueList
         }
      },
   ... -- # LOCAL_CONTENT
```

XML Representation:

```
<xs:element name="basicSafetyMessage" type="BasicSafetyMessage"/>
<xs:complexType name="BasicSafetyMessage" >
      <xs:sequence>
         <!-- Part I,  sent at all times without any tagging -->
         <xs:element name="msgID" type="DSRCmsgID" />
         <!-- App ID value,  1 byte -->
         <xs:element name="secMark" type="DSecond" />
         <!-- 2 bytes -->
```

```
<xs:element name="id" type="TemporaryID" />
<!-- 6 bytes
pos      PositionLocal3D, -->
<xs:element name="lat" type="Latitude" />
<!-- 4 bytes  (1/8th micro degrees) -->
<xs:element name="long" type="Longitude" />
<!-- 4 bytes -->
<xs:element name="elev" type="Elevation" />
<!-- 3 bytes
motion   Motion, -->
<xs:element name="speed" type="Speed" />
<!-- 2 bytes -->
<xs:element name="heading" type="Heading" />
<!-- 2 byte -->
<xs:element name="accelSet" type="AccelerationSet4Way" />
<!-- accel set  (four way)
control  Control, -->
<xs:element name="brakes" type="BrakeSystemStatus" />
<!-- 1 byte -->
<xs:element name="steering" type="SteeringWheelAngle" />
<!-- 2 bytes -->
<xs:element name="throttle" type="ThrottlePosition" />
<!-- 1 byte -->
<xs:element name="lightSet" type="ExteriorLights" />
<!-- 1 byte
basic    VehicleBasic, -->
<xs:element name="size" type="VehicleSize" />
<!-- 3 bytes
Part II,  send as required with short tags -->
<xs:element name="valueCnt1"  minOccurs="1">
   <xs:simpleType>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="32"/>
      </xs:restriction>
   </xs:simpleType>
</xs:element>
<!-- 1 byte -->
<xs:element name="items1" >
   <xs:complexType>
      <xs:sequence minOccurs="0" maxOccurs="32">
         <xs:element name="items1-item" >
            <xs:complexType>
               <xs:sequence>
                  <xs:element name="tag" type="StdTagList" />
                  <!-- 1 byte -->
                  <xs:element name="value" type="ValueList" />
               </xs:sequence>
            </xs:complexType>
         </xs:element>
      </xs:sequence>
   </xs:complexType>
</xs:element>
<!-- Part III,  send as required with 2-byte tags -->
<xs:element name="valueCnt2" >
   <xs:simpleType>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="32"/>
      </xs:restriction>
   </xs:simpleType>
</xs:element>
<xs:element name="items2" >
   <xs:complexType>
      <xs:sequence minOccurs="0" maxOccurs="32">
         <xs:element name="items2-item" >
            <xs:complexType>
               <xs:sequence>
                  <xs:element name="tag" type="TwoByteTagList" />
                  <xs:element name="data" >
                     <xs:complexType>
                        <xs:choice>
                           <xs:element name="payload" type="Payload" />
                           <xs:element name="value" type="ValueList" />
                        </xs:choice>
                     </xs:complexType>
                  </xs:element>
               </xs:sequence>
            </xs:complexType>
         </xs:element>
      </xs:sequence>
   </xs:complexType>
```

```
         </xs:element>
         <xs:element name="localBasicSafetyMessage" type="local:BasicSafetyMessage" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

Remarks: This message is divided into three primary parts with a slightly different message encoding plan used in each. It is important to understand this encoding system in order to decode this message. The first part of the message, Part I, is always sent at all times without exception. Because the data structures are known, this has no tagging present. Part II of the message consists of predetermined data frames and data elements of known length which follow in a defined order and may or may not be present in any specific instance of the message. This can be determined by examining the tag found before each element item in Part II of the message. This process is repeated until the end of the part II encoded content is reached. Part III allows the creator of the message to add additional content (both defined in this data dictionary and defined privately outside of the scope of this standard) as befitting his unique needs by using a simple delimited tag and value system. By this methodology an effective yet simple message encoding is created which manages the tradeoff between message decoding complexity and the need to conserve channel bandwidth.

5.3 Message: MSG_CommonSafetyRequest

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

Addition information (data elements and data frames) can be requested by this message to be placed into either the Part II or Part III sections of the basic safety message (Part I contains selected information that is always present in every message without exception). The method of selecting specific elements to be sent follows the same style of tagging that is used in encoding in Parts II and Part III.

Because the elements which can be selected in Part III are a super set of those defined in Part II, some overlap can result. It is recommended that elements be sent with Part II style encoding when possible. Observe that the encoding style in Part III allows for the inclusion of data elements outside the scope of this standard (so called "private data"). This is provided to allow vendor specific additions to the messages defined in this standard to occur in an interoperable way. When a device receives a request for a data element it does not understand or support, then that request is simply ignored.

ASN.1 Representation:

```
CommonSafetyRequest ::= SEQUENCE {
   msgID       DSRCmsgID,                  -- App ID value, 1 byte
   request2Cnt INTEGER (0..32),  -- 1 byte
   requests2   SEQUENCE (SIZE(0..32)) OF StdTagList,
                                           -- Part II items
   request3Cnt INTEGER (0..32),  -- 1 byte
   requests3   SEQUENCE (SIZE(0..32)) OF TwoByteTagList,
                                           -- Part III items
   ... -- # LOCAL_CONTENT
   }
```

XML Representation:

```
<xs:element name="commonSafetyRequest" type="CommonSafetyRequest"/>
<xs:complexType name="CommonSafetyRequest" >
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <!-- App ID value,  1 byte -->
         <xs:element name="request2Cnt"  minOccurs="1">
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte">
                  <xs:maxInclusive value="32"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- 1 byte -->
         <xs:element name="requests2" >
            <xs:complexType>
               <xs:sequence minOccurs="0" maxOccurs="32">
                  <xs:element name="requests2-item" type="StdTagList" />
                  <!-- Part II items -->
               </xs:sequence>
            </xs:complexType>
```

```
         </xs:element>
         <xs:element name="request3Cnt"  minOccurs="1">
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte">
                  <xs:maxInclusive value="32"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- 1 byte -->
         <xs:element name="requests3" >
            <xs:complexType>
               <xs:sequence minOccurs="0" maxOccurs="32">
                  <xs:element name="requests3-item" type="TwoByteTagList" />
                  <!-- Part III items -->
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <xs:element name="localCommonSafetyRequest" type="local:CommonSafetyRequest" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

5.4 Message: MSG_EmergencyVehicleAlert

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 ATIS roadside alert message which in turn uses the common ITIS phrase list to both describe the event and provide advice and recommendation for travelers. The Emergency Vehicle Alert message appends to the message some additional data elements regarding the overall type of vehicle involved and other useful data. Note that this message can be used by both private and public response vehicles, and that the relative priority of each (as well as security certificates) is determined in the application layer.

ASN.1 Representation:

```
EmergencyVehicleAlert ::= SEQUENCE {
   msgID            DSRCmsgID,  -- App ID value, 1 byte
   atisMsg          ATIS.RoadSideAlert,
   responseType     ResponseType,              -- zero if NA
   sirenUse         SirenInUse,
   lightsUse        LightbarInUse,
   multi            MultiVehicleReponse,
                    -- combine above three into one byte!
   mass             VehicleMass,
   basicType        VehicleType,  -- gross size and axle cnt

   -- type of vehicle and agency when known
   vehicleType      ITIS.VehicleGroupAffected,      -- zero if NA
   responseEquip    ITIS.IncidentResponseEquipment, -- zero if NA
   responderType    ITIS.ResponderGroupAffected,    -- zero if NA
   ... -- # LOCAL_CONTENT
```

XML Representation:

```
<xs:element name="emergencyVehicleAlert" type="EmergencyVehicleAlert"/>
<xs:complexType name="EmergencyVehicleAlert" >
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <!-- App ID value,  1 byte -->
         <xs:element name="atisMsg" type="atis:RoadSideAlert" />
         <xs:element name="responseType" type="ResponseType" />
         <!-- zero if NA -->
         <xs:element name="sirenUse" type="SirenInUse" />
         <xs:element name="lightsUse" type="LightbarInUse" />
         <xs:element name="multi" type="MultiVehicleReponse" />
         <!-- combine above three into one byte! -->
         <xs:element name="mass" type="VehicleMass" />
         <xs:element name="basicType" type="VehicleType" />
         <!-- gross size and axle cnt
         type of vehicle and agency when known -->
         <xs:element name="vehicleType" type="itis:VehicleGroupAffected" />
         <!-- zero if NA -->
         <xs:element name="responseEquip" type="itis:IncidentResponseEquipment" />
         <!-- zero if NA -->
         <xs:element name="responderType" type="itis:ResponderGroupAffected" />
         <!-- zero if NA -->
         <xs:element name="localEmergencyVehicleAlert" type="local:EmergencyVehicleAlert" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

5.5 Message: MSG_GenericTransferMsg

Use: The GenericTransferMsg provides a basic means to exchange one or more blocks of data across the interface. Each application using this message frame SHALL have a unique value assigned to the applicationID value and is allowed to have up to 255 simultaneous transfer sessions in operation at one time. If an application requires only a single session, it SHALL set the sessionID to be the value of zero. Within each unique applicationID / sessionID value pair there MAY be up to 65535 unique blocks of data sent, each with its own word count up to 65535 bytes in length. This is followed by the payLoad value, a sequence of octets up to 65535 bytes in length. Proper interpretation and any re-assembly of these blocks of data (if needed) SHALL be the responsibility of the application layer and is outside the scope of this message definition. In general, this message depends on the lower layers of the DSRC protocol for successful message delivery, but not to ensure message delivery order. A CRC value is provided (which is generated over the entire msg content including the payload) to detect data corruption.

In order to transfer data payloads larger than 65535 bytes in length, the sending application SHALL break them down into sequential blocks, and then send each with a common sessionID and its own blockID value. The total expected number of blocks can be determined from the blockCount value. The total size of the complete data payload MAY be determined by multiplying the blockCount value by the wordCount, although individual applications MAY establish their own rules for this (i.e word counts that vary across blocks are expressly allowed).

Therefore, the typical use of this message by an application is to establish a sessionID which will be static for the life of the transfer, devise a reasonable wordCount for each payload, divide the overall payload by the wordCount into N such payloads, and thereby creating the value for the blockCount. If the blockCount is more than one, then the message is sent with the blockID set to 0,1,2, etc. and the payload Octets and CRC set as needed until all the data is sent and the blockID is N-1 the value of the blockCount (indicating the last block is being sent). Upon receipt of this last message by the receiver, the sessionID may be used at that time to initiate another session. Note that other sessions, using other sessionIDs may be occurring during the same time. Management of sessionIDs is outside the scope of this message set.

The CRC value SHALL be computed by setting an initial CRC value of zero, and then computing the final value by processing the message a single byte at a time and with each element taken in order starting from the msgType up to and including all of the payload to determine the final value. The polynomial value and algorithm used SHALL be the CRC-CCITT.

ASN.1 Representation:

```
GenericTransferMsg ::= SEQUENCE {
   msgID       DSRCmsgID,                  -- App ID value, 1 byte
   sessionID       INTEGER (0..255),
   applicationID   INTEGER (0..65535),
   blockID         INTEGER (0..65535),  -- the block number which this is
   blockCount      INTEGER (0..65535),  -- the number of blocks in total
   wordCount       INTEGER (0..65535),  -- the number of bytes in this payload
   payLoad         PayloadData,         -- the payload data to be transferred
   crc             INTEGER (0..65535),  -- a CRC, if not provided by the framing
   ...
   }
```

XML Representation:

```
<xs:element name="genericTransferMsg" type="GenericTransferMsg"/>
<xs:complexType name="GenericTransferMsg" >
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <!-- App ID value,  1 byte -->
         <xs:element name="sessionID" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte"/>
            </xs:simpleType>
         </xs:element>
         <xs:element name="applicationID" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedShort"/>
            </xs:simpleType>
         </xs:element>
         <xs:element name="blockID" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedShort"/>
            </xs:simpleType>
         </xs:element>
```

```
         <!-- the block number which this is -->
         <xs:element name="blockCount" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedShort"/>
            </xs:simpleType>
         </xs:element>
         <!-- the number of blocks in total -->
         <xs:element name="wordCount" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedShort"/>
            </xs:simpleType>
         </xs:element>
         <!-- the number of bytes in this payload -->
         <xs:element name="payLoad" type="PayloadData" />
         <!-- the payload data to be transferred -->
         <xs:element name="crc" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedShort"/>
            </xs:simpleType>
         </xs:element>
         <!-- a CRC,  if not provided by the framing -->
      </xs:sequence>
</xs:complexType>
```

Remarks: This message allows for transfer of up to 4,295 Megs of data to be sent per session per application using a simplistic method without error recovery, but with basic error detection. It is intended to be a utility method to be used in developing DSRC applications, and not to be used or depended upon in real time operational systems because its excessive use by any party would easily disturb time critical systems by excessive bandwidth consumption.

5.6 Message: MSG_ProbeVehicleData

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

ASN.1 Representation:

```
ProbeVehicleData ::= SEQUENCE {
   msgID           DSRCmsgID,              -- App ID value, 1 byte
   startVector     FullPositionVector,     -- the space and time of
                                           -- transmission to the RSU
   vehicleType     VehicleType,            -- type of vehicle, 1 byte
   cntSnapshoots   INTEGER (1..32),        -- a count of how many snaphots
                                           -- type entires will follow
   snapshots       SEQUENCE (SIZE(1..32)) OF Snapshot,
                                           -- a seq of name-value pairs
                                           -- along with the space and time
                                           -- of the first measurement set
   ... -- # LOCAL_CONTENT
   } -- Est size about 64 bytes plus snapshot sizes (about 12 per)
```

XML Representation:

```
<xs:element name="probeVehicleData" type="ProbeVehicleData"/>
<xs:complexType name="ProbeVehicleData" >
      <xs:annotation>
         <xs:documentation>
            Est size about 64 bytes plus snapshot sizes  (about 12 per)
         </xs:documentation>
      </xs:annotation>
      <xs:sequence>
         <xs:element name="msgID" type="DSRCmsgID" />
         <!-- App ID value,  1 byte -->
         <xs:element name="startVector" type="FullPositionVector" />
         <!-- the space and time of
         transmission to the RSU -->
         <xs:element name="vehicleType" type="VehicleType" />
         <!-- type of vehicle,  1 byte -->
         <xs:element name="cntSnapshoots" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte">
```

```
                <xs:minInclusive value="1"/>
                <xs:maxInclusive value="32"/>
             </xs:restriction>
          </xs:simpleType>
       </xs:element>
       <!-- a count of how many snaphots
       type entires will follow -->
       <xs:element name="snapshots" >
          <xs:complexType>
             <xs:sequence minOccurs="1" maxOccurs="32">
                <xs:element name="snapshot" type="Snapshot" />
                <!-- a seq of name-value pairs along with the space and time of the first measurement set -->
             </xs:sequence>
          </xs:complexType>
       </xs:element>
       <xs:element name="localProbeVehicleData" type="local:ProbeVehicleData" minOccurs="0"/>
    </xs:sequence>
</xs:complexType>
```

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.

6. DATA FRAMES

DSRC data frames for this volume shall consist of the following data frames. Each data frame shall be further divided into specific entries and elements as defined in this clause. Typically, these entries are made up of content internal to this document (made up of entries that are either atomic or complex) and content external to this document (from other functional areas and companion volumes).

Definitions for these messages are presented in the following subclauses. The ASN is presented in a section called "ASN.1 Representation," formerly called "Format." In a similar manner, the equivalent XML expression is presented in a section called "XML Representation" which follows the translation rule set cited in Clause Two.

Regarding equivalent entries to be placed into a data registry. The mapping between data elements and analogous meta data entries have been explained in other ITS stds. In addition, some meta information is constant in this entire standard and need not be repeated with each entry here. These include the sponsor and steward of the entries [SAE], the registration status [registered once the standard is adopted] and the revision date [the date of the standards adoption]. The class name is always ITS.

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 to be normative as well. In addition, the commentary provided with each entry may also provide additional normative restrictions on the proper use of the entry which shall be followed. The XML productions follow directly from the ASN.1 specifications and the same rules shall be applied.

6.1 Data Frame: DF_AccelerationSet4Way

Use: A set of acceleration values in 3 orthogonal directions of the vehicle and with yaw rotation rate.

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
   }
```

XML Representation:

```
<xs:complexType name="AccelerationSet4Way" >
      <xs:sequence>
         <xs:element name="long" type="Acceleration" />
         <!-- Along the Vehicle Longitudinal axis -->
         <xs:element name="lat" type="Acceleration" />
         <!-- Along the Vehicle Lateral axis -->
         <xs:element name="vert" type="VerticalAcceleration" />
         <!-- Along the Vehicle Vertical axis -->
```

```
        <xs:element name="yaw" type="YawRate" />
      </xs:sequence>
</xs:complexType>
```

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

DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>.

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

6.2 Data Frame: DF_AccelSteerYawRateConfidence

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

ASN.1 Representation:

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

XML Representation:

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

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

DF	DF_ConfidenceSet	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

6.3 Data Frame: DF_Application Context Mark

Use: The Application Context Mark (ACM) provides a unique means of identifying each element of each specific application. A priority is assigned to each ACM, allowing a single application to utilize different priorities for different elements.

ASN.1 Representation:

```
AppContextMark ::= SEQUENCE {
   said          SpecificApplicationIdentification, -- SAID
   context       Context, -- see appropriate Appendix
   priority      Priority, -- in accordance with IEEE P1609
   ...
   }
```

XML Representation:

```
<xs:complexType name="AppContextMark" >
      <xs:sequence>
         <xs:element name="said" type="SpecificApplicationIdentification" />
         <!-- SAID -->
         <xs:element name="context" type="Context" />
         <!-- see appropriate Appendix -->
         <xs:element name="priority" type="Priority" />
```

```
         <!-- in accordance with IEEE P1609 -->
      </xs:sequence>
</xs:complexType>
```

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

6.4 Data Frame: DF_BrakeSystemStatus

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

ASN.1 Representation:

```
BrakeSystemStatus ::= SEQUENCE {
   wheelBrakes        BrakeAppliedStatus,
                      -- 4 bits
   traction           TractionControlState,
                      -- 2 bits
   abs                AntiLockBrakeStatus
                      -- 2 bits
   }
```

XML Representation:

```
<xs:complexType name="BrakeSystemStatus" >
      <xs:sequence>
         <xs:element name="wheelBrakes" type="BrakeAppliedStatus" />
         <!-- 4 bits -->
         <xs:element name="traction" type="TractionControlState" />
         <!-- 2 bits -->
         <xs:element name="abs" type="AntiLockBrakeStatus" />
         <!-- 2 bits -->
      </xs:sequence>
</xs:complexType>
```

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

DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>.

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

6.5 Data Frame: DF_ConfidenceSet

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

ASN.1 Representation:

```
ConfidenceSet ::= SEQUENCE {
   accelConfidence      AccelSteerYawRateConfidence,
                        -- contains lat, long, vert, and yaw
   speedConfidence      SpeedandHeadingConfidence,
   timeConfidence       TimeConfidence,
   posConfidence        PositionConfidenceSet,
   steerConfidence      SteeringWheelAngleConfidence,
   throttleConfidence   ThrottleConfidence
   }
```

XML Representation:

```
<xs:complexType name="ConfidenceSet" >
      <xs:sequence>
         <xs:element name="accelConfidence" type="AccelSteerYawRateConfidence" />
         <!-- contains lat,  long,  vert,  and yaw -->
         <xs:element name="speedConfidence" type="SpeedandHeadingConfidence" />
         <xs:element name="timeConfidence" type="TimeConfidence" />
         <xs:element name="posConfidence" type="PositionConfidenceSet" />
         <xs:element name="steerConfidence" type="SteeringWheelAngleConfidence" />
         <xs:element name="throttleConfidence" type="ThrottleConfidence" />
      </xs:sequence>
</xs:complexType>
```

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

DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

6.6 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. Because the length of each element is known, no inner element tagging is normally used in transmission. Thus, this data frame occupies 4 bytes in total.

ASN.1 Representation:

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

XML Representation:

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

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

6.7 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. Because the length of each element is known, no inner element tagging is normally used in transmission. Thus, this data frame occupies 8 bytes in total.

ASN.1 Representation:

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

XML Representation:

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

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

6.8 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. Because the length of each element is known, no inner element tagging is normally used in transmission. Thus, this data frame occupies 6 bytes in total.

ASN.1 Representation:

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

XML Representation:

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

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

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

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

6.9 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. Because the length of each element is known, no inner element tagging is normally used in transmission. Thus, this data frame occupies 2 bytes in total.

ASN.1 Representation:

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

XML Representation:

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

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

6.10 Data Frame: DF_DTime

Use: The DSRC style time is a compound value consisting of finite-length sequences of integers (not characters) of the form: "hh, mm, ss (sss+) (offset)" - as defined below. Because the length of each element is known, no inner element tagging is normally used in transmission. Thus, this data frame occupies 6 bytes in total, and 4 bytes when the time offset is not present. In typical use 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 bytes and provides a resolution of one millisecond over a range of one day.

ASN.1 Representation:

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

XML Representation:

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

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

6.11 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. Because the length of each element is known, no inner element tagging is normally used in transmission. Thus, this data frame occupies 3 bytes in total.

ASN.1 Representation:

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

XML Representation:

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

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

6.12 Data Frame: DF_FullPositionVector

Use: A complete report of the vehicle's position, speed, and heading. Used in the probe vehicle message as the initial position information (followed by shorter frames).

ASN.1 Representation:

```
FullPositionVector ::= SEQUENCE {
   lastMsg             DSecond,              -- 2 bytes, milli sec from last minute
   utcTime             DFullTime,            -- 6 bytes, time with minute precision
   long                Longitude,            -- 4 bytes, 1/8th microdegree
   lat                 Latitude,             -- 4 bytes, 1/8th microdegree
```

```
   elevation           Elevation,                -- 3 bytes
   heading             Heading,                  -- 2 bytes
   speed               Speed,                    -- 2 bytes
   timeConfidence      TimeConfidence,           -- 1 byte
   posConfidence       PositionConfidenceSet,    -- 1 byte
   speedConfidence     SpeedandHeadingConfidence, -- 1 byte
   ... -- # LOCAL_CONTENT
   } -- total size 26 bytes
```

XML Representation:

```
<xs:complexType name="FullPositionVector" >
      <xs:annotation>
         <xs:documentation>
            total size 24 bytes
         </xs:documentation>
      </xs:annotation>
      <xs:sequence>
         <xs:element name="lastMsg" type="DSecond" />
         <!-- 2 bytes,  milli sec from last minute -->
         <xs:element name="utcTime" type="DFullTime" />
         <!-- 6 bytes,  time with minute precision -->
         <xs:element name="long" type="Longitude" />
         <!-- 4 bytes,  1/8th microdegree -->
         <xs:element name="lat" type="Latitude" />
         <!-- 4 bytes,  1/8th microdegree -->
         <xs:element name="elevation" type="Elevation" />
         <!-- 3 bytes -->
         <xs:element name="heading" type="Heading" />
         <!-- 1 byte -->
         <xs:element name="speed" type="Speed" />
         <!-- 2 bytes -->
         <xs:element name="timeConfidence" type="TimeConfidence" />
         <!-- 1 byte -->
         <xs:element name="posConfidence" type="PositionConfidenceSet" />
         <!-- 1 byte -->
         <xs:element name="speedConfidence" type="SpeedandHeadingConfidence" />
         <!-- 1 byte -->
         <xs:element name="localFullPositionVector" type="local:FullPositionVector" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

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

DF	DF_Snapshot	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_ProbeVehicleData	<ASN> <XML>.

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

6.13 Data Frame: DF_Position2D

Use: A collection of the two 4 byte lat-long information elements used to build a complete 2D position set. No elevation data is sent in this 8 bytes data frame.

ASN.1 Representation:

```
Position2D ::= SEQUENCE {
   lat    Latitude,  -- in 1/8th micro degrees
   long   Longitude  -- in 1/8th micro degrees
   }
```

XML Representation:

```
<xs:complexType name="Position2D" >
      <xs:sequence>
         <xs:element name="lat" type="Latitude" />
         <!-- in 1/8th micro degrees -->
         <xs:element name="long" type="Longitude" />
         <!-- in 1/8th micro degrees -->
      </xs:sequence>
</xs:complexType>
```

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

6.14 Data Frame: DF_Position3D

Use: A collection of the two 4 byte lat-long information elements and the one 3 byte elevation used to build a complete 3D position set in 11 bytes.

ASN.1 Representation:

```
Position3D ::= SEQUENCE {
   lat         Latitude,    -- in 1/8th micro degrees
   long        Longitude,   -- in 1/8th micro degrees
   elevation   Elevation
   }
```

XML Representation:

```
<xs:complexType name="Position3D" >
      <xs:sequence>
         <xs:element name="lat" type="Latitude" />
         <!-- in 1/8th micro degrees -->
         <xs:element name="long" type="Longitude" />
         <!-- in 1/8th micro degrees -->
         <xs:element name="elevation" type="Elevation" />
      </xs:sequence>
</xs:complexType>
```

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

6.15 Data Frame: DF_PositionConfidenceSet

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

ASN.1 Representation:

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

XML Representation:

```
<xs:complexType name="PositionConfidenceSet" >
      <xs:sequence>
         <xs:element name="pos" type="PositionConfidence" />
         <!-- 4 bits,  for both hoz directions -->
         <xs:element name="elevation" type="ElevationConfidence" />
         <!-- 4 bits -->
      </xs:sequence>
</xs:complexType>
```

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

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

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

6.16 Data Frame: DF_SnapshotItem

Use: A set consisting of an item and an item value used to bundle snapshot data together for use.

ASN.1 Representation:

```
SnapshotItem ::= SEQUENCE {
   item     ValueList,
   value    VehicleStatusDeviceType
   }
```

XML Representation:

```
<xs:complexType name="SnapshotItem" >
      <xs:sequence>
         <xs:element name="item" type="ValueList" />
         <xs:element name="value" type="VehicleStatusDeviceType" />
      </xs:sequence>
</xs:complexType>
```

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

6.17 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 on a number of defined vehicle devices.

ASN.1 Representation:

```
Snapshot ::= SEQUENCE {
   thePosition  FullPositionVector,          -- data of the position and speed,
   cntVSDTs     INTEGER (0..31),             -- a count of how many vehicle
                                             -- status device type entires
                                             -- will follow,  1 byte
   deviceTypes  SEQUENCE (SIZE(0..31)) OF
                SnapshotItem,                -- a seq of name-value pairs
                                             -- which me may encode in the
                                             -- style as other msgs, need to see

   ... -- # LOCAL_CONTENT
   } -- Est size 2 bytes per payload item plus 10 for next position
```

XML Representation:

```
<xs:complexType name="Snapshot" >
      <xs:annotation>
         <xs:documentation>
            Est size 2 bytes per payload item plus 10 for next position
         </xs:documentation>
      </xs:annotation>
      <xs:sequence>
         <xs:element name="thePosition" type="FullPositionVector" />
         <!-- data of the position and speed, -->
         <xs:element name="cntVSDTs" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedByte">
                  <xs:maxInclusive value="31"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- a count of how many vehicle
         status device type entires
         will follow,   1 byte -->
         <xs:element name="deviceTypes" >
            <xs:complexType>
               <xs:sequence minOccurs="0" maxOccurs="31">
                  <xs:element name="deviceType" type="SnapshotItem" />
                  <!-- a seq of name-value pairs which me may encode in the style as other msgs, need to see -->
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <xs:element name="localSnapshot" type="local:Snapshot" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

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

DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_ProbeVehicleData	<ASN> <XML>.

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

6.18 Data Frame: DF_SpeedandHeadingConfidence

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

ASN.1 Representation:

```
SpeedandHeadingConfidence ::= SEQUENCE {
   heading    HeadingConfidence,    -- 3 bits
   speed      SpeedConfidence,      -- 3 bits
   throttle   ThrottleConfidence    -- 2 bits
   }
```

XML Representation:

```
<xs:complexType name="SpeedandHeadingConfidence" >
      <xs:sequence>
         <xs:element name="heading" type="HeadingConfidence" />
         <!-- 3 bits -->
         <xs:element name="speed" type="SpeedConfidence" />
         <!-- 3 bits -->
         <xs:element name="throttle" type="ThrottleConfidence" />
         <!-- 2 bits -->
      </xs:sequence>
</xs:complexType>
```

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

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

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

6.19 Data Frame: DF_Tail

Use: This data structure is a way to add pairs of names and associated values to a message. It typically appears at the end of a message (hence the name "tail"). The value carried in this portion of the message shall not be used to circumvent the structure of the messages. That said, this is an excellent way to add further meta-data to a message or to add content which a local deployment feels is needed but, which is not currently in the message set.

ASN.1 Representation:

```
Tail ::= SEQUENCE
     {
     entries SEQUENCE (SIZE (1..32)) OF SEQUENCE {
        tag    UTF8String (SIZE(1..20)),
        value  UTF8String (SIZE(1..200))
        }
        -- sets of addtional named data values
     }
```

XML Representation:

```
<xs:complexType name="Tail">
   <xs:sequence maxOccurs="32">
      <xs:element name="entry">
         <xs:complexType>
            <xs:sequence>
               <xs:element name="tag">
                  <xs:simpleType>
                     <xs:restriction base="xs:string">
```

```
                        <xs:minLength value="1"/>
                        <xs:maxLength value="20"/>
                     </xs:restriction>
                  </xs:simpleType>
               </xs:element>
               <xs:element name="value">
                  <xs:simpleType>
                     <xs:restriction base="xs:string">
                        <xs:minLength value="1"/>
                        <xs:maxLength value="200"/>
                     </xs:restriction>
                  </xs:simpleType>
               </xs:element>
            </xs:sequence>
         </xs:complexType>
      </xs:element>
      <!-- sets of addtional named data values -->
   </xs:sequence>
</xs:complexType>
```

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

Remarks: When used in DSRC message to add "XML like" tagging then the delimiting values of "<" and ">" should appear in the tag and values strings. This is not required in message transmissions which contain an explicit tagging system. If the tag and value string are to be expressed in XML added values of "<" or ">" shall be removed from the content.

6.20 Data Frame: DF_UpdateVector

Use: A minimal report of the vehicles position, speed, and heading. Used in the probe vehicle message as one of the subsequent reports of position information (preceded by a longer frame with additional information which does not vary).

ASN.1 Representation:

```
UpdateVector ::= SEQUENCE {
   lastMin              DMinute,          -- 1 byte
   lastSec              DSecond,          -- 2 bytes
   long                 Longitude,        -- 4 bytes, 1/8th microdegree
   lat                  Latitude,         -- 4 bytes, 1/8th microdegree
   heading              Heading,          -- 1 byte, 1.4 deg
   speed                Speed,            -- 1 byte
   elevation            Elevation,        -- 3 byte
   ... -- # LOCAL_CONTENT
   } -- a size of 16 bytes
```

XML Representation:

```
<xs:complexType name="UpdateVector" >
      <xs:annotation>
         <xs:documentation>
            a size of 16 bytes
         </xs:documentation>
      </xs:annotation>
      <xs:sequence>
         <xs:element name="lastMin" type="DMinute" />
         <!-- 1 byte -->
         <xs:element name="lastSec" type="DSecond" />
         <!-- 2 bytes -->
         <xs:element name="long" type="Longitude" />
         <!-- 4 bytes,  1/8th microdegree -->
         <xs:element name="lat" type="Latitude" />
         <!-- 4 bytes,  1/8th microdegree -->
         <xs:element name="heading" type="Heading" />
         <!-- 1 byte,  1.4 deg -->
         <xs:element name="speed" type="Speed" />
         <!-- 1 byte -->
         <xs:element name="elevation" type="Elevation" />
         <!-- 3 byte -->
         <xs:element name="localUpdateVector" type="local:UpdateVector" minOccurs="0"/>
      </xs:sequence>
</xs:complexType>
```

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

6.21 Data Frame: DF_ValueList

Use: A complete set of all the possible elements that may be chosen to follow after a one byte tag value in the DSRC message encoding. These same elements are assigned a tag value in the definition of the StdTagList element.

ASN.1 Representation:

```
ValueList ::= CHOICE {
   accelSteerYawRateConfidence     AccelSteerYawRateConfidence,
   acceleration                    Acceleration,
   accelerationSet4Way             AccelerationSet4Way,
   accelerationConfidence          AccelerationConfidence,
   airBagCount                     AirBagCount,
   ambientAirTemperature           AmbientAirTemperature,
   antiLockBrakeStatus             AntiLockBrakeStatus,
   applicationContextMark          AppContextMark,
   brakeAppliedPressure            BrakeAppliedPressure,
   brakeAppliedStatus              BrakeAppliedStatus,
   brakeBoostApplied               BrakeBoostApplied,
   brakeSystemStatus               BrakeSystemStatus,
   confidenceSet                   ConfidenceSet,
   dDate                           DDate,
   dDateTime                       DDateTime,
   dDay                            DDay,
   dFullTime                       DFullTime,
   dHour                           DHour,
   dMinute                         DMinute,
   dMonth                          DMonth,
   dMonthDay                       DMonthDay,
   drivingWheelAngle               DrivingWheelAngle,
   dSecond                         DSecond,
   dSRCmsgID                       DSRCmsgID,
   dTime                           DTime,
   dYear                           DYear,
   dYearMonth                      DYearMonth,
   elevation                       Elevation,
   elevationConfidence             ElevationConfidence,
   exteriorLights                  ExteriorLights,
   fullPositionVector              FullPositionVector,
   heading                         Heading,
   headingConfidence               HeadingConfidence,
   lightbarInUse                   LightbarInUse,
   latitude                        Latitude,
   longitude                       Longitude,
   multiVehicleReponse             MultiVehicleReponse,
   obstacleDirection               ObstacleDirection,
   obstacleDistance                ObstacleDistance,
   position2D                      Position2D,
   position3D                      Position3D,
   positionConfidence              PositionConfidence,
   positionConfidenceSet           PositionConfidenceSet,
   rainSensor                      RainSensor,
   responseType                    ResponseType,
   sirenInUse                      SirenInUse,
   snapshot                        Snapshot,
   speed                           Speed,
   speedandHeadingConfidence       SpeedandHeadingConfidence,
   speedConfidence                 SpeedConfidence,
   stabilityControlStatus          StabilityControlStatus,
   stdTagList                      StdTagList,
   steeringWheelAngle              SteeringWheelAngle,
   steeringWheelAngleConfidence    SteeringWheelAngleConfidence,
   steeringWheelAngleRateOfChange  SteeringWheelAngleRateOfChange,
   sunSensor                       SunSensor,
   temporaryID                     TemporaryID,
   throttlePosition                ThrottlePosition,
   throttleConfidence              ThrottleConfidence,
   timeConfidence                  TimeConfidence,
   tractionControlState            TractionControlState,
   updateVector                    UpdateVector,
   vehicleHeight                   VehicleHeight,
   vehicleLength                   VehicleLength,
   vehicleMass                     VehicleMass,
   vehicleSize                     VehicleSize,
   vehicleStatusDeviceType         VehicleStatusDeviceType,
   vehicleType                     VehicleType,
   vehicleWidth                    VehicleWidth,
```

```
   verticalAcceleration           VerticalAcceleration,
   verticalAccelerationThreshold  VerticalAccelerationThreshold,
   wiperRate                      WiperRate,
   wiperStatus                    WiperStatus,
   yawRate                        YawRate,
   yawRateConfidence              YawRateConfidence
   -- pick any single item/group from the above
```

XML Representation:

```
<xs:complexType name="ValueList" >
      <xs:choice>
         <xs:element name="accelSteerYawRateConfidence" type="AccelSteerYawRateConfidence" />
         <xs:element name="acceleration" type="Acceleration" />
         <xs:element name="accelerationSet4Way" type="AccelerationSet4Way" />
         <xs:element name="accelerationConfidence" type="AccelerationConfidence" />
         <xs:element name="airBagCount" type="AirBagCount" />
         <xs:element name="ambientAirTemperature" type="AmbientAirTemperature" />
         <xs:element name="antiLockBrakeStatus" type="AntiLockBrakeStatus" />
         <xs:element name="applicationContextMark" type="AppContextMark" />
         <xs:element name="brakeAppliedPressure" type="BrakeAppliedPressure" />
         <xs:element name="brakeAppliedStatus" type="BrakeAppliedStatus" />
         <xs:element name="brakeBoostApplied" type="BrakeBoostApplied" />
         <xs:element name="brakeSystemStatus" type="BrakeSystemStatus" />
         <xs:element name="confidenceSet" type="ConfidenceSet" />
         <xs:element name="dDate" type="DDate" />
         <xs:element name="dDateTime" type="DDateTime" />
         <xs:element name="dDay" type="DDay" />
         <xs:element name="dFullTime" type="DFullTime" />
         <xs:element name="dHour" type="DHour" />
         <xs:element name="dMinute" type="DMinute" />
         <xs:element name="dMonth" type="DMonth" />
         <xs:element name="dMonthDay" type="DMonthDay" />
         <xs:element name="drivingWheelAngle" type="DrivingWheelAngle" />
         <xs:element name="dSecond" type="DSecond" />
         <xs:element name="dSRCmsgID" type="DSRCmsgID" />
         <xs:element name="dTime" type="DTime" />
         <xs:element name="dYear" type="DYear" />
         <xs:element name="dYearMonth" type="DYearMonth" />
         <xs:element name="elevation" type="Elevation" />
         <xs:element name="elevationConfidence" type="ElevationConfidence" />
         <xs:element name="exteriorLights" type="ExteriorLights" />
         <xs:element name="fullPositionVector" type="FullPositionVector" />
         <xs:element name="heading" type="Heading" />
         <xs:element name="headingConfidence" type="HeadingConfidence" />
         <xs:element name="lightbarInUse" type="LightbarInUse" />
         <xs:element name="latitude" type="Latitude" />
         <xs:element name="longitude" type="Longitude" />
         <xs:element name="multiVehicleReponse" type="MultiVehicleReponse" />
         <xs:element name="obstacleDirection" type="ObstacleDirection" />
         <xs:element name="obstacleDistance" type="ObstacleDistance" />
         <xs:element name="position2D" type="Position2D" />
         <xs:element name="position3D" type="Position3D" />
         <xs:element name="positionConfidence" type="PositionConfidence" />
         <xs:element name="positionConfidenceSet" type="PositionConfidenceSet" />
         <xs:element name="rainSensor" type="RainSensor" />
         <xs:element name="responseType" type="ResponseType" />
         <xs:element name="sirenInUse" type="SirenInUse" />
         <xs:element name="snapshot" type="Snapshot" />
         <xs:element name="speed" type="Speed" />
         <xs:element name="speedandHeadingConfidence" type="SpeedandHeadingConfidence" />
         <xs:element name="speedConfidence" type="SpeedConfidence" />
         <xs:element name="stabilityControlStatus" type="StabilityControlStatus" />
         <xs:element name="stdTagList" type="StdTagList" />
         <xs:element name="steeringWheelAngle" type="SteeringWheelAngle" />
         <xs:element name="steeringWheelAngleConfidence" type="SteeringWheelAngleConfidence" />
         <xs:element name="steeringWheelAngleRateOfChange" type="SteeringWheelAngleRateOfChange" />
         <xs:element name="sunSensor" type="SunSensor" />
         <xs:element name="temporaryID" type="TemporaryID" />
         <xs:element name="throttlePosition" type="ThrottlePosition" />
         <xs:element name="throttleConfidence" type="ThrottleConfidence" />
         <xs:element name="timeConfidence" type="TimeConfidence" />
         <xs:element name="tractionControlState" type="TractionControlState" />
         <xs:element name="updateVector" type="UpdateVector" />
         <xs:element name="vehicleHeight" type="VehicleHeight" />
         <xs:element name="vehicleLength" type="VehicleLength" />
         <xs:element name="vehicleMass" type="VehicleMass" />
         <xs:element name="vehicleSize" type="VehicleSize" />
         <xs:element name="vehicleStatusDeviceType" type="VehicleStatusDeviceType" />
         <xs:element name="vehicleType" type="VehicleType" />
```

```
         <xs:element name="vehicleWidth" type="VehicleWidth" />
         <xs:element name="verticalAcceleration" type="VerticalAcceleration" />
         <xs:element name="verticalAccelerationThreshold" type="VerticalAccelerationThreshold" />
         <xs:element name="wiperRate" type="WiperRate" />
         <xs:element name="wiperStatus" type="WiperStatus" />
         <xs:element name="yawRate" type="YawRate" />
         <xs:element name="yawRateConfidence" type="YawRateConfidence" />
         <!-- pick any single item/group from the above -->
      </xs:choice>
</xs:complexType>
```

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

DF	DF_SnapshotItem	<ASN> <XML>, and
MSG	MSG_Ala Carte	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>.

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

6.22 Data Frame: DF_VehicleSize

Use: The VehicleSize is a data frame representing the vehicle length and vehicle width in a three byte value.

ASN.1 Representation:

```
VehicleSize ::= SEQUENCE {
   width     VehicleWidth,
   length    VehicleLength
   }  -- 3 bytes in length
```

XML Representation:

```
<xs:complexType name="VehicleSize" >
      <xs:annotation>
         <xs:documentation>
            3 bytes in length
         </xs:documentation>
      </xs:annotation>
      <xs:sequence>
         <xs:element name="width" type="VehicleWidth" />
         <xs:element name="length" type="VehicleLength" />
      </xs:sequence>
</xs:complexType>
```

Used by: This entry is 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_ValueList	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>.

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

6.23 Data Frame: DF_VehicleStatusDeviceType

Use: A data frame that is used to relate specific items of the vehicles status. This structure relates all the different types of information that can be related about the vehicle inside a probe message. Typically these are used in data event snapshots which are gathered and periodically reported to an RSU.

Observe that this data structure makes use of other defined data elements and data frames, enclosing them in a choice structure so that one (and only one) such item can be sent within the VehicleStatusDeviceType instance but that this data follows the definition of each defined elsewhere.

ASN.1 Representation:

```
VehicleStatusDeviceType ::= CHOICE {
   lights          ExteriorLights,                -- Exterior Lights
   wipers   SEQUENCE {
         status    WiperStatus,
         rate      WiperRate
         },                                       -- Wipers
```

```
   brakes   SEQUENCE {
         status     BrakeSystemStatus,
         pressure   BrakeAppliedPressure,
         boost      BrakeBoostApplied
         },                                          -- Brake Applied
   stab             StabilityControlStatus,          -- Stability Control
   trac             TractionControlState,            -- Traction Control
   abs              AntiLockBrakeStatus,             -- Anti-Lock Brakes
   sunS             SunSensor,                       -- Sun Sensor
   rainS            RainSensor,                      -- Rain Sensor
   airTemp          AmbientAirTemperature,           -- Air Temperature
   steering SEQUENCE {
         angle      SteeringWheelAngle,
         rate       SteeringWheelAngleRateOfChange,
         wheels     DrivingWheelAngle
         },
   vertAccelThres   VerticalAccelerationThreshold,   -- Wheel that Exceeded the
   vertAccel        VerticalAcceleration,            -- Vertical g Force Value
                                                     -- we do not have a vert Confidence
   hozAccelLong     Acceleration,                    -- Longitudinal Acceleration
   hozAccelLat      Acceleration,                    -- Lateral Acceleration
   hozAccelCon      AccelerationConfidence,          -- Acceleration Confidence
   obDist           ObstacleDistance,                -- Obstacle Distance
   obDirect         ObstacleDirection,               -- Obstacle Direction
   yaw              YawRate,                         -- Yaw Rate
   yawRateCon       YawRateConfidence,               -- Yaw Rate Confidence

   -- other items we may want to include here:
   xxx1             AccelSteerYawRateConfidence,
   xxx2             BrakeAppliedPressure,
   xxx3             PositionConfidenceSet,
   xxx4             ConfidenceSet,
   xxx5             SpeedandHeadingConfidence,
   xxx6             SpeedConfidence,
   xxx7             VehicleHeight,
   xxx8             VehicleMass,
   xxx9             VehicleType,

   ... -- # LOCAL_CONTENT
```

XML Representation:

```
<xs:complexType name="VehicleStatusDeviceType" >
      <xs:choice>
         <xs:element name="lights" type="ExteriorLights" />
         <!-- Exterior Lights -->
         <xs:element name="wipers" >
            <xs:complexType>
               <xs:sequence>
                  <xs:element name="status" type="WiperStatus" />
                  <xs:element name="rate" type="WiperRate" />
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <!-- Wipers -->
         <xs:element name="brakes" >
            <xs:complexType>
               <xs:sequence>
                  <xs:element name="status" type="BrakeSystemStatus" />
                  <xs:element name="pressure" type="BrakeAppliedPressure" />
                  <xs:element name="boost" type="BrakeBoostApplied" />
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <!-- Brake Applied -->
         <xs:element name="stab" type="StabilityControlStatus" />
         <!-- Stability Control -->
         <xs:element name="trac" type="TractionControlState" />
         <!-- Traction Control -->
         <xs:element name="abs" type="AntiLockBrakeStatus" />
         <!-- Anti-Lock Brakes -->
         <xs:element name="sunS" type="SunSensor" />
         <!-- Sun Sensor -->
         <xs:element name="rainS" type="RainSensor" />
         <!-- Rain Sensor -->
         <xs:element name="airTemp" type="AmbientAirTemperature" />
         <!-- Air Temperature -->
         <xs:element name="steering" >
            <xs:complexType>
               <xs:sequence>
```

```
                <xs:element name="angle" type="SteeringWheelAngle" />
                <xs:element name="rate" type="SteeringWheelAngleRateOfChange" />
                <xs:element name="wheels" type="DrivingWheelAngle" />
              </xs:sequence>
            </xs:complexType>
          </xs:element>
          <xs:element name="vertAccelThres" type="VerticalAccelerationThreshold" />
          <!-- Wheel that Exceeded the -->
          <xs:element name="vertAccel" type="VerticalAcceleration" />
          <!-- Vertical g Force Value
          we do not have a vert Confidence -->
          <xs:element name="hozAccelLong" type="Acceleration" />
          <!-- Longitudinal Acceleration -->
          <xs:element name="hozAccelLat" type="Acceleration" />
          <!-- Lateral Acceleration -->
          <xs:element name="hozAccelCon" type="AccelerationConfidence" />
          <!-- Acceleration Confidence -->
          <xs:element name="obDist" type="ObstacleDistance" />
          <!-- Obstacle Distance -->
          <xs:element name="obDirect" type="ObstacleDirection" />
          <!-- Obstacle Direction -->
          <xs:element name="yaw" type="YawRate" />
          <!-- Yaw Rate -->
          <xs:element name="yawRateCon" type="YawRateConfidence" />
          <!-- Yaw Rate Confidence
          other items we may want to include here: -->
          <xs:element name="xxx1" type="AccelSteerYawRateConfidence" />
          <xs:element name="xxx2" type="BrakeAppliedPressure" />
          <xs:element name="xxx3" type="PositionConfidenceSet" />
          <xs:element name="xxx4" type="ConfidenceSet" />
          <xs:element name="xxx5" type="SpeedandHeadingConfidence" />
          <xs:element name="xxx6" type="SpeedConfidence" />
          <xs:element name="xxx7" type="VehicleHeight" />
          <xs:element name="xxx8" type="VehicleMass" />
          <xs:element name="xxx9" type="VehicleType" />
          <xs:element name="localVehicleStatusDeviceType" type="local:VehicleStatusDeviceType" minOccurs="0"/>
        </xs:choice>
</xs:complexType>
```

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

DF	DF_SnapshotItem	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>.

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

7. DATA ELEMENTS

Messages and data frames specified in Clauses 5 and 6 shall be composed of message elements. Any message or data frame specified in Clauses 6 or 7 shall have all of its DEs specified in this clause, except those DEs that are primitive ASN.1 data types or those that are adopted from other functional areas, or defined in other volumes of the family of standards. In the later cases, the referenced standards shall be consulted.

Regarding equivalent entries to be placed into a data registry. The mapping between data elements and analogous meta data entries have been explained in other ITS stds. In addition, some meta information is constant in this entire standard and need not be repeated with each entry here. These include the sponsor and steward of the entries [SAE], the registration status [registered once the standard is adopted] and the revision date [the date of the standards adoption]. The class name is always ITS.

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 to be normative as well. In addition, the commentary provided with each entry may also provide additional normative restrictions on the proper use of the entry which shall be followed. The XML productions follow directly from the ASN.1 specifications and the same rules shall be applied.

7.1 Data Element: DE_Acceleration

Use: A data element representing the signed acceleration of the vehicle along some known axis in units of 0.01 meters per second squared. A range of over 2Gs is supported. Accelerations in the directions of forward and to the right are taken as positive. A 2 byte long value when sent.

Longitudinal acceleration is the acceleration along the X axis or the vehicle's direction of travel in parallel with a front to rear centerline. Negative values indicate braking action.

Lateral acceleration is the acceleration along the Y axis or perpendicular to the vehicle's direction of travel in parallel with a left-to right centerline. Negative values indicate left turning action and positive values indicate right-turning action.

ASN.1 Representation:

```
Acceleration ::= INTEGER (-2000..2000) -- LSB units are 0.01 m/s^2
```

XML Representation:

```
<xs:simpleType name="Acceleration" >
      <xs:annotation>
         <xs:documentation>
            LSB units are 0.01 m/s^2
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:short">
         <xs:minInclusive value="-2000"/>
         <xs:maxInclusive value="2000"/>
      </xs:restriction>
</xs:simpleType>
```

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

DF	DF_AccelerationSet4Way	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

7.2 Data Element: DE_AccelerationConfidence

Use: This DE is used to provide to listeners the confidence interval of the 95% confidence level for the currently reported value of DE_Acceleration, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

ASN.1 Representation:

```
AccelerationConfidence ::= ENUMERATED {
   notEquipped  (0), -- B'000  Not Equipped
   accl-100-00  (1), -- B'001  100  meters / second squared
   accl-010-00  (2), -- B'010  10   meters / second squared
   accl-005-00  (3), -- B'011  5    meters / second squared
   accl-001-00  (4), -- B'100  1    meters / second squared
   accl-000-10  (5), -- B'101  0.1  meters / second squared
   accl-000-05  (6), -- B'110  0.05 meters / second squared
   accl-000-01  (7)  -- B'111  0.01 meters / second squared
   }
```

XML Representation:

```
<xs:simpleType name="AccelerationConfidence" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0) -- B&apos;000  Not Equipped
            accl 100 00 (1) -- B&apos;001  100  meters / second squared
            accl 010 00 (2) -- B&apos;010  10   meters / second squared
            accl 005 00 (3) -- B&apos;011  5    meters / second squared
            accl 001 00 (4) -- B&apos;100  1    meters / second squared
            accl 000 10 (5) -- B&apos;101  0.1  meters / second squared
            accl 000 05 (6) -- B&apos;110  0.05 meters / second squared
            accl 000 01 (7) -- B&apos;111  0.01 meters / second squared
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 3 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="accl 100 00"/>
               <xs:enumeration value="accl 010 00"/>
               <xs:enumeration value="accl 005 00"/>
               <xs:enumeration value="accl 001 00"/>
               <xs:enumeration value="accl 000 10"/>
               <xs:enumeration value="accl 000 05"/>
               <xs:enumeration value="accl 000 01"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

DF	DF_AccelSteerYawRateConfidence	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

7.3 Data Element: DE_AirBagCount

Use: The number of air bags in a given context or condition (in the vehicle, activated, deployed etc.).

ASN.1 Representation:

```
AirBagCount ::= INTEGER (0..100) -- edit to proper ranges
```

XML Representation:

```
<xs:simpleType name="AirBagCount" >
      <xs:annotation>
         <xs:documentation>
            edit to proper ranges
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="100"/>
      </xs:restriction>
</xs:simpleType>
```

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

7.4 Data Element: DE_AmbientAirTemperature

Use: This data element is used to relate the measured Ambient Air Temperature from a vehicle or other device. Its measurement range and precession follows that defined by the relevant ODB-II standards. This provides for a precision of one degree centigrade and a range of -40 to +150 degrees encoded in a one byte value. The value of -40 deg C is encoded as zero and every degree above that increments the transmitted value by one resulting in a transmission range of 0 to 191. Hence, a measurement value representing 25 degrees centigrade is transmitted as 40+25=65 or Hex 0x41.

ASN.1 Representation:

```
AmbientAirTemperature ::= INTEGER (0..191) -- in deg C with a -40 offset
```

XML Representation:

```
<xs:simpleType name="AmbientAirTemperature" >
      <xs:annotation>
         <xs:documentation>
            in deg C with a -40 offset
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="191"/>
      </xs:restriction>
</xs:simpleType>
```

Used by: This entry is 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_ValueList	<ASN> <XML>, and	
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.	

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

7.5 Data Element: DE_AntiLockBrakeStatus

Use: This data element reflects the current state of the Anti-Lock Brake systems status. The "Anti-Lock Brake Status" Probe Data Element is intended to inform Probe Data Users as to whether or not the vehicles Anti-Lock Brake system was engaged/activated at the time the Probe Data snapshot was taken. The element merely indicates "Engaged" or "Not Engaged". An engaged/activated Anti-Lock Brake System could indicate an extreme braking condition or a slippery roadway condition. An engaged/activated Anti-Lock Brake system triggers the vehicle's Probe Data system to take a snapshot of all vehicle Probe Data elements.

ASN.1 Representation:

```
AntiLockBrakeStatus ::= ENUMERATED {
   notEquipped (0), -- B'00  Not Equipped
   off         (1), -- B'01  Off
   on          (2), -- B'10  On
   engaged     (3)  -- B'11  Engaged
   }
```

XML Representation:

```
<xs:simpleType name="AntiLockBrakeStatus" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0) -- B&amp;apos;00  Not Equipped
            off (1) -- B&amp;apos;01  Off
            on (2) -- B&amp;apos;10  On
            engaged (3) -- B&amp;apos;11  Engaged
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 2 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
```

```
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="off"/>
               <xs:enumeration value="on"/>
               <xs:enumeration value="engaged"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

DF	DF_BrakeSystemStatus	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

7.6 Data Element: DE_BrakeAppliedPressure

Use: The applied pressure of the vehicle brake system.

ASN.1 Representation:

```
BrakeAppliedPressure ::= ENUMERATED {
   notEquipped  (0),  -- B'0000 Not Equipped
   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
   }
```

XML Representation:

```
<xs:simpleType name="BrakeAppliedPressure" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0) -- B&apos;0000 Not Equipped
            minPressure (1) -- B&apos;0001 Minimum Braking Pressure
            bkLvl 2 (2) -- B&apos;0010
            bkLvl 3 (3) -- B&apos;0011
            bkLvl 4 (4) -- B&apos;0100
            bkLvl 5 (5) -- B&apos;0101
            bkLvl 6 (6) -- B&apos;0110
            bkLvl 7 (7) -- B&apos;0111
            bkLvl 8 (8) -- B&apos;1000
            bkLvl 9 (9) -- B&apos;1001
            bkLvl 10 (10) -- B&apos;1010
            bkLvl 11 (11) -- B&apos;1011
            bkLvl 12 (12) -- B&apos;1100
            bkLvl 13 (13) -- B&apos;1101
            bkLvl 14 (14) -- B&apos;1110
            maxPressure (15) -- B&apos;1111 Maximum Braking Pressure
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 4 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="15"/>
            </xs:restriction>
```

```
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="minPressure"/>
               <xs:enumeration value="bkLvl 2"/>
               <xs:enumeration value="bkLvl 3"/>
               <xs:enumeration value="bkLvl 4"/>
               <xs:enumeration value="bkLvl 5"/>
               <xs:enumeration value="bkLvl 6"/>
               <xs:enumeration value="bkLvl 7"/>
               <xs:enumeration value="bkLvl 8"/>
               <xs:enumeration value="bkLvl 9"/>
               <xs:enumeration value="bkLvl 10"/>
               <xs:enumeration value="bkLvl 11"/>
               <xs:enumeration value="bkLvl 12"/>
               <xs:enumeration value="bkLvl 13"/>
               <xs:enumeration value="bkLvl 14"/>
               <xs:enumeration value="maxPressure"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

Used by: This entry is 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_ValueList	<ASN> <XML>	, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>	.

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

7.7 Data Element: DE_BrakeAppliedStatus

Use: A bit string enumerating the status of various brake systems (different wheels) of the vehicle. Brake applied status indicates when vehicle braking has occurred. This may be used by traffic management centers to determine that an incident or congestion may be present. It is possible for some vehicles to provide an indication of how hard the braking action is but at this time only an indication that braking has occurred is used.

ASN.1 Representation:

```
BrakeAppliedStatus ::= BIT STRING {
   -- allOff    ( ),     B'0000  The condition All Off
   leftFront    (0), -- B'0001  Left Front Active
   leftRear     (1), -- B'0010  Left Rear Active
   rightFront   (2), -- B'0100  Right Front Active
   rightRear    (3)  -- B'1000  Right Rear Active
   -- allOn     ( )      B'1111  The condition All On
```

XML Representation:

```
<xs:simpleType name="BrakeAppliedStatus-item" >
      <xs:annotation>
         <xs:appinfo>
             -- allOff    ( )  ,     B&apos;0000  The condition All Off
            leftFront (0) -- B&apos;0001  Left Front Active
            leftRear (1) -- B&apos;0010  Left Rear Active
            rightFront (2) -- B&apos;0100  Right Front Active
            rightRear (3) -- B&apos;1000  Right Rear Active
             -- allOn     ( )      B&apos;1111  The condition All On
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:int">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="leftFront"/>
               <xs:enumeration value="leftRear"/>
               <xs:enumeration value="rightFront"/>
               <xs:enumeration value="rightRear"/>
            </xs:restriction>
```

```
        </xs:simpleType >
      </xs:union>
</xs:simpleType>
<xs:simpleType name="BrakeAppliedStatus">
   <xs:list itemType="BrakeAppliedStatus-item"/>
</xs:simpleType>
```

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_BrakeSystemStatus	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>.

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

Remarks: Current thinking of the committee members to deal with issue of trailer and long-axle style vehicle is to have another message which can be used in these cases and which would convey the overall length and style of the vehicle and trailer involved.

7.8 Data Element: DE_BrakeBoostApplied

Use: A data element which when set to "on" indicates emergency braking.

This data element is an on/off value which indicates engagement of the vehicle's brake boost assist function. Brake boost assist is available on some vehicles. It detects the potential of a situation requiring maximum braking and pre-charges the brake system even before the driver presses the brake pedal. This situation is detected either by measuring a rapid release of the accelerator pedal or via a forward sensing system. Some systems also apply full braking when the driver presses the pedal, even with a light force. Multiple probe data reports re activation of brake boost at the same location is an indication of an emergency situation on the road and is therefore of use to road authorities.

ASN.1 Representation:

```
BrakeBoostApplied ::= ENUMERATED {
     notEquipped   (0),
     off           (1),
     on            (2)
     }
```

XML Representation:

```
<xs:simpleType name="BrakeBoostApplied" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0)
            off (1)
            on (2)
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="2"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="off"/>
               <xs:enumeration value="on"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

7.9 Data Element: DE_DDay

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

ASN.1 Representation:

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

XML Representation:

```
<xs:simpleType name="DDay" >
      <xs:annotation>
         <xs:documentation>
            units of days
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="31"/>
      </xs:restriction>
</xs:simpleType>
```

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

DF	DF_DDate	<ASN> <XML>, and
DF	DF_DDateTime	<ASN> <XML>, and
DF	DF_DFullTime	<ASN> <XML>, and
DF	DF_DMonthDay	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>.

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

7.10 Data Element: DE_DHour

Use: The DSRC style hour is a simple value consisting of integer values from zero to 23 representing the hours within a day. The value of 31 SHALL represent an unknown value, the range 24 to 30 is reserved.

ASN.1 Representation:

```
DHour ::= INTEGER (0..31) -- units of hours
```

XML Representation:

```
<xs:simpleType name="DHour" >
      <xs:annotation>
         <xs:documentation>
            units of hours
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="31"/>
      </xs:restriction>
</xs:simpleType>
```

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

DF	DF_DDateTime	<ASN> <XML>, and
DF	DF_DFullTime	<ASN> <XML>, and
DF	DF_DTime	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>.

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

7.11 Data Element: DE_DMinute

Use: The DSRC style minute is a simple value consisting of integer values from zero to 59 representing the minutes within an hour. The value of 63 SHALL represent an unknown value, the range 60 to 62 is reserved.

ASN.1 Representation:

```
DMinute ::= INTEGER (0..63) -- units of minutes
```

XML Representation:

```
<xs:simpleType name="DMinute" >
      <xs:annotation>
         <xs:documentation>
            units of minutes
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="63"/>
      </xs:restriction>
</xs:simpleType>
```

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

DF	DF_DDateTime	<ASN> <XML>, and
DF	DF_DFullTime	<ASN> <XML>, and
DF	DF_DTime	<ASN> <XML>, and
DF	DF_UpdateVector	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>.

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

7.12 Data Element: DE_DMonth

Use: The DSRC style month is a simple value consisting of integer values from one to 12 representing the month within a year. The value of 15 SHALL represent an unknown value. The range 13 to 14 and the value zero are all reserved.

ASN.1 Representation:

```
DMonth ::= INTEGER (0..15) -- units of months
```

XML Representation:

```
<xs:simpleType name="DMonth" >
      <xs:annotation>
         <xs:documentation>
            units of months
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="15"/>
      </xs:restriction>
</xs:simpleType>
```

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> <XML>, and
DF	DF_DDateTime	<ASN> <XML>, and
DF	DF_DFullTime	<ASN> <XML>, and
DF	DF_DMonthDay	<ASN> <XML>, and
DF	DF_DYearMonth	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>.

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

7.13 Data Element: DE_DrivingWheelAngle

Use: The angle of the front (steering) wheel, expressed in a signed (to the right being positive) value with units of 0.3333 degrees and a range of plus or minus 42.33 degrees. The value of zero shall be when both wheels are pointed such as to drive the vehicle in a straight ahead direction (the tow-in angle of each side being equal and canceling each other out). A value of zero shall be sent when unknown.

ASN.1 Representation:

```
DrivingWheelAngle ::= INTEGER (-127..127)
   -- LSB units of 0.3333 degrees.
```

XML Representation:

```
<xs:simpleType name="DrivingWheelAngle" >
      <xs:annotation>
         <xs:documentation>
            LSB units of 0.3333 degrees.
            a range of 42.33 degrees each way
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:byte">
         <xs:minInclusive value="-127"/>
      </xs:restriction>
</xs:simpleType>
```

Used by: This entry is 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_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

7.14 Data Element: DE_DSecond

Use: The DSRC style second is a simple value consisting of integer values from zero to 60000 representing the milliseconds within a minute. A leap second is represented by the value 60000. The value of 65535 SHALL represent an unknown value in the range of the minute, other values from 60001 to 65534 are reserved.

ASN.1 Representation:

```
DSecond ::= INTEGER (0..65535) -- units of milliseconds
```

XML Representation:

```
<xs:simpleType name="DSecond" >
      <xs:annotation>
         <xs:documentation>
            units of milliseconds
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

Used by: This entry is directly used by the following 6 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_DDateTime	<ASN> <XML>, and
DF	DF_DTime	<ASN> <XML>, and
DF	DF_FullPositionVector	<ASN> <XML>, and
DF	DF_UpdateVector	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>.

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

Remarks: 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://en.wikipedia.org/wiki/Leap_second

7.15 Data Element: DE_DSRC MessageID

Use: The DSRC Message ID is an element used to define which type of message follows in the messages of this standard. The values for ACID and ACM of a given application are contained in a lower layer of the WSMP process, and along with the message itself, are presented to the application after being transported as a stream of bytes. This data element is typically the first byte and used to tell the receiving application how to interpret the remaining bytes (i.e. what message structure has been used).

ASN.1 Representation:

```
DSRCmsgID ::= ENUMERATED {
   reserved                    (0),
   alaCarteMessage             (1),
   basicSafetyMessage          (2),
   commonSafetyRequest         (3),
   emergencyVehicleAlert       (4),
   genericTransferMsg          (5),
   probeVehicleData            (6),
   ... -- # LOCAL_CONTENT
   }
   -- values to 127 reserved for std use
```

XML Representation:

```
<xs:simpleType name="DSRCmsgID" >
      <xs:annotation>
         <xs:appinfo>
            reserved (0)
            alaCarteMessage (1)
            basicSafetyMessage (2)
            commonSafetyRequest (3)
            emergencyVehicleAlert (4)
            genericTransferMsg (5)
            probeVehicleData (6)
         </xs:appinfo>
         <xs:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="6"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="reserved"/>
               <xs:enumeration value="alaCarteMessage"/>
               <xs:enumeration value="basicSafetyMessage"/>
               <xs:enumeration value="commonSafetyRequest"/>
               <xs:enumeration value="emergencyVehicleAlert"/>
               <xs:enumeration value="genericTransferMsg"/>
               <xs:enumeration value="probeVehicleData"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType>
            <xs:restriction base="local:DSRCmsgID" />
         </xs:simpleType>
      </xs:union>
</xs:simpleType>
```


Used by: This entry is directly used by the following 6 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>, and
MSG	MSG_CommonSafetyRequest	<ASN> <XML>, and

MSG	MSG_EmergencyVehicleAlert	<ASN> <XML>, and
MSG	MSG_GenericTransferMsg	<ASN> <XML>, and
MSG	MSG_ProbeVehicleData	<ASN> <XML>.

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

7.16 Data Element: DE_DYear

Use: The DSRC style year is a simple value consisting of integer values from zero to 9999 representing the year according to the Gregorian calendar date system. The value of zero SHALL represent an unknown value.

ASN.1 Representation:

```
DYear ::= INTEGER (0..9999) -- units of years
```

XML Representation:

```
<xs:simpleType name="DYear" >
      <xs:annotation>
         <xs:documentation>
            units of years
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="9999"/>
      </xs:restriction>
</xs:simpleType>
```

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

DF	DF_DDate	<ASN> <XML>, and
DF	DF_DDateTime	<ASN> <XML>, and
DF	DF_DFullTime	<ASN> <XML>, and
DF	DF_DYearMonth	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>.

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

7.17 Data Element: DE_ElevationConfidence

Use: This DE is used to provide to listeners the confidence interval of the 95% confidence level for the currently reported value of DE_Elevation, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

ASN.1 Representation:

```
ElevationConfidence ::= ENUMERATED {
   notEquipped (0),  -- B'0000  Not Equipped
   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)
   }
```

XML Representation:

```
<xs:simpleType name="ElevationConfidence" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0) -- B&apos;0000  Not Equipped
            elev 500 00 (1) -- B&apos;0001   (500 m)
            elev 200 00 (2) -- B&apos;0010   (200 m)
            elev 100 00 (3) -- B&apos;0011   (100 m)
            elev 050 00 (4) -- B&apos;0100   (50 m)
            elev 020 00 (5) -- B&apos;0101   (20 m)
            elev 010 00 (6) -- B&apos;0110   (10 m)
            elev 005 00 (7) -- B&apos;0111   (5 m)
            elev 002 00 (8) -- B&apos;1000   (2 m)
            elev 001 00 (9) -- B&apos;1001   (1 m)
            elev 000 50 (10) -- B&apos;1010   (50 cm)
            elev 000 20 (11) -- B&apos;1011   (20 cm)
            elev 000 10 (12) -- B&apos;1100   (10 cm)
            elev 000 05 (13) -- B&apos;1101   (5 cm)
            elev 000 02 (14) -- B&apos;1110   (2 cm)
            elev 000 01 (15) -- B&apos;1111   (1 cm)
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 4 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="15"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="elev 500 00"/>
               <xs:enumeration value="elev 200 00"/>
               <xs:enumeration value="elev 100 00"/>
               <xs:enumeration value="elev 050 00"/>
               <xs:enumeration value="elev 020 00"/>
               <xs:enumeration value="elev 010 00"/>
               <xs:enumeration value="elev 005 00"/>
               <xs:enumeration value="elev 002 00"/>
               <xs:enumeration value="elev 001 00"/>
               <xs:enumeration value="elev 000 50"/>
               <xs:enumeration value="elev 000 20"/>
               <xs:enumeration value="elev 000 10"/>
               <xs:enumeration value="elev 000 05"/>
               <xs:enumeration value="elev 000 02"/>
               <xs:enumeration value="elev 000 01"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```


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_PositionConfidenceSet	<ASN> <XML>, and	
DF	DF_ValueList	<ASN> <XML>.	

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

7.18 Data Element: DE_Elevation

Use: Elevation, a value of 3 bytes expressed in meters above the reference ellipsoid (unsigned), offset by 1 km (value of 0 = 1 km below the reference ellipsoid), and with an LSBit of 0.1 meter. Note that the offset is not part of the value range transmitted. Note that this element is 3 bytes in length.

ASN.1 Representation:

```
Elevation ::= INTEGER (0..16777215) -- 10 cm LSB with a 1Km neg offset
```

XML Representation:

```
<xs:simpleType name="Elevation" >
      <xs:annotation>
         <xs:documentation>
            10 cm LSB with a 1Km neg offset
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedInt">
         <xs:maxInclusive value="16777215"/>
      </xs:restriction>
</xs:simpleType>
```

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_FullPositionVector	<ASN> <XML>, and
DF	DF_Position3D	<ASN> <XML>, and
DF	DF_UpdateVector	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>, and
DF	DF_Height:frame	<ASN> <XML>, and
DF	DF_SpaceVector	<ASN> <XML>.

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

Remarks: The value of zero SHALL be used when an unknown elevation must be sent. The Elevation shall be taken from the spatial center of the vehicle, when a vehicle is being measured.

7.19 Data Element: DE_ExteriorLights

Use: The status of various exterior lights encoded in a bit string which can be used to relate the current vehicle settings.

The "Vehicle Exterior Lights" Probe Data Element provides the status of all exterior lights on the vehicle. As currently defined, these are: parking lights, headlights (*lo* and *hi* beam, automatic light control), fog lights, daytime running lights, turn signals (right / left) and hazard signals. Should the need for additional types of light be needed, a new data element will be added.

ASN.1 Representation:

```
ExteriorLights ::= BIT STRING {
   -- allLightsOff             ( ),     B'0000-0000
   lowBeamHeadlightsOn         (0), -- B'0000-0001
   highBeamHeadlightsOn        (1), -- B'0000-0010
   leftTurnSignalOn            (2), -- B'0000-0100
   rightTurnSignalOn           (3), -- B'0000-1000
   -- hazardSignalOn           ( ),     B'0000-1100
   automaticLightControlOn     (4), -- B'0001-0000
   daytimeRunningLightsOn      (5), -- B'0010-0000
   fogLightOn                  (6), -- B'0100-0000
   parkingLightsOn             (7)  -- B'1000-0000
```

XML Representation:

```
<xs:simpleType name="ExteriorLights-item" >
      <xs:annotation>
         <xs:appinfo>
             -- allLightsOff             ( )  ,     B&apos;0000-0000
            lowBeamHeadlightsOn (0) -- B&apos;0000-0001
            highBeamHeadlightsOn (1) -- B&apos;0000-0010
            leftTurnSignalOn (2) -- B&apos;0000-0100
            rightTurnSignalOn (3) -- B&apos;0000-1000
             -- hazardSignalOn           ( )  ,     B&apos;0000-1100
            automaticLightControlOn (4) -- B&apos;0001-0000
            daytimeRunningLightsOn (5) -- B&apos;0010-0000
            fogLightOn (6) -- B&apos;0100-0000
            parkingLightsOn (7) -- B&apos;1000-0000
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:int">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="lowBeamHeadlightsOn"/>
               <xs:enumeration value="highBeamHeadlightsOn"/>
               <xs:enumeration value="leftTurnSignalOn"/>
               <xs:enumeration value="rightTurnSignalOn"/>
               <xs:enumeration value="automaticLightControlOn"/>
               <xs:enumeration value="daytimeRunningLightsOn"/>
               <xs:enumeration value="fogLightOn"/>
               <xs:enumeration value="parkingLightsOn"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
<xs:simpleType name="ExteriorLights">
   <xs:list itemType="ExteriorLights-item"/>
</xs:simpleType>
```

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

DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>.

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

7.20 Data Element: DE_HeadingConfidence

Use: This DE is used to provide to listeners the confidence interval of the 95% confidence level for the currently reported value of DE_Heading, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

ASN.1 Representation:

```
HeadingConfidence ::= ENUMERATED {
   notEquipped (0), -- B'000  Not Equipped
   prec45deg   (1), -- B'001  45   degrees
   prec10deg   (2), -- B'010  10   degrees
   prec05deg   (3), -- B'011  5    degrees
   prec01deg   (4), -- B'100  1    degrees
```

```
   prec0-1deg  (5), -- B'101  0.1  degrees
   prec0-05deg (6), -- B'110  0.05 degrees
   prec0-01deg (7)  -- B'111  0.01 degrees
   }
```

XML Representation:

```
<xs:simpleType name="HeadingConfidence" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0) -- B&apos;000  Not Equipped
            prec45deg (1) -- B&apos;001  45   degrees
            prec10deg (2) -- B&apos;010  10   degrees
            prec05deg (3) -- B&apos;011  5    degrees
            prec01deg (4) -- B&apos;100  1    degrees
            prec0 1deg (5) -- B&apos;101  0.1  degrees
            prec0 05deg (6) -- B&apos;110  0.05 degrees
            prec0 01deg (7) -- B&apos;111  0.01 degrees
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 3 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="prec45deg"/>
               <xs:enumeration value="prec10deg"/>
               <xs:enumeration value="prec05deg"/>
               <xs:enumeration value="prec01deg"/>
               <xs:enumeration value="prec0 1deg"/>
               <xs:enumeration value="prec0 05deg"/>
               <xs:enumeration value="prec0 01deg"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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_SpeedandHeadingConfidence	<ASN> <XML>	, and
DF	DF_ValueList	<ASN> <XML>	.

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

7.21 Data Element: DE_Heading

Use: The current heading of the vehicle, expressed in signed units of 0.005493247 degrees from North (such that 65,535 such degrees represent 360 degrees). North shall be defined as the axis defined by the WSG-84 coordinate system and its reference ellipsoid. Headings "to the east" are defined as the positive direction. A 2 byte value.

ASN.1 Representation:

```
Heading ::= INTEGER (0..65535) -- LSB of 0.00549 degrees
```

XML Representation:

```
<xs:simpleType name="Heading" >
      <xs:annotation>
         <xs:documentation>
            LSB of 0.00549 degrees
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

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

DF	DF_FullPositionVector	<ASN> <XML>, and
DF	DF_UpdateVector	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>, and
DF	DF_SpaceVector	<ASN> <XML>.

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

Remarks: Note that one byte heading data elements are found in other parts of ITS.

7.22 Data Element: DE_Latitude

Use: The geographic latitude of a node, expressed in 1/8th integer microdegrees, as a 32 bit value and with reference to the horizontal datum specified by horizontalDatum.

ASN.1 Representation:

```
Latitude ::= INTEGER (-7200000000..720000000)
   -- in LSB = 1/8 micro degree
```

XML Representation:

```
<xs:simpleType name="Latitude" >
      <xs:annotation>
         <xs:documentation>
            in LSB = 1/8 micro degree
            Providing a range of plus-minus 90 degrees
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:int">
         <xs:minInclusive value="-7200000000"/>
         <xs:maxInclusive value="720000000"/>
      </xs:restriction>
</xs:simpleType>
```

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_FullPositionVector	<ASN> <XML>, and
DF	DF_Position2D	<ASN> <XML>, and
DF	DF_Position3D	<ASN> <XML>, and
DF	DF_UpdateVector	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>, and
DF	DF_SpaceVector	<ASN> <XML>.

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

7.23 Data Element: DE_LightbarInUse

Use: A data element which is set if any sort of additional visible lighting-alerting system is currently in use. This includes light bars and the various symbols they can indicate as well as arrow boards, flashing lights, (including back up alerts) and any other form of lighting not found on normal vehicles of this type or related to safety systems.

Used to reflect any type or style of visual alerting when a vehicle is progressing and transmitting DSRC messages to others nearby vehicles about its path.

Suggest a better encoding would have some provision for type of light beyond the on/off flashing mindset and include the "move left-right" flashes which are increasingly set up when the response vehicle is used as the "first cone" of the event when on scene. Also transportation response vehicles often have small arrow or sign boards on them.

ASN.1 Representation:

```
LightbarInUse ::= ENUMERATED {
     notEquipped   (0),
     notInUse      (1),
     inUse         (2),
     reserved      (3)  -- for future use
     }
   -- schoolBusLights
```

XML Representation:

```
<xs:simpleType name="LightbarInUse" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0)
            notInUse (1)
            inUse (2)
            reserved (3) -- for future use
         </xs:appinfo>
         <xs:documentation>
            schoolBusLights
            posible direction arrow board uses here too?
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="notInUse"/>
               <xs:enumeration value="inUse"/>
               <xs:enumeration value="reserved"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_EmergencyVehicleAlert	<ASN> <XML>.

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

Remarks: See also the entry for ExteriorLights.

7.24 Data Element: DE_Longitude

Use: The geographic longitude of a node, expressed in 1/8th integer microdegrees, as a 32 bit value and with reference to the horizontal datum specified by horizontalDatum.

ASN.1 Representation:

```
Longitude ::= INTEGER (-1440000000..1440000000)
   -- in LSB = 1/8 micro degree
```

XML Representation:

```
<xs:simpleType name="Longitude" >
      <xs:annotation>
         <xs:documentation>
            in LSB = 1/8 micro degree
            Providing a range of plus-minus 180 degrees
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:int">
         <xs:minInclusive value="-1440000000"/>
         <xs:maxInclusive value="1440000000"/>
      </xs:restriction>
</xs:simpleType>
```

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_FullPositionVector	<ASN> <XML>, and
DF	DF_Position2D	<ASN> <XML>, and
DF	DF_Position3D	<ASN> <XML>, and
DF	DF_UpdateVector	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>, and
DF	DF_SpaceVector	<ASN> <XML>.

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

7.25 Data Element: DE_MultiVehicleReponse

Use: A data element which is set if the vehicle transmitting believes that more than one vehicle (regardless of the dispatch or command and control organization of those vehicles or their agency) are currently in-route or involved in the response to the event. When received in a message by another vehicle OBU, this data element indicates to other vehicles that addition response vehicles may be converging to the same location and that addition 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:

```
MultiVehicleReponse ::= ENUMERATED {
     notEquipped   (0),
     singleVehicle (1),
     multiVehicle  (2),
     reserved      (3)  -- for future use
     }
```

XML Representation:

```
<xs:simpleType name="MultiVehicleReponse">
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0)
            singleVehicle (1)
            multiVehicle (2)
            reserved (3) -- for future use
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="singleVehicle"/>
               <xs:enumeration value="multiVehicle"/>
               <xs:enumeration value="reserved"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_EmergencyVehicleAlert	<ASN> <XML>.

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

7.26 Data Element: DE_ObstacleDirection

Use: As a companion data element to Obstacle Distance, this data element draws from the output of a forward sensing system to report the obstacle direction from the vehicle detecting and reporting the obstacle. The data is expressed in degrees as azimuth relative to forward direction of vehicle.

ASN.1 Representation:

```
ObstacleDirection ::= Heading -- Use the header DE for this unless it proves different.
```

XML Representation:

```
<xs:simpleType name="ObstacleDirection" >
      <xs:annotation>
         <xs:documentation>
            Use the header DE for this unless it proves different.
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base ="Heading"/>
</xs:simpleType>
```

Used by: This entry is 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_ValueList	<ASN> <XML>, and	
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.	

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

7.27 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..999) -- units of meters
```

XML Representation:

```
<xs:simpleType name="ObstacleDistance" >
      <xs:annotation>
         <xs:documentation>
            units of meters
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="999"/>
      </xs:restriction>
</xs:simpleType>
```

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

DF	DF_ValueList	<ASN> <XML>, and	
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.	

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

7.28 Data Element: DE_PayloadData

Use: A stream of octets to be exchanged.

ASN.1 Representation:

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

XML Representation:

```
<xs:complexType name="PayloadData" >
   <xs:simpleContent>
      <xs:extension base="PayloadData-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="PayloadData-string">
   <xs:restriction base="xs:base64Binary">
      <xs:minLength value="2"/>
      <xs:maxLength value="2731"/>
   </xs:restriction>
</xs:simpleType >
```

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

7.29 Data Element: DE_Payload

Use: A data element to convey bulk information as a stream of bytes.

ASN.1 Representation:

```
Payload ::= OCTET STRING (SIZE(1..64))
```

XML Representation:

```
<xs:complexType name="Payload" >
   <xs:simpleContent>
      <xs:extension base="Payload-string" >
         <xs:attribute name="EncodingType" use="required">
           <xs:simpleType>
              <xs:restriction base="xs:NMTOKEN">
                 <xs:enumeration value="base64Binary"/>
              </xs:restriction>
           </xs:simpleType>
         </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="Payload-string">
   <xs:restriction base="xs:base64Binary">
      <xs:minLength value="2"/>
      <xs:maxLength value="86"/>
   </xs:restriction>
</xs:simpleType >
```

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_Ala Carte	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>.

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

7.30 Data Element: DE_PositionConfidence

Use: This DE is used to provide to listeners the confidence interval of the 95% confidence level for the currently reported value of entries such as the DE_Position entries, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. It is used in the horizontal plane. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

ASN.1 Representation:

```
PositionConfidence ::= ENUMERATED {
   notEquipped (0),  -- B'0000  Not Equipped
   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
   }
```

XML Representation:

```
<xs:simpleType name="PositionConfidence" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0) -- B&apos;0000  Not Equipped
            a500m (1) -- B&apos;0001  500m  or about 5 * 10 ^ -3 decimal degrees
            a200m (2) -- B&apos;0010  200m  or about 2 * 10 ^ -3 decimal degrees
            a100m (3) -- B&apos;0011  100m  or about 1 * 10 ^ -3 decimal degrees
            a50m (4) -- B&apos;0100  50m   or about 5 * 10 ^ -4 decimal degrees
            a20m (5) -- B&apos;0101  20m   or about 2 * 10 ^ -4 decimal degrees
            a10m (6) -- B&apos;0110  10m   or about 1 * 10 ^ -4 decimal degrees
            a5m (7) -- B&apos;0111  5m    or about 5 * 10 ^ -5 decimal degrees
            a2m (8) -- B&apos;1000  2m    or about 2 * 10 ^ -5 decimal degrees
            a1m (9) -- B&apos;1001  1m    or about 1 * 10 ^ -5 decimal degrees
            a50cm (10) -- B&apos;1010  0.50m or about 5 * 10 ^ -6 decimal degrees
            a20cm (11) -- B&apos;1011  0.20m or about 2 * 10 ^ -6 decimal degrees
            a10cm (12) -- B&apos;1100  0.10m or about 1 * 10 ^ -6 decimal degrees
            a5cm (13) -- B&apos;1101  0.05m or about 5 * 10 ^ -7 decimal degrees
            a2cm (14) -- B&apos;1110  0.02m or about 2 * 10 ^ -7 decimal degrees
            a1cm (15) -- B&apos;1111  0.01m or about 1 * 10 ^ -7 decimal degrees
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 4 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="15"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="a500m"/>
               <xs:enumeration value="a200m"/>
               <xs:enumeration value="a100m"/>
               <xs:enumeration value="a50m"/>
               <xs:enumeration value="a20m"/>
```

```
               <xs:enumeration value="a10m"/>
               <xs:enumeration value="a5m"/>
               <xs:enumeration value="a2m"/>
               <xs:enumeration value="a1m"/>
               <xs:enumeration value="a50cm"/>
               <xs:enumeration value="a20cm"/>
               <xs:enumeration value="a10cm"/>
               <xs:enumeration value="a5cm"/>
               <xs:enumeration value="a2cm"/>
               <xs:enumeration value="a1cm"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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_PositionConfidenceSet	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>

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.

7.31 Data Element: DE_RainSensor

Use: A general sensor of rain intensity which requires further interpretation by the OEM for precise semantic meaning.

The "Rain Sensor" Probe Data Element is intended to inform Probe Data Users as to how hard it was raining/snowing in the area the vehicle was traveling at the time the Probe Data snapshot was taken. The value of the Rain Sensor data element ranges from 0-7, with 0 indicating "No Rain/Snow", 1 indicating "Light Mist", and 7 indicating "Heavy Downpour". This information could be sent to vehicles approaching the area to warn drives of raining/snowing conditions ahead or it could provide Traffic Operation Centers with locations most likely in need of a snowplow.

ASN.1 Representation:

```
RainSensor ::= ENUMERATED {
     none                (0),
     lightMist           (1),
     heavyMist           (2),
     lightRainOrDrizzle  (3),
     rain                (4),
     moderateRain        (5),
     heavyRain           (6),
     heavyDownpour       (7)
     }
```

XML Representation:

```
<xs:simpleType name="RainSensor" >
      <xs:annotation>
         <xs:appinfo>
            none (0)
            lightMist (1)
            heavyMist (2)
            lightRainOrDrizzle (3)
            rain (4)
            moderateRain (5)
            heavyRain (6)
            heavyDownpour (7)
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
```

```
            <xs:enumeration value="none"/>
            <xs:enumeration value="lightMist"/>
            <xs:enumeration value="heavyMist"/>
            <xs:enumeration value="lightRainOrDrizzle"/>
            <xs:enumeration value="rain"/>
            <xs:enumeration value="moderateRain"/>
            <xs:enumeration value="heavyRain"/>
            <xs:enumeration value="heavyDownpour"/>
         </xs:restriction>
      </xs:simpleType >
   </xs:union>
</xs:simpleType>
```

Used by: This entry is 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_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

Remarks: It is recommended that Automotive Manufacturers divide the range of their Rain Sensors into 8 resistance ranges corresponding to the above scale. For Example: a sensor that has a resistance range from 12K Ohms (Max Rain Fall) to 250 Ohms (No Rain Fall) will have the following resistance value ranges:

0=250 to 1749 Ohms
1=1750 to 3249 Ohms
2=3250 to 4749 Ohms
3=4750 to 6249 Ohms
4=6250 to 7749 Ohms
5=7750 to 9249 Ohms
6=9250 to 10749 Ohms
7= 10501 to 12000 Ohms

7.32 Data Element: DE_ResponseType

Use: The response type which this vehicle is engaged in at the time an alerting message is being sent. A this time only emergency and non-emergency are defined; however other types of operational modes are expected to be added.

The type of response which a public safety, or other type of vehicle, is engaged in when transmitting emergency alerts. Intended to be used as part of the DSRC safety message for public safety vehicles operating in the area.

ASN.1 Representation:

```
ResponseType ::= ENUMERATED {
   notInUseOrNotEquipped     (0),
   emergency                 (1),
   nonEmergency              (2),
   pursuit                   (3)
   -- all others Future Use
   }
   -- values to 127 reserved for std use
```

XML Representation:

```
<xs:simpleType name="ResponseType" >
      <xs:annotation>
         <xs:appinfo>
            notInUseOrNotEquipped (0)
            emergency (1)
            nonEmergency (2)
            pursuit (3) -- all others Future Use
         </xs:appinfo>
         <xs:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
```

```
            <xs:minInclusive value="0"/>
            <xs:maxInclusive value="3"/>
         </xs:restriction>
      </xs:simpleType>
      <xs:simpleType>
         <xs:restriction base="xs:string">
            <xs:enumeration value="notInUseOrNotEquipped"/>
            <xs:enumeration value="emergency"/>
            <xs:enumeration value="nonEmergency"/>
            <xs:enumeration value="pursuit"/>
         </xs:restriction>
      </xs:simpleType >
   </xs:union>
</xs:simpleType>
```

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_ValueList	<ASN> <XML>, and
MSG	MSG_EmergencyVehicleAlert	<ASN> <XML>

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

Remarks: There are remaining issues with this data element, and changes may occur after serious review by a number of different agencies types. For example, codes (such as NEMSIS codes) are not really uniform and understood (even within a single service); the urgency of a "code 3" run is different in different parts of the world. Perhaps the common element here is what action the receiving driver is supposed to do (nothing, follow flagman, be alert, pull over, etc.). See also some of the "mandatory" ITIS advice codes like this. For some applications, some slow speed maneuvering type codes are likely added in future editions (moving a fire truck or tow truck around an incident scene, for example).

7.33 Data Element: DE_SirenInUse

Use: A data element which is set if any sort of audible alarm is being emitted from the vehicle. This includes various common sirens as well as backup up beepers and other slow speed maneuvering alerts.

Used to reflect any type or style of audio alerting when a vehicle is progressing and transmitting DSRC messages to others about its path. Intended to be used as part of the DSRC safety message for public safety vehicles operating in the area.

ASN.1 Representation:

```
SirenInUse ::= ENUMERATED {
     notEquipped    (0),
     notInUse       (1),
     inUse          (2),
     reserved       (3)   -- for future use
     }
```

XML Representation:

```
<xs:simpleType name="SirenInUse" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0)
            notInUse (1)
            inUse (2)
            reserved (3) -- for future use
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="notInUse"/>
               <xs:enumeration value="inUse"/>
               <xs:enumeration value="reserved"/>
            </xs:restriction>
```

```
        </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_EmergencyVehicleAlert	<ASN> <XML>.

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

7.34 Data Element: DE_SpeedConfidence

Use: This DE is used to provide to listeners the confidence interval of the 95% confidence level for the currently reported value of DE_Speed, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

ASN.1 Representation:

```
SpeedConfidence ::= ENUMERATED {
   notEquipped (0), -- B'000  Not Equipped
   prec100ms   (1), -- B'001  100  meters / sec
   prec10ms    (2), -- B'010  10   meters / sec
   prec5ms     (3), -- B'011  5    meters / sec
   prec1ms     (4), -- B'100  1    meters / sec
   prec0-1ms   (5), -- B'101  0.1  meters / sec
   prec0-05ms  (6), -- B'110  0.05 meters / sec
   prec0-01ms  (7)  -- B'111  0.01 meters / sec
   }
```

XML Representation:

```
<xs:simpleType name="SpeedConfidence" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0) -- B&apos;000  Not Equipped
            prec100ms (1) -- B&apos;001  100  meters / sec
            prec10ms (2) -- B&apos;010  10   meters / sec
            prec5ms (3) -- B&apos;011  5    meters / sec
            prec1ms (4) -- B&apos;100  1    meters / sec
            prec0 1ms (5) -- B&apos;101  0.1  meters / sec
            prec0 05ms (6) -- B&apos;110  0.05 meters / sec
            prec0 01ms (7) -- B&apos;111  0.01 meters / sec
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 3 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="prec100ms"/>
               <xs:enumeration value="prec10ms"/>
               <xs:enumeration value="prec5ms"/>
               <xs:enumeration value="prec1ms"/>
               <xs:enumeration value="prec0 1ms"/>
               <xs:enumeration value="prec0 05ms"/>
               <xs:enumeration value="prec0 01ms"/>
            </xs:restriction>
```

```
        </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

DF	DF_SpeedandHeadingConfidence	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

7.35 Data Element: DE_Speed

Use: The vehicle speed expressed in signed units of 0.01 meters per second. Negative values imply the vehicle in moving in reverse.

ASN.1 Representation:

```
Speed ::= INTEGER (-32765..32765) -- Units of 0.01 m/s
```

XML Representation:

```
<xs:simpleType name="Speed" >
      <xs:annotation>
         <xs:documentation>
            Units of 0.01 m/s
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:short">
         <xs:minInclusive value="-32765"/>
         <xs:maxInclusive value="32765"/>
      </xs:restriction>
</xs:simpleType>
```

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

DF	DF_FullPositionVector	<ASN> <XML>, and
DF	DF_UpdateVector	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>, and
DF	DF_SpaceVector	<ASN> <XML>.

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

7.36 Data Element: DE_StabilityControlStatus

Use: This data element reflects the current state of the stability control systems status.

The "Stability Control Status" Probe Data Element is intended to inform Probe Data Users whether the vehicle's stability control unit was engaged at the time a Probe Data snapshot was taken. A typical stability control unit uses the vehicle's yaw rate to determine how far off-axis a vehicle is while taking a turn. This data is correlated with wheel speed, steering angle and acceleration position. If the vehicle is determined to be too far off-axis, corrective action is taken by automatically applying braking force to separate wheels independent of the driver's actions. The element informs the user if the vehicle is NOT equipped with a stability control system. If the vehicle is equipped with a stability control system, the element reports whether the system is Off, or in an Active state.

ASN.1 Representation:

```
StabilityControlStatus ::= ENUMERATED {
   notEquipped (0), -- B'00  Not Equipped
   off         (1), -- B'01  Off
   on          (2)  -- B'10  On or active

   }
```

XML Representation:

```
<xs:simpleType name="StabilityControlStatus" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0) -- B&amp;apos;00  Not Equipped
            off (1) -- B&amp;apos;01  Off
            on (2) -- B&amp;apos;10  On or active
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 2 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="2"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="off"/>
               <xs:enumeration value="on"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

DF	DF_ValueList	<ASN> <XML>, and	
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.	

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

7.37 Data Element: DE_StdTagList

Use: A set of enumerated values (one byte long) which assigns the tag value for each data element or data frame defined in the standard which could be transmitted in the WSM encoding format of encoded bytes.

ASN.1 Representation:

```
StdTagList ::= ENUMERATED {
   -- pick any single item/group below,
   reserved                    (0),
   accelandYawConfidence       (1),
   acceleration                (2),
   accelerationSet4Way         (3),
   accelerationConfidence      (4),
   airBagCount                 (5),
   ambientAirTemperature       (6),
   antiLockBrakeStatus         (7),
   appContextMark              (8),
   brakeAppliedPressure        (9),
   brakeAppliedStatus          (10),
   brakeBoostApplied           (11),
   brakeSystemStatus           (12),
   dDate                       (13),
   dDateTime                   (14),
   dDay                        (15),
   dFullTime                   (16),
   dHour                       (17),
   dMinute                     (18),
   dMonth                      (19),
   dMonthDay                   (20),
   drivingWheelAngle           (21),
   dSecond                     (22),
   dSRCmsgID                   (23),
   dTime                       (24),
   dYear                       (25),
   dYearMonth                  (26),
   elevation                   (27),
   elevationConfidence         (28),
```

```
   exteriorLights                (29),
   fullPositionVector            (30),
   heading                       (31),
   headingConfidence             (32),
   lightbarInUse                 (33),
   latitude                      (34),
   longitude                     (35),
   multiVehicleReponse           (36),
   obstacleDirection             (37),
   obstacleDistance              (38),
   position2D                    (39),
   position3D                    (40),
   positionConfidence            (41),
   positionConfidenceSet         (42),
   confidenceSet                 (43),
   rainSensor                    (44),
   responseType                  (45),
   sirenInUse                    (46),
   snapshot                      (47),
   speed                         (48),
   speedandHeadingConfidence     (49),
   speedConfidence               (50),
   stabilityControlStatus        (51),
   stdTagList                    (52),
   steeringWheelAngle            (53),
   steeringWheelAngleConfidence  (54),
   steeringWheelAngleRateOfChange (55),
   sunSensor                     (56),
   temporaryID                   (57),
   throttlePosition              (58),
   throttleConfidence            (59),
   timeConfidence                (60),
   tractionControlState          (61),
   updateVector                  (62),
   vehicleHeight                 (63),
   vehicleLength                 (64),
   vehicleMass                   (65),
   vehicleSize                   (66),
   vehicleStatusDeviceType       (67),
   vehicleType                   (68),
   vehicleWidth                  (69),
   verticalAcceleration          (70),
   verticalAccelerationThreshold (71),
   wiperRate                     (72),
   wiperStatus                   (73),
   yawRate                       (74),
   yawRateConfidence             (75),
   ...
```

XML Representation:

```
<xs:simpleType name="StdTagList" >
      <xs:annotation>
         <xs:appinfo>
             -- pick any single item/group below ,
            reserved (0)
            accelandYawConfidence (1)
            acceleration (2)
            accelerationSet4Way (3)
            accelerationConfidence (4)
            airBagCount (5)
            ambientAirTemperature (6)
            antiLockBrakeStatus (7)
            appContextMark (8)
            brakeAppliedPressure (9)
            brakeAppliedStatus (10)
            brakeBoostApplied (11)
            brakeSystemStatus (12)
            dDate (13)
            dDateTime (14)
            dDay (15)
            dFullTime (16)
            dHour (17)
            dMinute (18)
            dMonth (19)
            dMonthDay (20)
            drivingWheelAngle (21)
            dSecond (22)
            dSRCmsgID (23)
            dTime (24)
```

```
      dYear (25)
      dYearMonth (26)
      elevation (27)
      elevationConfidence (28)
      exteriorLights (29)
      fullPositionVector (30)
      heading (31)
      headingConfidence (32)
      lightbarInUse (33)
      latitude (34)
      longitude (35)
      multiVehicleReponse (36)
      obstacleDirection (37)
      obstacleDistance (38)
      position2D (39)
      position3D (40)
      positionConfidence (41)
      positionConfidenceSet (42)
      confidenceSet (43)
      rainSensor (44)
      responseType (45)
      sirenInUse (46)
      snapshot (47)
      speed (48)
      speedandHeadingConfidence (49)
      speedConfidence (50)
      stabilityControlStatus (51)
      stdTagList (52)
      steeringWheelAngle (53)
      steeringWheelAngleConfidence (54)
      steeringWheelAngleRateOfChange (55)
      sunSensor (56)
      temporaryID (57)
      throttlePosition (58)
      throttleConfidence (59)
      timeConfidence (60)
      tractionControlState (61)
      updateVector (62)
      vehicleHeight (63)
      vehicleLength (64)
      vehicleMass (65)
      vehicleSize (66)
      vehicleStatusDeviceType (67)
      vehicleType (68)
      vehicleWidth (69)
      verticalAcceleration (70)
      verticalAccelerationThreshold (71)
      wiperRate (72)
      wiperStatus (73)
      yawRate (74)
      yawRateConfidence (75)
   </xs:appinfo>
</xs:annotation>
<xs:union>
   <xs:simpleType>
      <xs:restriction base="xs:unsignedInt">
         <xs:minInclusive value="0"/>
         <xs:maxInclusive value="75"/>
      </xs:restriction>
   </xs:simpleType>
   <xs:simpleType>
      <xs:restriction base="xs:string">
         <xs:enumeration value="reserved"/>
         <xs:enumeration value="accelandYawConfidence"/>
         <xs:enumeration value="acceleration"/>
         <xs:enumeration value="accelerationSet4Way"/>
         <xs:enumeration value="accelerationConfidence"/>
         <xs:enumeration value="airBagCount"/>
         <xs:enumeration value="ambientAirTemperature"/>
         <xs:enumeration value="antiLockBrakeStatus"/>
         <xs:enumeration value="appContextMark"/>
         <xs:enumeration value="brakeAppliedPressure"/>
         <xs:enumeration value="brakeAppliedStatus"/>
         <xs:enumeration value="brakeBoostApplied"/>
         <xs:enumeration value="brakeSystemStatus"/>
         <xs:enumeration value="dDate"/>
         <xs:enumeration value="dDateTime"/>
         <xs:enumeration value="dDay"/>
         <xs:enumeration value="dFullTime"/>
         <xs:enumeration value="dHour"/>
```

```
            <xs:enumeration value="dMinute"/>
            <xs:enumeration value="dMonth"/>
            <xs:enumeration value="dMonthDay"/>
            <xs:enumeration value="drivingWheelAngle"/>
            <xs:enumeration value="dSecond"/>
            <xs:enumeration value="dSRCmsgID"/>
            <xs:enumeration value="dTime"/>
            <xs:enumeration value="dYear"/>
            <xs:enumeration value="dYearMonth"/>
            <xs:enumeration value="elevation"/>
            <xs:enumeration value="elevationConfidence"/>
            <xs:enumeration value="exteriorLights"/>
            <xs:enumeration value="fullPositionVector"/>
            <xs:enumeration value="heading"/>
            <xs:enumeration value="headingConfidence"/>
            <xs:enumeration value="lightbarInUse"/>
            <xs:enumeration value="latitude"/>
            <xs:enumeration value="longitude"/>
            <xs:enumeration value="multiVehicleReponse"/>
            <xs:enumeration value="obstacleDirection"/>
            <xs:enumeration value="obstacleDistance"/>
            <xs:enumeration value="position2D"/>
            <xs:enumeration value="position3D"/>
            <xs:enumeration value="positionConfidence"/>
            <xs:enumeration value="positionConfidenceSet"/>
            <xs:enumeration value="confidenceSet"/>
            <xs:enumeration value="rainSensor"/>
            <xs:enumeration value="responseType"/>
            <xs:enumeration value="sirenInUse"/>
            <xs:enumeration value="snapshot"/>
            <xs:enumeration value="speed"/>
            <xs:enumeration value="speedandHeadingConfidence"/>
            <xs:enumeration value="speedConfidence"/>
            <xs:enumeration value="stabilityControlStatus"/>
            <xs:enumeration value="stdTagList"/>
            <xs:enumeration value="steeringWheelAngle"/>
            <xs:enumeration value="steeringWheelAngleConfidence"/>
            <xs:enumeration value="steeringWheelAngleRateOfChange"/>
            <xs:enumeration value="sunSensor"/>
            <xs:enumeration value="temporaryID"/>
            <xs:enumeration value="throttlePosition"/>
            <xs:enumeration value="throttleConfidence"/>
            <xs:enumeration value="timeConfidence"/>
            <xs:enumeration value="tractionControlState"/>
            <xs:enumeration value="updateVector"/>
            <xs:enumeration value="vehicleHeight"/>
            <xs:enumeration value="vehicleLength"/>
            <xs:enumeration value="vehicleMass"/>
            <xs:enumeration value="vehicleSize"/>
            <xs:enumeration value="vehicleStatusDeviceType"/>
            <xs:enumeration value="vehicleType"/>
            <xs:enumeration value="vehicleWidth"/>
            <xs:enumeration value="verticalAcceleration"/>
            <xs:enumeration value="verticalAccelerationThreshold"/>
            <xs:enumeration value="wiperRate"/>
            <xs:enumeration value="wiperStatus"/>
            <xs:enumeration value="yawRate"/>
            <xs:enumeration value="yawRateConfidence"/>
          </xs:restriction>
        </xs:simpleType >
      </xs:union>
</xs:simpleType>
```


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

DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_Ala Carte	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>, and
MSG	MSG_CommonSafetyRequest	<ASN> <XML>.

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

7.38 Data Element: DE_SteeringWheelAngleConfidence

Use: This DE is used to provide to listeners the confidence interval of the 95% confidence level for the currently reported value of DE_SteeringWheelAngle, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

ASN.1 Representation:

```
SteeringWheelAngleConfidence ::= ENUMERATED {
   notEquipped (0), -- B'00  Not Equipped
   prec10deg   (1), -- B'01  2 degrees
   prec1deg    (2), -- B'10  1 degree
   prec0-02deg (3)  -- B'11  0.02 degrees
   }
```

XML Representation:

```
<xs:simpleType name="SteeringWheelAngleConfidence" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0) -- B&apos;00  Not Equipped
            prec10deg (1) -- B&apos;01  2 degrees
            prec1deg (2) -- B&apos;10  1 degree
            prec0 02deg (3) -- B&apos;11  0.02 degrees
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 2 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="prec10deg"/>
               <xs:enumeration value="prec1deg"/>
               <xs:enumeration value="prec0 02deg"/>
            </xs:restriction>
         </xs:simpleType>
      </xs:union>
</xs:simpleType>
```


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

DF	DF_AccelSteerYawRateConfidence	<ASN> <XML>, and
DF	DF_ConfidenceSet	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>.

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

7.39 Data Element: DE_SteeringWheelAngleRateOfChange

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

ASN.1 Representation:

```
SteeringWheelAngleRateOfChange ::= INTEGER (-127..127)
```

XML Representation:

```
<xs:simpleType name="SteeringWheelAngleRateOfChange" >
      <xs:annotation>
         <xs:documentation>
            LSB is 3 degrees per second
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:byte">
         <xs:minInclusive value="-127"/>
      </xs:restriction>
</xs:simpleType>
```

Used by: This entry is 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_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

Remarks: This element may be used by road maintenance operations to determine presence of an obstruction or pothole in the roadway.

7.40 Data Element: DE_SteeringWheelAngle

Use: The angle of the steering wheel, expressed in a signed (to the right being positive) value with units of 0.02 degrees.

ASN.1 Representation:

```
SteeringWheelAngle ::= INTEGER (-32767..32768)
   -- LSB units of 0.02 degrees.
   -- a range of 655.36 degrees each way
```

XML Representation:

```
<xs:simpleType name="SteeringWheelAngle" >
      <xs:annotation>
         <xs:documentation>
            LSB units of 0.02 degrees.
            a range of 655.36 degrees each way
            (1.82 full rotations in either direction)
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:int">
         <xs:minInclusive value="-32767"/>
         <xs:maxInclusive value="32768"/>
      </xs:restriction>
</xs:simpleType>
```

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

DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>.

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

7.41 Data Element: DE_SunSensor

Use: The "Sun Sensor" Probe Data Element is intended to inform Probe Data Users as to the level of Sun Light in the area the vehicle was traveling at the time the Probe Data snapshot was taken. The value of the Sun Sensor data element ranges from 0-7, with 0 indicating "Complete Darkness", 1 indicating "Minimal Sun Light", and 7 indicating "Maximum Sun Light". This information could be sent to vehicles approaching the area to tell drives to be prepared for sunny/clouding conditions ahead or a Weather Server for monitoring weather conditions in the area.

ASN.1 Representation:

```
SunSensor ::= INTEGER (0..1000)
```

XML Representation:

```
<xs:simpleType name="SunSensor" >
      <xs:annotation>
         <xs:documentation>
            units of watts / m2
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="1000"/>
      </xs:restriction>
</xs:simpleType>
```

Used by: This entry is 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_ValueList	<ASN> <XML>, and	
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.	

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

Remarks: It is recommended that Automotive Manufacturers divide the range of their Sun Sensors into 8 resistance ranges corresponding to the above scale. For Example: a sensor that has a resistance range from 12K Ohms (No Light) to 250 Ohms (Max Light) will have the following resistance value ranges:

- # 0= 10501 to 12000 Ohms
- # 1=9250 to 10749 Ohms
- # 2=7750 to 9249 Ohms
- # 3=6250 to 7749 Ohms
- # 4=4750 to 6249 Ohms
- # 5=3250 to 4749 Ohms
- # 6=1750 to 3249 Ohms
- # 7=250 to 1749 Ohms

7.42 Data Element: DE_TemporaryID

Use: This is the 6 byte random MAC/IP address, called the temporary ID, since the MAC address is randomly generated at various times according to a timer, or vehicle start-up, or possibly other events. In essence, the MAC value for a mobile OBU device (unlike a typical wireless or wired 802 device) will periodically change to ensure the overall anonymity of the vehicle. Because this value is used as a means to identify the local vehicles that are interacting during an encounter, it is used in the message set.

ASN.1 Representation:

```
TemporaryID ::= OCTET STRING (SIZE(6)) -- a 6 byte string array
```

XML Representation:

```
<xs:complexType name="TemporaryID" >
   <xs:simpleContent>
      <xs:annotation>
         <xs:documentation>
            a 6 byte string array
         </xs:documentation>
      </xs:annotation>
      <xs:extension base="TemporaryID-string" >
```

```
        <xs:attribute name="EncodingType" use="required">
          <xs:simpleType>
             <xs:restriction base="xs:NMTOKEN">
                <xs:enumeration value="base64Binary"/>
             </xs:restriction>
          </xs:simpleType>
        </xs:attribute>
      </xs:extension>
   </xs:simpleContent>
</xs:complexType>
<xs:simpleType name="TemporaryID-string">
   <xs:restriction base="xs:base64Binary">
      <xs:length value="8"/>
   </xs:restriction>
</xs:simpleType >
```

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

DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>.

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

7.43 Data Element: DE_ThrottleConfidence

Use: This DE is used to provide to listeners the confidence interval of the 95% confidence level for the currently reported value of DE_Throttle, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

ASN.1 Representation:

```
ThrottleConfidence ::= ENUMERATED {
   notEquipped     (0), -- B'00  Not Equipped
   prec10percent   (1), -- B'01  10  percent
   prec1percent    (2), -- B'10  1   percent
   prec0-5percent  (3)  -- B'11  0.5 percent
   }
```

XML Representation:

```
<xs:simpleType name="ThrottleConfidence" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0) -- B&apos;00  Not Equipped
            prec10percent (1) -- B&apos;01  10  percent
            prec1percent (2) -- B&apos;10  1   percent
            prec0 5percent (3) -- B&apos;11  0.5 percent
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 2 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="prec10percent"/>
               <xs:enumeration value="prec1percent"/>
               <xs:enumeration value="prec0 5percent"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

DF	DF_ConfidenceSet	<ASN> <XML>, and
DF	DF_SpeedandHeadingConfidence	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>.

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

7.44 Data Element: DE_ThrottlePosition

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

ASN.1 Representation:

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

XML Representation:

```
<xs:simpleType name="ThrottlePosition" >
      <xs:annotation>
         <xs:documentation>
            LSB units are 0.5 percent
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="200"/>
      </xs:restriction>
</xs:simpleType>
```

Used by: This entry is 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_ValueList	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>.

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

7.45 Data Element: DE_TimeConfidence

Use: This DE is used to provide to listeners the confidence interval of the 95% confidence level for the currently reported value of time, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

ASN.1 Representation:

```
TimeConfidence ::= ENUMERATED {
   notEquipped  (0),  -- B'0000  Not Equipped
   time-100-000 (1),  -- B'0001  100 Seconds
   time-050-000 (2),  -- B'0010  50 Seconds
   time-020-000 (3),  -- B'0011  20 Seconds
   time-010-000 (4),  -- B'0100  10 Seconds
   time-002-000 (5),  -- B'0101  2 Seconds
   time-001-000 (6),  -- B'0110  1 Second
   time-000-500 (7),  -- B'0111  0.5 Seconds
   time-000-200 (8),  -- B'1000  0.2 Seconds
   time-000-100 (9),  -- B'1001  0.1 Seconds
   time-000-050 (10), -- B'1010  0.05 Seconds
   time-000-020 (11), -- B'1011  0.02 Seconds
   time-000-010 (12), -- B'1100  0.01 Seconds
   time-000-005 (13), -- B'1101  0.005 Seconds
   time-000-002 (14), -- B'1110  0.002 Seconds
   time-000-001 (15)  -- B'1111  0.001 Seconds
   }
```

XML Representation:

```
<xs:simpleType name="TimeConfidence" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0) -- B&apos;0000  Not Equipped
            time 100 000 (1) -- B&apos;0001  100 Seconds
            time 050 000 (2) -- B&apos;0010  50 Seconds
            time 020 000 (3) -- B&apos;0011  20 Seconds
            time 010 000 (4) -- B&apos;0100  10 Seconds
            time 002 000 (5) -- B&apos;0101  2 Seconds
            time 001 000 (6) -- B&apos;0110  1 Second
            time 000 500 (7) -- B&apos;0111  0.5 Seconds
            time 000 200 (8) -- B&apos;1000  0.2 Seconds
            time 000 100 (9) -- B&apos;1001  0.1 Seconds
            time 000 050 (10) -- B&apos;1010  0.05 Seconds
            time 000 020 (11) -- B&apos;1011  0.02 Seconds
            time 000 010 (12) -- B&apos;1100  0.01 Seconds
            time 000 005 (13) -- B&apos;1101  0.005 Seconds
            time 000 002 (14) -- B&apos;1110  0.002 Seconds
            time 000 001 (15) -- B&apos;1111  0.001 Seconds
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 4 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="15"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="time 100 000"/>
               <xs:enumeration value="time 050 000"/>
               <xs:enumeration value="time 020 000"/>
               <xs:enumeration value="time 010 000"/>
               <xs:enumeration value="time 002 000"/>
               <xs:enumeration value="time 001 000"/>
               <xs:enumeration value="time 000 500"/>
               <xs:enumeration value="time 000 200"/>
               <xs:enumeration value="time 000 100"/>
               <xs:enumeration value="time 000 050"/>
               <xs:enumeration value="time 000 020"/>
               <xs:enumeration value="time 000 010"/>
               <xs:enumeration value="time 000 005"/>
               <xs:enumeration value="time 000 002"/>
               <xs:enumeration value="time 000 001"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```


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

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

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

7.46 Data Element: DE_TractionControlState

Use: The status of the vehicle traction system. The "Traction Control Status" Probe Data Element is intended to inform Probe Data Users whether one or more of the vehicle's drive wheels was slipping during an acceleration at the time the Probe Data snapshot was taken. The element informs the user if the vehicle is NOT equipped with a traction control system. If the vehicle is equipped with a traction control system, the element reports whether the system is in an Off, On or Engaged state.

ASN.1 Representation:

```
TractionControlState ::= ENUMERATED {
   notEquipped (0), -- B'00  Not Equipped
   off         (1), -- B'01  Off
   on          (2), -- B'10  On
   engaged     (3)  -- B'11  Engaged
   }
```

XML Representation:

```
<xs:simpleType name="TractionControlState" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0) -- B&apos;00  Not Equipped
            off (1) -- B&apos;01  Off
            on (2) -- B&apos;10  On
            engaged (3) -- B&apos;11  Engaged
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 2 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="off"/>
               <xs:enumeration value="on"/>
               <xs:enumeration value="engaged"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

DF	DF_BrakeSystemStatus	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

7.47 Data Element: DE_TwoByteTagList

Use: A set of values (two bytes long) which assigns the tag value for data elements or data frames NOT defined in the standard which could be transmitted in the WSM encoding format of encoded bytes. The definition of these elements (semantic meaning and transmitted byte length) is expected to be exchanged by the using parties by means outside the scope of this standard. The value range where the most significant byte is set to zero is reserved for use in mapping to existing single byte tags into this range (where the lower byte shall follow in the setting and meaning provided by the StdTagList element). The value range where the most significant byte is set to 255 shall be reserved for future use. In keeping with the general practices for ITS for expansion ranges, local values should begin to assign with an upper value of 127. So in practice the first assigned element would be 0x80, 0x01 and so on. The sub-range with an upper byte of 0x32 to 0x64 is further defined to be data of variable length where the byte following the two byte tag is the byte count of the data to follow.

ASN.1 Representation:

```
TwoByteTagList ::= INTEGER (0..65535)
    -- Values with the upper byte = 0 TO 127, or = 255
    -- are reserved for use by the DSRC std
    -- Local use should set the upper byte to 127 and above
```

XML Representation:

```
<xs:simpleType name="TwoByteTagList" >
      <xs:annotation>
         <xs:documentation>
            Values with the upper byte = 0 TO 127,  or = 255
            are reserved for use by the DSRC std
            Local use should set the upper byte to 127 and above
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

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

MSG	MSG_Ala Carte	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>, and
MSG	MSG_CommonSafetyRequest	<ASN> <XML>

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

Remarks: Note that when the first byte of a tag is zero that the lower bytes may simply be parsed as if it is a StdTagList element and the definition used for the bytes which follow it. In cases where the data content which follows this tag may be of indeterminate length (such as a string) a termination character must be agreed upon by all users of the message to enable the correct parsing of the element.

7.48 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..255)
    -- the height of the vehicle
    -- LSB units of 5 cm, range to 12.75 meters
```

XML Representation:

```
<xs:simpleType name="VehicleHeight" >
      <xs:annotation>
         <xs:documentation>
            the height of the vehicle
            LSB units of 5 cm, range to 12.75 meters
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte"/>
</xs:simpleType>
```

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

DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

Remarks: Observe that this data element is often combined with DE_VehicleWidth when used.

7.49 Data Element: DE_VehicleLength

Use: The length of the vehicle expressed in centimeters, unsigned. Note that this is a 14 bit value and it is combined with a 10 bit value to form a 3 byte data frame. When sent alone it shall occupy 2 bytes with the upper two bits being set to zero.

ASN.1 Representation:
```
VehicleLength ::= INTEGER (0..16383) -- LSB units are 1 cm
```

XML Representation:
```
<xs:simpleType name="VehicleLength" >
      <xs:annotation>
         <xs:documentation>
            LSB units are 1 cm
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="16383"/>
      </xs:restriction>
</xs:simpleType>
```

Used by: This entry is 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_ValueList	<ASN> <XML>, and
DF	DF_VehicleSize	<ASN> <XML>

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

7.50 Data Element: DE_VehicleMass

Use: The mass of the vehicle. With an LSB of 25 kg, this produces a max range of 6375kg (14,025 lbs). Mass should reflect current gross mass of vehicle and contents if known, otherwise an average laden value should be established. If cases where the mass is greater then 6375 Kg then the value of 255 shall be used.

ASN.1 Representation:
```
VehicleMass ::= INTEGER (0..255) -- mass with an LSB of 25 Kg
```

XML Representation:
```
<xs:simpleType name="VehicleMass" >
      <xs:annotation>
         <xs:documentation>
            mass with an LSB of 25 Kg
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte"/>
</xs:simpleType>
```

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

DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>, and
MSG	MSG_EmergencyVehicleAlert	<ASN> <XML>.

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

7.51 Data Element: DE_VehicleType

Use: The type (classification) of the vehicle in DSRC terms of overall size.

ASN.1 Representation:
```
VehicleType ::= ENUMERATED {
   none                 (0),  -- Not Equipped, Not known
   unknown              (1),  -- Does not fit any other category
   special              (2),  -- Special use
   moto                 (3),  -- Motorcycle
   car                  (4),  -- Passenger car
   carOther             (5),  -- Four tire single units
   bus                  (6),  -- Buses
   axleCnt2             (7),  -- Two axle, six tire single units
   axleCnt3             (8),  -- Three axle, single units
   axleCnt4             (9),  -- Four or more axle, single unit
```

```
   axleCnt4Trailer      (10), -- Four or less axle, single trailer
   axleCnt5Trailer      (11), -- Five or less axle, single trailer
   axleCnt6Trailer      (12), -- Six or more axle, single trailer
   axleCnt5MultiTrailer (13), -- Five or less axle, multi-trailer
   axleCnt6MultiTrailer (14), -- Six axle, multi-trailer
   axleCnt7MultiTrailer (15),  -- Seven or more axle, multi-trailer
   ... -- # LOCAL_CONTENT
   }
   -- values to 127 reserved for std use
```

XML Representation:

```
<xs:simpleType name="VehicleType" >
      <xs:annotation>
         <xs:appinfo>
            none (0) -- Not Equipped ,
            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 ,
            axleCnt3 (8) -- Three axle ,
            axleCnt4 (9) -- Four or more axle ,
            axleCnt4Trailer (10) -- Four or less axle ,
            axleCnt5Trailer (11) -- Five or less axle ,
            axleCnt6Trailer (12) -- Six or more axle ,
            axleCnt5MultiTrailer (13) -- Five or less axle ,
            axleCnt6MultiTrailer (14) -- Six axle ,
            axleCnt7MultiTrailer (15) -- Seven or more axle ,
         </xs:appinfo>
         <xs:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="15"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="none"/>
               <xs:enumeration value="unknown"/>
               <xs:enumeration value="special"/>
               <xs:enumeration value="moto"/>
               <xs:enumeration value="car"/>
               <xs:enumeration value="carOther"/>
               <xs:enumeration value="bus"/>
               <xs:enumeration value="axleCnt2"/>
               <xs:enumeration value="axleCnt3"/>
               <xs:enumeration value="axleCnt4"/>
               <xs:enumeration value="axleCnt4Trailer"/>
               <xs:enumeration value="axleCnt5Trailer"/>
               <xs:enumeration value="axleCnt6Trailer"/>
               <xs:enumeration value="axleCnt5MultiTrailer"/>
               <xs:enumeration value="axleCnt6MultiTrailer"/>
               <xs:enumeration value="axleCnt7MultiTrailer"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType>
            <xs:restriction base="local:VehicleType" />
         </xs:simpleType>
      </xs:union>
</xs:simpleType>
```


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_ValueList	<ASN> <XML>, and	
DF	DF_VehicleStatusDeviceType	<ASN> <XML>, and	

MSG	MSG_EmergencyVehicleAlert	<ASN> <XML>, and
MSG	MSG_ProbeVehicleData	<ASN> <XML>.

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

7.52 Data Element: DE_VehicleWidth

Use: The width of the vehicle expressed in centimeters, unsigned. Note that this is a 10 bit value and it is combined with a 14 bit value to form a 3 byte data frame. When sent alone it shall occupy 2 bytes with the upper six bits being set to zero. The width shall be the widest point of the vehicle with all factory installed equipment.

ASN.1 Representation:

```
VehicleWidth ::= INTEGER (0..1023) -- LSB units are 1 cm
```

XML Representation:

```
<xs:simpleType name="VehicleWidth" >
      <xs:annotation>
         <xs:documentation>
            LSB units are 1 cm
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort">
         <xs:maxInclusive value="1023"/>
      </xs:restriction>
</xs:simpleType>
```

Used by: This entry is 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_ValueList	<ASN> <XML>, and
DF	DF_VehicleSize	<ASN> <XML>.

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

Remarks: Observe that this data element is often combined with DE_VehicleHeight when used.

7.53 Data Element: DE_VerticalAccelerationThreshold

Use: A bit string enumerating when a preset threshold for vertical acceleration is exceeded at each wheel.

The "Wheel that exceeded Vertical G Threshold" Probe Data Element is intended to inform Probe Data Users which vehicle wheel has exceeded a pre-determined threshold of a percent change in vertical G acceleration per second at the time a Probe Data snapshot was taken. This element is primarily intended to be used in the detection of potholes and similar road abnormalities. This element only provides information for four wheeled vehicles. The element informs the user if the vehicle is NOT equipped with accelerometers on its wheels or that the system is off. When a wheel does exceed the threshold, the element provides details on the particular wheel by specifying Left Front, Left Rear, Right Front and Right Rear.

ASN.1 Representation:

```
VerticalAccelerationThreshold ::= BIT STRING {
   -- allOff    (0),     B'0000  The condition All Off or not equipped
   leftFront    (0), -- B'0001  Left Front Event
   leftRear     (1), -- B'0010  Left Rear Event
   rightFront   (2), -- B'0100  Right Front Event
   rightRear    (3)  -- B'1000  Right Rear Event
```

XML Representation:

```
<xs:simpleType name="VerticalAccelerationThreshold-item" >
      <xs:annotation>
         <xs:appinfo>
             -- allOff    (0)  ,     B&apos;0000  The condition All Off or not equipped
            leftFront (0) -- B&apos;0001  Left Front Event
            leftRear (1) -- B&apos;0010  Left Rear Event
            rightFront (2) -- B&apos;0100  Right Front Event
            rightRear (3) -- B&apos;1000  Right Rear Event
         </xs:appinfo>
```

```
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:int">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="leftFront"/>
               <xs:enumeration value="leftRear"/>
               <xs:enumeration value="rightFront"/>
               <xs:enumeration value="rightRear"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
<xs:simpleType name="VerticalAccelerationThreshold">
   <xs:list itemType="VerticalAccelerationThreshold-item"/>
</xs:simpleType>
```

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_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

7.54 Data Element: DE_VerticalAcceleration

Use: A data element representing the signed vertical acceleration of the vehicle along the vertical axis in units of 0.080 meters per second squared. This provides a range of over 1G in each direction in a one byte value.

ASN.1 Representation:

```
VerticalAcceleration ::= INTEGER (-127..127) -- LSB units are 0.080 m/s^2
```

XML Representation:

```
<xs:simpleType name="VerticalAcceleration" >
      <xs:annotation>
         <xs:documentation>
            LSB units are 0.080 m/s^2
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:byte">
         <xs:minInclusive value="-127"/>
      </xs:restriction>
</xs:simpleType>
```

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

DF	DF_AccelerationSet4Way	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

7.55 Data Element: DE_WiperRate

Use: The current rate at which wiper sweeps are taking place on the subject vehicle. In units of sweeps per minute. Use a value of 1 for any sweep rate with a period greater than 60 seconds.

ASN.1 Representation:

```
WiperRate ::= INTEGER (0..255) -- units of sweeps per minute
```

XML Representation:

```
<xs:simpleType name="WiperRate" >
      <xs:annotation>
         <xs:documentation>
            units of sweeps per minute
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte"/>
</xs:simpleType>
```

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

DF	DF_ValueList	<ASN> <XML>	, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>	.

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

7.56 Data Element: DE_WiperStatus

Use: The current status of the wiper system on the subject vehicle.

The "Wiper Status" Probe Data Element is intended to inform Probe Data Users whether or not it was raining/snowing at the vehicles location at the time the Probe Data snapshot was taken. The element also provides an indication as to how hard it was raining/snowing by including the "Swipes Per Minute" of the wiper blades across the windshield. The higher the "Swipes Per Minute", the harder it was raining/snowing. The element also includes whether the wipers were turned on manually (driver activated) or automatically (rain sensor activated) to provide additional information as to driving conditions in the area of the vehicle.

ASN.1 Representation:

```
WiperStatus ::= ENUMERATED {
     notEquipped         (0),
     off                 (1),
     intermittent        (2),
     low                 (3),
     high                (4),
     automaticPresent  (256), -- Auto wipper equipped
     ... -- # LOCAL_CONTENT
     }
```

XML Representation:

```
<xs:simpleType name="WiperStatus" >
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0)
            off (1)
            intermittent (2)
            low (3)
            high (4)
            automaticPresent (256) -- Auto wipper equipped
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="256"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="off"/>
               <xs:enumeration value="intermittent"/>
               <xs:enumeration value="low"/>
               <xs:enumeration value="high"/>
               <xs:enumeration value="automaticPresent"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType>
            <xs:restriction base="local:WiperStatus" />
```

```
      </xs:simpleType>
   </xs:union>
</xs:simpleType>
```

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

DF	DF_ValueList	<ASN> <XML>, and	
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.	

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

Remarks: See also the data element WiperRate which conveys the current sweep rate of wiper strokes.

7.57 Data Element: DE_YawRateConfidence

Use: This DE is used to provide to listeners the confidence interval of the 95% confidence level for the currently reported value of DE_YAWRate, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate yaw rate. This data element is only to provide the listener with information on the limitations of the sensing system; not to support any type of automatic error correction or to imply a guaranteed maximum error. This data element should not be used for fault detection or diagnosis, but if a vehicle is able to detect a fault, the confidence interval should be increased accordingly.

The frame of references and axis of rotation used shall be accordance with that defined in SAE J670, Issued 1976-07 and its successors. Note the definitions provided in Figure 1 (Tire Axis System) and Figure 2 (Directional Control Axis Systems).

ASN.1 Representation:

```
YawRateConfidence ::= ENUMERATED {
   notEquipped    (0), -- B'000  Not Equipped
   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
   }
```

XML Representation:

```
<xs:simpleType name="YawRateConfidence">
      <xs:annotation>
         <xs:appinfo>
            notEquipped (0) -- B&apos;000  Not Equipped
            degSec 100 00 (1) -- B&apos;001  100  deg/sec
            degSec 010 00 (2) -- B&apos;010  10   deg/sec
            degSec 005 00 (3) -- B&apos;011  5    deg/sec
            degSec 001 00 (4) -- B&apos;100  1    deg/sec
            degSec 000 10 (5) -- B&apos;101  0.1  deg/sec
            degSec 000 05 (6) -- B&apos;110  0.05 deg/sec
            degSec 000 01 (7) -- B&apos;111  0.01 deg/sec
         </xs:appinfo>
         <xs:documentation>
            Encoded as a 3 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="notEquipped"/>
               <xs:enumeration value="degSec 100 00"/>
               <xs:enumeration value="degSec 010 00"/>
               <xs:enumeration value="degSec 005 00"/>
               <xs:enumeration value="degSec 001 00"/>
               <xs:enumeration value="degSec 000 10"/>
```

```
            <xs:enumeration value="degSec 000 05"/>
            <xs:enumeration value="degSec 000 01"/>
         </xs:restriction>
      </xs:simpleType >
   </xs:union>
</xs:simpleType>
```

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

DF	DF_AccelSteerYawRateConfidence	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

7.58 Data Element: DE_YawRate

Use: The Yaw Rate of the vehicle, a signed value (to the right being positive) and expressed in 0.01 degrees per second. The "Yaw Rate" Probe Data Element is used in conjunction with the "Yaw Rate Confidence" Probe Data Element to inform Probe Data Users on the amount of a vehicle's rotation about it's longitudinal axis within a certain time period at the time a Probe Data snapshot was taken. The Yaw Rate Element reports the vehicle's rotation in degrees per second with the Yaw Rate Confidence Element providing additional information on the coarseness of the Yaw Rate element also in degrees per second

ASN.1 Representation:

```
YawRate ::= INTEGER (0..65535) -- LSB units of 0.01 degrees per second
```

XML Representation:

```
<xs:simpleType name="YawRate" >
   <xs:annotation>
      <xs:documentation>
         LSB units of 0.01 degrees per second
      </xs:documentation>
   </xs:annotation>
   <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

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

DF	DF_AccelerationSet4Way	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
DF	DF_VehicleStatusDeviceType	<ASN> <XML>.

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

8. EXTERNAL DATA ENTRIES

Data entries specified in Clauses 6 and 7 are also composed of message elements defined by other standards bodies. These "foreign" elements are defined in the sections which follow. These definitions were taken from the then-current adopted standards of these organizations when possible, and from the best available sources when not. The referenced standards shall be consulted for further information regarding their proper use. Unless otherwise noted in each entry, the below ASN.1 and XML definitions shall be taken as the governing definition when used in this standard, even when a more current standard is adopted by the issuing organization. Deployment needs to approach the elements in this section with caution as they are subject to change and can be difficult to coordinate. It is important that the deployment have a firm grasp of the definitions to be used in this area. When changes and improvements are made, ensure that all parties are involved and coordinated.

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 to be normative as well. In addition, the commentary provided with each entry may also provide additional normative restrictions on the proper use of the entry which shall be followed. The XML productions follow directly from the ASN.1 specifications and the same rules shall be applied.

8.1 Data Element: DE_Extent [ATIS]

Use: The spatial distance over which this message applies and should be presented to the driver. Under certain conditions some messages may never be shown to the driver of a vehicle if they are short in duration and other conflicting needs supercede the display until such time as the subject message is no longer relevant.

ASN.1 Representation:

```
Extent ::= ENUMERATED {
    useInstantlyOnly   (0),
    useFor3meters      (1),
    useFor10meters     (2),
    useFor50meters     (3),
    useFor100meters    (4),
    useFor500meters    (5),
    useFor1000meters   (6),
    useFor5000meters   (7),
    forever          (255)  -- very wide area
    }
    -- encode as a single byte
```

XML Representation:

```
<xs:simpleType name="Extent" >
      <xs:annotation>
         <xs:appinfo>
            useInstantlyOnly (0)
            useFor3meters (1)
            useFor10meters (2)
            useFor50meters (3)
            useFor100meters (4)
            useFor500meters (5)
            useFor1000meters (6)
            useFor5000meters (7)
            forever (255) -- very wide area
         </xs:appinfo>
         <xs:documentation>
            encode as a single byte
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="255"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="useInstantlyOnly"/>
               <xs:enumeration value="useFor3meters"/>
               <xs:enumeration value="useFor10meters"/>
               <xs:enumeration value="useFor50meters"/>
               <xs:enumeration value="useFor100meters"/>
               <xs:enumeration value="useFor500meters"/>
               <xs:enumeration value="useFor1000meters"/>
               <xs:enumeration value="useFor5000meters"/>
               <xs:enumeration value="forever"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

8.2 Data Element: DE_FurtherInfoID [ATIS]

Use: This data element provides a link number to other messages (described here and in other message set standards) which relate to the same event. Use zero when unkown or not present.

ASN.1 Representation:

```
FurtherInfoID ::= INTEGER (0..65535)
   -- a link to any other incident
   -- information data that may be available
   -- in the normal ATIS incident description
   -- or other messages
```

XML Representation:

```
<xs:simpleType name="FurtherInfoID" >
      <xs:annotation>
         <xs:documentation>
            a link to any other incident
            information data that may be available
            in the normal ATIS incident description
            or other messages
            two bytes in length
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

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

Remarks: Some message sets allow a request of other relevant messages by use of this ID, some others do not. Some messages do not yet support this ID and force the message receiver to sort the recovered message to align event geographically. This is expected to be an area of harmonization. Developers should also note that data from different source agencies can vary with the numbering used as well.

8.3 Data Element: DE_MAYDAY_Heading_number [ATIS]

Use: The value of heading. This element is used to convey the heading of the device when moving. Units are in 360/254 degrees where the value of 0x00 is taken to be due north, 0x01 is taken to be slightly east of north.

ASN.1 Representation:

```
Heading ::= INTEGER (0..255)
     -- Vaild Encoding rules , an unsigned 8 bit value
     -- 0 = due north, larger going clockwise (east of north)
     -- (0..253) 360/254 degrees per bit
     -- 254 = no heading at all (stationary)
     -- determined by
     -- examining the velocity DE
     -- 255 = heading not known
```

XML Representation:

```
<xs:simpleType name="Heading" >
      <xs:annotation>
         <xs:documentation>
            Vaild Encoding rules ,  an unsigned 8 bit value
            0 = due north,  larger going clockwise  (east of north)
            (0..253)  360/254 degrees per bit
            254 = no heading at all  (stationary)
            determined by
            examining the velocity DE
            255 = heading not known
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte"/>
</xs:simpleType>
```

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

DF	DF_FullPositionVector	<ASN> <XML>, and
DF	DF_UpdateVector	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and
MSG	MSG_BasicSafetyMessage	<ASN> <XML>, and
DF	DF_SpaceVector	<ASN> <XML>.

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

Formula: Encode as an unsigned 8 bit value with 0 = due north, increasing going clockwise (east of north) and (0..253) 360/254 degrees per bit. Use values of 254 = no heading at all (stationary) and 255 = heading not known.

Remarks: No accuracy requirement known. Note that magnetic north can vary from giod north considerably and in the presence of local objects. This element was originally defined in J2313. From Section 8.12 "Heading."

8.4 Data Element: DE_MAYDAY_Location_quality_code [ATIS]

Use: A value representing the "goodness" of the position estimate (accuracy). The element is used to convey the relative quality of a GPS generated location. This quality value is enumerated as shown, as follows below.

ASN.1 Representation:

```
Location-quality ::= ENUMERATED {
     loc-qual-bt1m       (0), -- quality better than 1 meter
     loc-qual-bt5m       (1), -- quality better than 5 meters
     loc-qual-bt12m      (2), -- quality better than 12.5 meters
     loc-qual-bt50m      (3), -- quality better than 50 meters
     loc-qual-bt125m     (4), -- quality better than 125 meters
     loc-qual-bt500m     (5), -- quality better than 500 meters
     loc-qual-bt1250m    (6), -- quality better than 1250 meters
     loc-qual-unknown    (7) -- quality value unknown
     } -- 3 bits, appends with loc-tech to make one octet (0..7)
```

XML Representation:

```
<xs:simpleType name="Location-quality" >
      <xs:annotation>
         <xs:appinfo>
            loc qual bt1m (0) -- quality better than 1 meter
            loc qual bt5m (1) -- quality better than 5 meters
            loc qual bt12m (2) -- quality better than 12.5 meters
            loc qual bt50m (3) -- quality better than 50 meters
            loc qual bt125m (4) -- quality better than 125 meters
            loc qual bt500m (5) -- quality better than 500 meters
            loc qual bt1250m (6) -- quality better than 1250 meters
            loc qual unknown (7) -- quality value unknown
         </xs:appinfo>
         <xs:documentation>
            3 bits,  appends with loc-tech to make one octet  (0..7)
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="7"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="loc qual bt1m"/>
               <xs:enumeration value="loc qual bt5m"/>
               <xs:enumeration value="loc qual bt12m"/>
               <xs:enumeration value="loc qual bt50m"/>
               <xs:enumeration value="loc qual bt125m"/>
               <xs:enumeration value="loc qual bt500m"/>
               <xs:enumeration value="loc qual bt1250m"/>
               <xs:enumeration value="loc qual unknown"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

Remarks: This element was originally defined in J2313. From Section 8.35 "Location-Quality." This element is used by the IEEE IM effort relating to the accuracy of location information.

8.5 Data Element: DE_MAYDAY_Location_tech_code [ATIS]

Use: The technology used to determine the position of the vehicle. This element is used to convey what type of technology was used to determine the position (other elements it is used with in messages). The nav-system flag in the sender flag word shall be set to reflect the device technologies available.

ASN.1 Representation:

```
Location-tech ::= ENUMERATED {
     loc-tech-unknown     (0), -- technology type unknown
     loc-tech-GPS         (1), -- GPS technology only
     loc-tech-DGPS        (2), -- differential GPS (DGPS) technology
     loc-tech-drGPS       (3), -- dead reckoning system w/GPS
     loc-tech-drDGPS      (4), -- dead reckoning system w/DGPS
     loc-tech-dr          (5), -- dead reckoning only
     loc-tech-nav         (6), -- autonomous navigation system on-board
     ...,
     loc-tech-fault       (31) -- feature is not working
     }    -- (0..31) 5 bits, appends with loc-quality to make one octet
```

XML Representation:

```
<xs:simpleType name="Location-tech" >
      <xs:annotation>
         <xs:appinfo>
            loc tech unknown (0) -- technology type unknown
            loc tech GPS (1) -- GPS technology only
            loc tech DGPS (2) -- differential GPS  (DGPS)  technology
            loc tech drGPS (3) -- dead reckoning system w/GPS
            loc tech drDGPS (4) -- dead reckoning system w/DGPS
            loc tech dr (5) -- dead reckoning only
            loc tech nav (6) -- autonomous navigation system on-board
            loc tech fault (31) -- feature is not working
         </xs:appinfo>
         <xs:documentation>
            (0..31)  5 bits,  appends with loc-quality to make one octet
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="31"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="loc tech unknown"/>
               <xs:enumeration value="loc tech GPS"/>
               <xs:enumeration value="loc tech DGPS"/>
               <xs:enumeration value="loc tech drGPS"/>
               <xs:enumeration value="loc tech drDGPS"/>
               <xs:enumeration value="loc tech dr"/>
               <xs:enumeration value="loc tech nav"/>
               <xs:enumeration value="loc tech fault"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```


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

Remarks: This element was originally defined in J2313. From Section 8.15 "Location-Tech."

8.6 Data Element: DE_Priority [ATIS]

Use: A priority for the alert message, giving urgency of this message. A relative degree of merit compared with other similar messages for this type (not other message being sent by the device, nor a priority of display urgency at the receiver).

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 drive is of only modest impact. The value 111xxxxx shall be the highest level of priority and shall be consider the most important level. When choices of display order or transmission order are considered, messages with this level of priority shall be given precedence. The remaining 6 levels shall be used as determined by local conventions.

ASN.1 Representation:

```
Priority ::= INTEGER (0..255)
    -- Follow definition notes on setting these bits
```

XML Representation:

```
<xs:simpleType name="Priority" >
      <xs:annotation>
         <xs:documentation>
            Follow definition notes on setting these bits
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte"/>
</xs:simpleType>
```

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

DF	DF_Application Context Mark	<ASN> <XML>, and
MSG	MSG_RoadSideAlert	<ASN> <XML>.

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

Remarks: Note that a well chosen roadway with a set of priority schemes chosen to be very well managed can be thrown into chaos when an incident event occurs in it and when emergency response equipment enters the transmission zone during the response to the event. Local agreements on practices, including road side unit (RSU) placement, will be needed to insure correct operation.

8.7 Data Element: DE_Speed [ATIS]

Use: Need to define.

ASN.1 Representation:

```
Speed ::= INTEGER (0..100) -- edit to proper ranges
```

XML Representation:

```
<xs:simpleType name="Speed" >
      <xs:annotation>
         <xs:documentation>
            edit to proper ranges
         </xs:documentation>
      </xs:annotation>
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="100"/>
      </xs:restriction>
</xs:simpleType>
```

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

DF	DF_FullPositionVector	<ASN> <XML>, and
DF	DF_UpdateVector	<ASN> <XML>, and
DF	DF_ValueList	<ASN> <XML>, and

MSG	MSG_BasicSafetyMessage	<ASN> <XML>, and
DF	DF_SpaceVector	<ASN> <XML>.

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

8.8 Message: MSG_RoadSideAlert [ATIS]

Use: This message is used to send alerts for nearby hazards to travelers. Unlike most 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 the alerting of roadway hazards; not for vehicle cooperative communications, mayday, or other safety applications (see SAE J2735 for these). 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 space vector section of the message gives a simple vector for where the hazard is located (fixed or moving) and can be used to filter some messages as being not applicable. Consider a "train approaching" message which indicates the train is in fact traveling away from the receiver. The basic messages types themselves are represented in the standard ITIS codes send only in their integer representation formats. This ITIS list is national in scope, never outdated (items can only be added), and in this use does not allow local additions, refer to SAE J2540-1 for the complete code list. A priority level for the message is also sent, which may be matched to various other priorities in the cockpit to determine the order and type of message presentation to minimize driver distraction. Message transmission priority is typically handled in the IEEE 1609 standard layer in the application stack and is a function of the application type. A duration field provides a gross level for the range (distance) of applicability for the message over distance. For example, some messages are no longer meaningful to the traveler once the vehicle has moved a distance down the roadway link.

In many cases a complex event will also be explained in the other ATIS messages, and a linkage value is given in those cases when such data is available. Note that this message is often hard coded in transmission, that the byte ordering is known and fixed, and therefore no tagging is required to denote internal elements. The tail element is not used when transmitted over DSRC media and using the Wave Short Message (WSM) protocol to preserve the fixed and known byte size of the message. The message in this form is exactly 37 bytes in length.

ASN.1 Representation:

```
RoadSideAlert ::= SEQUENCE {
   typeEvent      ITIS.ITIScodes
                  -- a category and an item from that category
                  -- all ITS uses use the same types here
                  -- to explain the type of  the
                  -- alert / danger / hazard involved
                  -- two bytes in length
   description    SEQUENCE (SIZE(8)) OF ITIS.ITIScodes,
                  -- eight ITIS code entries to further
                  -- describe the event, give advice, or any
                  -- other ITIS codes
                  -- non used positions are set to zero
                  -- 16 bytes in length
   priority       Priority,
                  -- the urgency of this message, a relative
                  -- degree of merit compared with other
                  -- similar messages for this type (not other
                  -- message being sent by the device), nor a
                  -- priority of display urgency
                  -- one byte in length
   extent         Extent,
                  -- the spatial distance over which this
                  -- message applies and should be presented
                  -- to the driver
                  -- one byte in length
   spaceVector    SpaceVector,
                  -- a compact summary of the position,
                  -- heading, rate of speed, etc of the
                  -- event in question. Including stationary
```

```
                -- and wide area events.
                -- 15 bytes in length
   furtherInfoID FurtherInfoID
                -- a link to any other incident
                -- information data that may be available
                -- in the normal ATIS incident description
                -- or other messages
                -- two bytes in length
    }
    -- note that typically the above is encoded as a
    -- sequence of 37 known bytes when send over DSRC media
```

XML Representation:

```
<xs:element name="roadSideAlert" type="RoadSideAlert"/>
<xs:complexType name="RoadSideAlert" >
      <xs:annotation>
         <xs:documentation>
            note that typically the above is encoded as a
            sequence of 37 known bytes when send over DSRC media
         </xs:documentation>
      </xs:annotation>
      <xs:sequence>
         <xs:element name="typeEvent" >
            <xs:simpleType>
               <xs:restriction base ="itis:ITIScodes"/>
            </xs:simpleType>
         </xs:element>
         <!-- a category and an item from that category
         all ITS stds use the same types here
         to explain the type of  the
         alert / danger / hazard involved
         two bytes in length -->
         <xs:element name="description" >
            <xs:complexType>
               <xs:sequence minOccurs="8" maxOccurs="8">
                  <xs:element name="description-item" >
                     <xs:simpleType>
                        <xs:restriction base ="itis:ITIScodes"/>
                     </xs:simpleType>
                  </xs:element>
                  <!-- eight ITIS code entries to further describe the event,  give advice,  or any other ITIS
codes non used positions are set to zero 16 bytes in length -->
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <xs:element name="priority" type="Priority" />
         <!-- the urgency of this message, a relative
         degree of merit compared with other
         similar messages for this type  (not other
         message being sent by the device) ,  nor a
         priority of display urgency
         one byte in length -->
         <xs:element name="extent" type="Extent" />
         <!-- the spatial distance over which this
         message applies and should be presented
         to the driver
         one byte in length -->
         <xs:element name="spaceVector" type="SpaceVector" />
         <!-- a compact summary of the position,
         heading,  rate of speed,  etc of the
         event in question. Including stationary
         and wide area events.
         15 bytes in length -->
         <xs:element name="furtherInfoID" type="FurtherInfoID" />
         <!-- a link to any other incident
         information data that may be available
         in the normal ATIS incident description
         or other messages
         two bytes in length -->
      </xs:sequence>
</xs:complexType>
```

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

Remarks: Updated to conform to current styles and DSRC needs in the this (3rd) revision of the ATIS standard. Deployments should also consult SAE J2735 "DSRC Message Set" for several additional use cases dealing with mobile and stationary public safety vehicles using this message. When used in other public safety messages, additonal elements may be appended to form new message types.

8.9 Data Frame: DF_SpaceVector [ATIS]

Use: This data frame provides a concise summary of an object's position (X,Y,Z) and motion vector (heading and rate of speed), as well as the positioning technology employed and relative accuracy expected. Typically, this vector is applied to stationary items, such as the location of an event, or to a moving location where the relative offset distance and the heading vector with respect to the listener is most important. If the position is not known, values of zero would be used in X,Y,Z. If the heading or speed is not known, values of zero shall be used. Observe that the 32-bit values for Lat-Long provides a least significant bit (a resolution) of approximately 4 inches in North America.

ASN.1 Representation:

```
SpaceVector ::= SEQUENCE  {
    lat       DSRC.Latitude,    -- a 4 byte value
    long      DSRC.Longitude,   -- a 4 byte value
    heading   Heading,          -- a 1 byte value from geoids north
    speed     Speed,            -- a 2 byte field in units
                                -- of 0.01 meters per second
    vertical  DSRC.Elevation,   -- 3 byte field
    techType  Location-tech,    -- how the position was obtained, acts
                                -- as a relative measure of merit
                                -- from [SAE-J2313::Location-tech]
    quality   Location-quality  -- estimate of accuracy for this location
                                -- from [SAE-J2313::Location-quality]
                                -- above two items form one 8 bit field
    }
    -- this element fits in exactly 15 bytes
```

XML Representation:

```
<xs:complexType name="SpaceVector" >
      <xs:annotation>
         <xs:documentation>
            this element fits in exactly 15 bytes
         </xs:documentation>
      </xs:annotation>
      <xs:sequence>
         <xs:element name="lat" type="dsrc:Latitude" />
         <!-- a 4 byte value -->
         <xs:element name="long" type="dsrc:Longitude" />
         <!-- a 4 byte value -->
         <xs:element name="heading" type="Heading" />
         <!-- a 1 byte value from geoids north -->
         <xs:element name="speed" type="Speed" />
         <!-- a 2 byte field in units
         of 0.01 meters per second -->
         <xs:element name="vertical" type="dsrc:Elevation" />
         <!-- 3 byte field -->
         <xs:element name="techType" type="Location-tech" />
         <!-- how the position was obtained,  acts
         as a relative measure of merit
         from [SAE-J2313::Location-tech] -->
         <xs:element name="quality" type="Location-quality" />
         <!-- estimate of accuracy for this location
         from [SAE-J2313::Location-quality]
         above two items form one 8 bit field -->
      </xs:sequence>
</xs:complexType>
```

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

Remarks: The definitions for Lat-Long etc. follow those defined and found elsewhere in the SAE J2735 work on DSRC message sets, which in turn are derived from the normal LRMS definitions.

8.10 Data Element: DE_HorizontalDatum:cd [LRMS]

Use: The underlying horizontal geodetic datum for a geographic coordinate.

ASN.1 Representation:

```
HorizontalDatum ::= ENUMERATED {wgs-84          (0),
 wgs-84egm-96     (1),
 nad83            (2),
 nad27            (3),
 ... -- # LOCAL_CONTENT
}
```

XML Representation:

```
<xs:simpleType name="HorizontalDatum" >
      <xs:annotation>
         <xs:appinfo>
            wgs 84 (0)
            wgs 84egm 96 (1)
            nad83 (2)
            nad27 (3)
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="wgs 84"/>
               <xs:enumeration value="wgs 84egm 96"/>
               <xs:enumeration value="nad83"/>
               <xs:enumeration value="nad27"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType>
            <xs:restriction base="local:HorizontalDatum" />
         </xs:simpleType>
      </xs:union>
</xs:simpleType>
```

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

8.11 Data Element: DE_Incident Response Equipment [ITIS]

Use: The ITIS enumeration list commonly refered to as "Incident Response Equipment," is assigned the upper byte value of [39] (which provides for value ranges from 9984 to 10239, inclusive). This list is formally called "IncidentResponseEquipment" in the ASN.1 and XML productions. The items in this enumeration list are not allowed to be used as an event category classification. This list contains a total of 72 different phrases. The remaining 55 values up to the lower byte value of [127] are reserved for additional "national" phrases in this byte range. Local phrases may be added to the list starting with the lower byte value of 128 and proceeding upward from there (in other words, the first value assigned for any local additions to this list would be given the value 10112).

ASN.1 Representation:

```
IncidentResponseEquipment ::= ENUMERATED {
   ground-fire-suppression          (9985),
   heavy-ground-equipment           (9986),
   aircraft                         (9988),
   marine-equipment                 (9989),
   support-equipment                (9990),
   medical-rescue-unit              (9991),
   other                            (9993),   -- Depreciated by fire standards, do not
                                              -- use
   ground-fire-suppression-other    (9994),
   engine                           (9995),
   truck-or-aerial                  (9996),
   quint                            (9997),   -- A five-function type of fire apparatus.
                                              -- The units in the movie Backdraft were
                                              -- quints
```

```
   tanker-pumper-combination        (9998),
   brush-truck                      (10000),
   aircraft-rescue-firefighting     (10001),
   heavy-ground-equipment-other     (10004),
   dozer-or-plow                    (10005),
   tractor                          (10006),
   tanker-or-tender                 (10008),
   aircraft-other                   (10024),
   aircraft-fixed-wing-tanker       (10025),
   helitanker                       (10026),
   helicopter                       (10027),
   marine-equipment-other           (10034),
   fire-boat-with-pump              (10035),
   boat-no-pump                     (10036),
   support-apparatus-other          (10044),
   breathing-apparatus-support      (10045),
   light-and-air-unit               (10046),
   medical-rescue-unit-other        (10054),
   rescue-unit                      (10055),
   urban-search-rescue-unit         (10056),
   high-angle-rescue                (10057),
   crash-fire-rescue                (10058),
   bLS-unit                         (10059),
   aLS-unit                         (10060),
   mobile-command-post              (10075),  -- Depreciated, do not use
   chief-officer-car                (10076),
   hAZMAT-unit                      (10077),
   type-i-hand-crew                 (10078),
   type-ii-hand-crew                (10079),
   privately-owned-vehicle          (10083),  -- (Often found in volunteer fire teams)
   other-apparatus-resource         (10084),  -- (Remapped from fire code zero)
   ambulance                        (10085),
   bomb-squad-van                   (10086),
   combine-harvester                (10087),
   construction-vehicle             (10088),
   farm-tractor                     (10089),
   grass-cutting-machines           (10090),
   hAZMAT-containment-tow           (10091),
   heavy-tow                        (10092),
   light-tow                        (10094),
   flatbed-tow                      (10114),
   hedge-cutting-machines           (10093),
   mobile-crane                     (10095),
   refuse-collection-vehicle        (10096),
   resurfacing-vehicle              (10097),
   road-sweeper                     (10098),
   roadside-litter-collection-crews (10099),
   salvage-vehicle                  (10100),
   sand-truck                       (10101),
   snowplow                         (10102),
   steam-roller                     (10103),
   swat-team-van                    (10104),
   track-laying-vehicle             (10105),
   unknown-vehicle                  (10106),
   white-lining-vehicle             (10107),  -- Consider using Roadwork "road marking
                                              -- operations" unless the objective is to
                                              -- refer to the specific vehicle of this
                                              -- type.  Alternative Rendering: line
                                              -- painting vehicle
   dump-truck                       (10108),
   supervisor-vehicle               (10109),
   snow-blower                      (10110),
   rotary-snow-blower               (10111),
   road-grader                      (10112),  -- Alternative term: motor grader
   steam-truck                      (10113),  -- A special truck that thaws culverts and
                                              -- storm drains
   ... -- # LOCAL_CONTENT_ITIS
   }
```


XML Representation:

```
<xs:simpleType name="IncidentResponseEquipment" >
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="9984"/>
               <xs:maxInclusive value="10239"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
```

```
      <xs:restriction base="xs:string">
         <xs:enumeration value="ground fire suppression" id="_9985"/>
         <xs:enumeration value="heavy ground equipment" id="_9986"/>
         <xs:enumeration value="aircraft" id="_9988"/>
         <xs:enumeration value="marine equipment" id="_9989"/>
         <xs:enumeration value="support equipment" id="_9990"/>
         <xs:enumeration value="medical rescue unit" id="_9991"/>
         <xs:enumeration value="other" id="_9993"/>
         <xs:enumeration value="ground fire suppression other" id="_9994"/>
         <xs:enumeration value="engine" id="_9995"/>
         <xs:enumeration value="truck or aerial" id="_9996"/>
         <xs:enumeration value="quint" id="_9997"/>
         <xs:enumeration value="tanker pumper combination" id="_9998"/>
         <xs:enumeration value="brush truck" id="_10000"/>
         <xs:enumeration value="aircraft rescue firefighting" id="_10001"/>
         <xs:enumeration value="heavy ground equipment other" id="_10004"/>
         <xs:enumeration value="dozer or plow" id="_10005"/>
         <xs:enumeration value="tractor" id="_10006"/>
         <xs:enumeration value="tanker or tender" id="_10008"/>
         <xs:enumeration value="aircraft other" id="_10024"/>
         <xs:enumeration value="aircraft fixed wing tanker" id="_10025"/>
         <xs:enumeration value="helitanker" id="_10026"/>
         <xs:enumeration value="helicopter" id="_10027"/>
         <xs:enumeration value="marine equipment other" id="_10034"/>
         <xs:enumeration value="fire boat with pump" id="_10035"/>
         <xs:enumeration value="boat no pump" id="_10036"/>
         <xs:enumeration value="support apparatus other" id="_10044"/>
         <xs:enumeration value="breathing apparatus support" id="_10045"/>
         <xs:enumeration value="light and air unit" id="_10046"/>
         <xs:enumeration value="medical rescue unit other" id="_10054"/>
         <xs:enumeration value="rescue unit" id="_10055"/>
         <xs:enumeration value="urban search rescue unit" id="_10056"/>
         <xs:enumeration value="high angle rescue" id="_10057"/>
         <xs:enumeration value="crash fire rescue" id="_10058"/>
         <xs:enumeration value="bLS unit" id="_10059"/>
         <xs:enumeration value="aLS unit" id="_10060"/>
         <xs:enumeration value="mobile command post" id="_10075"/>
         <xs:enumeration value="chief officer car" id="_10076"/>
         <xs:enumeration value="hAZMAT unit" id="_10077"/>
         <xs:enumeration value="type i hand crew" id="_10078"/>
         <xs:enumeration value="type ii hand crew" id="_10079"/>
         <xs:enumeration value="privately owned vehicle" id="_10083"/>
         <xs:enumeration value="other apparatus resource" id="_10084"/>
         <xs:enumeration value="ambulance" id="_10085"/>
         <xs:enumeration value="bomb squad van" id="_10086"/>
         <xs:enumeration value="combine harvester" id="_10087"/>
         <xs:enumeration value="construction vehicle" id="_10088"/>
         <xs:enumeration value="farm tractor" id="_10089"/>
         <xs:enumeration value="grass cutting machines" id="_10090"/>
         <xs:enumeration value="HAZMAT containment tow" id="_10091"/>
         <xs:enumeration value="heavy tow" id="_10092"/>
         <xs:enumeration value="light tow" id="_10094"/>
         <xs:enumeration value="flatbed tow" id="_10114"/>
         <xs:enumeration value="hedge cutting machines" id="_10093"/>
         <xs:enumeration value="mobile crane" id="_10095"/>
         <xs:enumeration value="refuse collection vehicle" id="_10096"/>
         <xs:enumeration value="resurfacing vehicle" id="_10097"/>
         <xs:enumeration value="road sweeper" id="_10098"/>
         <xs:enumeration value="roadside litter collection crews" id="_10099"/>
         <xs:enumeration value="salvage vehicle" id="_10100"/>
         <xs:enumeration value="sand truck" id="_10101"/>
         <xs:enumeration value="snowplow" id="_10102"/>
         <xs:enumeration value="steam roller" id="_10103"/>
         <xs:enumeration value="swat team van" id="_10104"/>
         <xs:enumeration value="track laying vehicle" id="_10105"/>
         <xs:enumeration value="unknown vehicle" id="_10106"/>
         <xs:enumeration value="white lining vehicle" id="_10107"/>
         <xs:enumeration value="dump truck" id="_10108"/>
         <xs:enumeration value="supervisor vehicle" id="_10109"/>
         <xs:enumeration value="snow blower" id="_10110"/>
         <xs:enumeration value="rotary snow blower" id="_10111"/>
         <xs:enumeration value="road grader" id="_10112"/>
         <xs:enumeration value="steam truck" id="_10113"/>
      </xs:restriction>
   </xs:simpleType >
   <xs:simpleType>
      <xs:restriction base="xs:string">
         <xs:pattern value="\[.+\].*"/>
      </xs:restriction>
   </xs:simpleType>
```

```
         <xs:simpleType>
            <xs:restriction base="local:IncidentResponseEquipment" />
         </xs:simpleType>
      </xs:union>
</xs:simpleType>
```

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

8.12 Data Element: DE_ITIS_Text [ITIS]

Use: Simple text used with ITIS codes.

ASN.1 Representation:

```
ITIStext ::= IA5String (SIZE(1..500))
```

XML Representation:

```
<xs:simpleType name="ITIStext" >
      <xs:restriction base="xs:string">
         <xs:minLength value="1"/>
         <xs:maxLength value="500"/>
      </xs:restriction>
</xs:simpleType>
```

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

8.13 Data Element: DE_Responder Group Affected [ITIS]

Use: The ITIS enumeration list commonly refered to as "Responder Group Affected," is assigned the upper byte value of [38] (which provides for value ranges from 9728 to 9983, inclusive). This list is formally called "ResponderGroupAffected" in the ASN.1 and XML productions. Items from this enumeration list can be used as an event category classification. This list contains a total of 14 different phrases. The remaining 113 values up to the lower byte value of [127] are reserved for additional "national" phrases in this byte range. Local phrases may be added to the list starting with the lower byte value of 128 and proceeding upward from there (in other words, the first value assigned for any local additions to this list would be given the value 9856).

ASN.1 Representation:

```
ResponderGroupAffected ::= ENUMERATED  {
   emergency-vehicle-units           (9729),  -- Default phrase, to be used when one of
                                              -- the below does not fit better
   federal-law-enforcement-units     (9730),
   state-police-units                (9731),
   county-police-units               (9732),  -- Hint: also sheriff response units
   local-police-units                (9733),
   ambulance-units                   (9734),
   rescue-units                      (9735),
   fire-units                        (9736),
   hAZMAT-units                      (9737),
   light-tow-unit                    (9738),
   heavy-tow-unit                    (9739),
   freeway-service-patrols           (9740),
   transportation-response-units     (9741),
   private-contractor-response-units (9742),
   ... -- # LOCAL_CONTENT_ITIS
   }
   -- These groups are used in coordinated response and staging area information
   -- (rather than typically consumer related)
```

XML Representation:

```
<xs:simpleType name="ResponderGroupAffected" >
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="9728"/>
               <xs:maxInclusive value="9983"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="emergency vehicle units" id="_9729"/>
```

```
            <xs:enumeration value="federal law enforcement units" id="_9730"/>
            <xs:enumeration value="state police units" id="_9731"/>
            <xs:enumeration value="county police units" id="_9732"/>
            <xs:enumeration value="local police units" id="_9733"/>
            <xs:enumeration value="ambulance units" id="_9734"/>
            <xs:enumeration value="rescue units" id="_9735"/>
            <xs:enumeration value="fire units" id="_9736"/>
            <xs:enumeration value="hAZMAT units" id="_9737"/>
            <xs:enumeration value="light tow unit" id="_9738"/>
            <xs:enumeration value="heavy tow unit" id="_9739"/>
            <xs:enumeration value="freeway service patrols" id="_9740"/>
            <xs:enumeration value="transportation response units" id="_9741"/>
            <xs:enumeration value="private contractor response units" id="_9742"/>
         </xs:restriction>
      </xs:simpleType >
      <xs:simpleType>
         <xs:restriction base="xs:string">
            <xs:pattern value="\[.+\].*"/>
         </xs:restriction>
      </xs:simpleType>
      <xs:simpleType>
         <xs:restriction base="local:ResponderGroupAffected" />
      </xs:simpleType>
   </xs:union>
</xs:simpleType>
```

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

8.14 Data Element: DE_Vehicle Groups Affected [ITIS]

Use: The ITIS enumeration list commonly refered to as "Vehicle Groups Affected," is assigned the upper byte value of [36] (which provides for value ranges from 9216 to 9471, inclusive). This list is formally called "VehicleGroupAffected" in the ASN.1 and XML productions. Items from this enumeration list can be used as an event category classification. This list contains a total of 35 different phrases. The remaining 92 values up to the lower byte value of [127] are reserved for additional "national" phrases in this byte range. Local phrases may be added to the list starting with the lower byte value of 128 and proceeding upward from there (in other words, the first value assigned for any local additions to this list would be given the value 9344).

ASN.1 Representation:

```
VehicleGroupAffected ::= ENUMERATED  {
   all-vehicles                          (9217),
   bicycles                              (9218),
   motorcycles                           (9219),  -- to include mopeds as well
   cars                                  (9220),  -- (remapped from ERM value of
                                                  -- zero)
   light-vehicles                        (9221),
   cars-and-light-vehicles               (9222),
   cars-with-trailers                    (9223),
   cars-with-recreational-trailers       (9224),
   vehicles-with-trailers                (9225),
   heavy-vehicles                        (9226),
   trucks                                (9227),
   buses                                 (9228),
   articulated-buses                     (9229),
   school-buses                          (9230),
   vehicles-with-semi-trailers           (9231),
   vehicles-with-double-trailers         (9232),  -- Alternative Rendering:  western
                                                  -- doubles
   high-profile-vehicles                 (9233),
   wide-vehicles                         (9234),
   long-vehicles                         (9235),
   hazardous-loads                       (9236),
   exceptional-loads                     (9237),
   abnormal-loads                        (9238),
   convoys                               (9239),
   maintenance-vehicles                  (9240),
   delivery-vehicles                     (9241),
   vehicles-with-even-numbered-license-plates (9242),
   vehicles-with-odd-numbered-license-plates  (9243),
   vehicles-with-parking-permits         (9244),
   vehicles-with-catalytic-converters    (9245),
   vehicles-without-catalytic-converters (9246),
   gas-powered-vehicles                  (9247),
   diesel-powered-vehicles               (9248),
```

```
   lPG-vehicles                            (9249),
   military-convoys                        (9250),
   military-vehicles                       (9251),
   ... -- # LOCAL_CONTENT_ITIS
   }
   -- Classification of vehicles and types of transport
```

XML Representation:

```
<xs:simpleType name="VehicleGroupAffected" >
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="9216"/>
               <xs:maxInclusive value="9471"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="all vehicles" id="_9217"/>
               <xs:enumeration value="bicycles" id="_9218"/>
               <xs:enumeration value="motorcycles" id="_9219"/>
               <xs:enumeration value="cars" id="_9220"/>
               <xs:enumeration value="light vehicles" id="_9221"/>
               <xs:enumeration value="cars and light vehicles" id="_9222"/>
               <xs:enumeration value="cars with trailers" id="_9223"/>
               <xs:enumeration value="cars with recreational trailers" id="_9224"/>
               <xs:enumeration value="vehicles with trailers" id="_9225"/>
               <xs:enumeration value="heavy vehicles" id="_9226"/>
               <xs:enumeration value="trucks" id="_9227"/>
               <xs:enumeration value="buses" id="_9228"/>
               <xs:enumeration value="articulated buses" id="_9229"/>
               <xs:enumeration value="school buses" id="_9230"/>
               <xs:enumeration value="vehicles with semi trailers" id="_9231"/>
               <xs:enumeration value="vehicles with double trailers" id="_9232"/>
               <xs:enumeration value="high profile vehicles" id="_9233"/>
               <xs:enumeration value="wide vehicles" id="_9234"/>
               <xs:enumeration value="long vehicles" id="_9235"/>
               <xs:enumeration value="hazardous loads" id="_9236"/>
               <xs:enumeration value="exceptional loads" id="_9237"/>
               <xs:enumeration value="abnormal loads" id="_9238"/>
               <xs:enumeration value="convoys" id="_9239"/>
               <xs:enumeration value="maintenance vehicles" id="_9240"/>
               <xs:enumeration value="delivery vehicles" id="_9241"/>
               <xs:enumeration value="vehicles with even numbered license plates" id="_9242"/>
               <xs:enumeration value="vehicles with odd numbered license plates" id="_9243"/>
               <xs:enumeration value="vehicles with parking permits" id="_9244"/>
               <xs:enumeration value="vehicles with catalytic converters" id="_9245"/>
               <xs:enumeration value="vehicles without catalytic converters" id="_9246"/>
               <xs:enumeration value="gas powered vehicles" id="_9247"/>
               <xs:enumeration value="diesel powered vehicles" id="_9248"/>
               <xs:enumeration value="lPG vehicles" id="_9249"/>
               <xs:enumeration value="military convoys" id="_9250"/>
               <xs:enumeration value="military vehicles" id="_9251"/>
            </xs:restriction>
         </xs:simpleType >
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:pattern value="\[.+\].*"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="local:VehicleGroupAffected" />
         </xs:simpleType>
      </xs:union>
</xs:simpleType>
```

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

8.15 Data Frame: DF_Angle:frame [LRMS]

Use: An angle expressed as a choice of degrees, radians, or 0.01 (centi-) degrees.

ASN.1 Representation:

```
Angle ::= CHOICE {
     deg     REAL (0..360),
     rad     REAL (0..6.2832),
     cdeg    INTEGER (0..36000) -- cdeg is in
                                -- hundredths of degrees
       }
```

XML Representation:

```
<xs:complexType name="Angle" >
      <xs:choice>
         <xs:element name="deg" >
            <xs:simpleType>
            <xs:restriction base="xs:float">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="360"/>
            </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- Warning, above may need hand editing -->
         <!-- observe that min-max restrictions have -->
         <!-- not been added to this template yet -->
         <xs:element name="rad" >
            <xs:simpleType>
            <xs:restriction base="xs:float">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="6"/>
            </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- Warning, above may need hand editing -->
         <!-- observe that min-max restrictions have -->
         <!-- not been added to this template yet -->
         <xs:element name="cdeg" >
            <xs:simpleType>
               <xs:restriction base="xs:unsignedShort">
                  <xs:maxInclusive value="36000"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <!-- cdeg is in
         hundredths of degrees -->
      </xs:choice>
</xs:complexType>
```

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

8.16 Data Frame: DF_Distance:frame [LRMS]

Use: A choice of distance values, in integer or REAL expressions. Note that data elements for REAL representations are suffixed with Dec. Distance choices are, in most cases, standard English and Metric units. The exception is 'block' and 'blkdec', which are common expressions for distance in urban areas.

ASN.1 Representation:

```
Distance ::= CHOICE {  m      INTEGER (-10000000..10000000),
          mDec   REAL (-10000000..10000000),
          mm     INTEGER (-1000000..1000000),
          mmDec  REAL (-1000000..1000000),
          dm     INTEGER (-1000000..1000000),
          dmDec  REAL (-1000000..1000000),
          yd     INTEGER (-17600000..17600000),
          ydDec  REAL (-17600000..17600000),
          ft     INTEGER (-52800000..52800000),
          ftDec  REAL (-52800000..52800000),
          in     INTEGER (-1000000..1000000),
          inDec  REAL (-1000000..1000000),
          mi     INTEGER (-10000..10000),
          miDec  REAL (-10000..10000),
```

```
        km     INTEGER (-10000..10000),
        kmDec  REAL (-10000..10000),
        block  INTEGER (-1000..1000),
        blkDec REAL (-1000..1000)
      }
```

XML Representation:

```
<xs:complexType name="Distance" >
      <xs:choice>
         <xs:element name="m" >
            <xs:simpleType>
               <xs:restriction base="xs:int">
                  <xs:minInclusive value="-10000000"/>
                  <xs:maxInclusive value="+10000000"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="mDec" >
            <xs:simpleType>
            <xs:restriction base="xs:decimal">
               <xs:minInclusive value="-10000000"/>
               <xs:maxInclusive value="+10000000"/>
            </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="mm" >
            <xs:simpleType>
               <xs:restriction base="xs:int">
                  <xs:minInclusive value="-1000000"/>
                  <xs:maxInclusive value="+1000000"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="mmDec" >
            <xs:simpleType>
            <xs:restriction base="xs:decimal">
               <xs:minInclusive value="-1000000"/>
               <xs:maxInclusive value="+1000000"/>
            </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="dm" >
            <xs:simpleType>
               <xs:restriction base="xs:int">
                  <xs:minInclusive value="-1000000"/>
                  <xs:maxInclusive value="+1000000"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="dmDec" >
            <xs:simpleType>
            <xs:restriction base="xs:decimal">
               <xs:minInclusive value="-1000000"/>
               <xs:maxInclusive value="+1000000"/>
            </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="yd" >
            <xs:simpleType>
               <xs:restriction base="xs:int">
                  <xs:minInclusive value="-17600000"/>
                  <xs:maxInclusive value="+17600000"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="ydDec" >
            <xs:simpleType>
            <xs:restriction base="xs:decimal">
               <xs:minInclusive value="-17600000"/>
               <xs:maxInclusive value="+17600000"/>
            </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="ft" >
            <xs:simpleType>
               <xs:restriction base="xs:int">
                  <xs:minInclusive value="-52800000"/>
                  <xs:maxInclusive value="+52800000"/>
               </xs:restriction>
```

```
            </xs:simpleType>
         </xs:element>
         <xs:element name="ftDec" >
            <xs:simpleType>
            <xs:restriction base="xs:decimal">
               <xs:minInclusive value="-52800000"/>
               <xs:maxInclusive value="+52800000"/>
            </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="in" >
            <xs:simpleType>
               <xs:restriction base="xs:int">
                  <xs:minInclusive value="-1000000"/>
                  <xs:maxInclusive value="+1000000"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="inDec" >
            <xs:simpleType>
            <xs:restriction base="xs:decimal">
               <xs:minInclusive value="-1000000"/>
               <xs:maxInclusive value="+1000000"/>
            </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="mi" >
            <xs:simpleType>
               <xs:restriction base="xs:short">
                  <xs:minInclusive value="-10000"/>
                  <xs:maxInclusive value="+10000"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="miDec" >
            <xs:simpleType>
            <xs:restriction base="xs:decimal">
               <xs:minInclusive value="-10000"/>
               <xs:maxInclusive value="+10000"/>
            </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="km" >
            <xs:simpleType>
               <xs:restriction base="xs:short">
                  <xs:minInclusive value="-10000"/>
                  <xs:maxInclusive value="+10000"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="kmDec" >
            <xs:simpleType>
            <xs:restriction base="xs:decimal">
               <xs:minInclusive value="-10000"/>
               <xs:maxInclusive value="+10000"/>
            </xs:restriction>
            </xs:simpleType>
         </xs:element>
        <xs:element name="block" >
            <xs:simpleType>
               <xs:restriction base="xs:short">
                  <xs:minInclusive value="-1000"/>
                  <xs:maxInclusive value="+1000"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:element>
         <xs:element name="blkDec" >
            <xs:simpleType>
            <xs:restriction base="xs:decimal">
               <xs:minInclusive value="-1000"/>
               <xs:maxInclusive value="+1000"/>
            </xs:restriction>
            </xs:simpleType>
         </xs:element>
      </xs:choice>
</xs:complexType>
```

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

Remarks: Errors in LRMS ASN.1 were corrected.

8.17 Data Frame: DF_Height:frame [LRMS]

Use: A vertical height expressed as either an altitude with respect to a vertical datum, or a vertical level from -128 to +127, where level 0 is the ground surface, or ground level of a structure. For highway intersections or other transportation features, the zero level is the ground surface level, whether or not traffic occurs on the ground surface through the intersection or brunnel. For example, for bridges, the lowest level of the bridge would be level +1 and, for tunnels, the highest level would be level -1. For parking structures or buildings, the zero level is that level called "ground" or "main" or "lobby" or "first" floor, or otherwise most closely associated with the surrounding ground surface. Note that for a building, the VerticalLevel may not correspond to the official number of or label on a floor, but refers to the relative level with respect to the zero level. This concept is useable in countries with differing numbering conventions for building floors.

ASN.1 Representation:

```
Height ::= CHOICE {
   altdatum  SEQUENCE {
      altitude       Distance,
      verticalDatum  VerticalDatum OPTIONAL
                      }, -- # UNTAGGED
   -- removed: verticalLevel  VerticalLevel
   elevation      DSRC.Elevation
```

XML Representation:

```
<xs:complexType name="Height" >
      <xs:choice>
         <xs:sequence>
            <xs:element name="altitude" type="Distance" />
            <xs:element name="verticalDatum" type="VerticalDatum"  minOccurs="0"/>
         </xs:sequence>
         <!-- removed: verticalLevel  VerticalLevel -->
         <xs:element name="elevation" type="dsrc:Elevation" />
      </xs:choice>
</xs:complexType>
```

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

Remarks: Note that in the DSRC system of use, the entry for "verticalLevel VerticalLevel" has been replaced by the local form of Elevation.

8.18 Data Frame: DF_ITIS-Codes_And_Text [ITIS]

Use: The use of ITIS codes interspersed with free text. The complete set of ITIS codes can be found in Volume Two of the J2540 Standard. This is a set of nealry 1,500 items which are used to encode common events and list items in ITS.

ASN.1 Representation:

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

XML Representation:

```
<xs:complexType name="ITIScodesAndText" >
   <xs:sequence minOccurs="1" maxOccurs="100">
      <xs:choice >
         <xs:element name="itis" type="ITIScodes" />
         <xs:element name="text" type="ITIStext" />
      </xs:choice>
   </xs:sequence>
</xs:complexType>
```

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 (and lengthy) listing of these codes and for an XML rendering.

8.19 Data Element: ESS_EssMobileFriction [NTCIP]

Use: Indicates measured coefficient of friction in percent. The value 101 shall indicate an error condition or missing value.

ASN.1 Representation:
```
EssMobileFriction ::= INTEGER (0..101)
```

XML Representation:
```
<xs:simpleType name="EssMobileFriction" >
      <xs:restriction base="xs:unsignedByte">
         <xs:maxInclusive value="101"/>
      </xs:restriction>
</xs:simpleType>
```

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

8.20 Data Element: ESS_EssPrecipRate_quantity [NTCIP]

Use: The rainfall, or water equivalent of snow, rate in tenths of grams per square meter per second (for rain, this is approximately to 0.36 mm/hr). A value of 65535 shall indicate an error condition or missing value.

ASN.1 Representation:
```
EssPrecipRate ::= INTEGER (0..65535)
```

XML Representation:
```
<xs:simpleType name="EssPrecipRate" >
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

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

8.21 Data Element: ESS_EssPrecipSituation_code [NTCIP]

Use: Describes the weather situation in terms of precipitation.

ASN.1 Representation:
```
EssPrecipSituation ::= ENUMERATED {
   other (1),
   unknown (2),
   noPrecipitation (3),
   unidentifiedSlight (4),
   unidentifiedModerate (5),
   unidentifiedHeavy (6),
   snowSlight (7),
   snowModerate (8),
   snowHeavy (9),
   rainSlight (10),
   rainModerate (11),
   rainHeavy (12),
   frozenPrecipitationSlight (13),
   frozenPrecipitationModerate (14),
   frozenPrecipitationHeavy (15)
   }
```

XML Representation:
```
<xs:simpleType name="EssPrecipSituation" >
      <xs:annotation>
         <xs:appinfo>
            other (1)
            unknown (2)
            noPrecipitation (3)
            unidentifiedSlight (4)
            unidentifiedModerate (5)
            unidentifiedHeavy (6)
```

```
            snowSlight (7)
            snowModerate (8)
            snowHeavy (9)
            rainSlight (10)
            rainModerate (11)
            rainHeavy (12)
            frozenPrecipitationSlight (13)
            frozenPrecipitationModerate (14)
            frozenPrecipitationHeavy (15)
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="1"/>
               <xs:maxInclusive value="15"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="other"/>
               <xs:enumeration value="unknown"/>
               <xs:enumeration value="noPrecipitation"/>
               <xs:enumeration value="unidentifiedSlight"/>
               <xs:enumeration value="unidentifiedModerate"/>
               <xs:enumeration value="unidentifiedHeavy"/>
               <xs:enumeration value="snowSlight"/>
               <xs:enumeration value="snowModerate"/>
               <xs:enumeration value="snowHeavy"/>
               <xs:enumeration value="rainSlight"/>
               <xs:enumeration value="rainModerate"/>
               <xs:enumeration value="rainHeavy"/>
               <xs:enumeration value="frozenPrecipitationSlight"/>
               <xs:enumeration value="frozenPrecipitationModerate"/>
               <xs:enumeration value="frozenPrecipitationHeavy"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

8.22 Data Element: ESS_EssPrecipYesNo_code [NTCIP]

Use: Indicates whether or not moisture is detected by the sensor.

ASN.1 Representation:

```
EssPrecipYesNo ::= ENUMERATED {precip (1), noPrecip (2), error (3)}
```

XML Representation:

```
<xs:simpleType name="EssPrecipYesNo" >
      <xs:annotation>
         <xs:appinfo>
            precip (1)
            noPrecip (2)
            error (3)
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="1"/>
               <xs:maxInclusive value="3"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="precip"/>
               <xs:enumeration value="noPrecip"/>
               <xs:enumeration value="error"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

Remarks: Used in ATIS to gross coverage area reports, not just point sensor measurements.

8.23 Data Element: ESS_EssSolarRadiation_quantity [NTCIP]

Use: The direct solar radiation integrated over the 24 hours preceding the observation in Joules, per square meter. A value of 65535 shall indicate a missing value.

ASN.1 Representation:

```
EssSolarRadiation ::= INTEGER (0..65535)
```

XML Representation:

```
<xs:simpleType name="EssSolarRadiation" >
      <xs:restriction base="xs:unsignedShort"/>
</xs:simpleType>
```

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

8.24 Value Domain: EXT_Int-latitude32 [LRMS]

Use: Value Domain for the geographic latitude of a node or point, expressed in integer microdegrees.

ASN.1 Representation:

```
Int-latitude32 ::= INTEGER (-90000000..90000000)
```

XML Representation:

```
<xs:simpleType name="Int-latitude32" >
      <xs:restriction base="xs:int">
         <xs:minInclusive value="-90000000"/>
         <xs:maxInclusive value="90000000"/>
      </xs:restriction>
</xs:simpleType>
```

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

8.25 Value Domain: EXT_Int-longitude32 [LRMS]

Use: Value Domain for the geographic longitude of a node or point, expressed in integer microdegrees.

ASN.1 Representation:

```
Int-longitude32 ::= INTEGER (-180000000..180000000)
```

XML Representation:

```
<xs:simpleType name="Int-longitude32" >
      <xs:restriction base="xs:int">
         <xs:minInclusive value="-180000000"/>
         <xs:maxInclusive value="180000000"/>
      </xs:restriction>
</xs:simpleType>
```

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

8.26 Data Element: EXT_ITIS_Codes [ITIS]

Use: The complete set of ITIS codes can be found in Volume Two of the J2540 Standard. This is a set of over 1,000 items which are used to encode common events and list items in ITS.

ASN.1 Representation:

```
ITIScodes ::= INTEGER (0..65565)
-- The defined list of ITIS codes are 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 deployment 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 2 other data structures in this standard (record type, descriptive name, ASN.1, and XML name (if present) of each):

DF	DF_ITIS-Codes_And_Text	<ASN> <XML>, and
MSG	MSG_RoadSideAlert	<ASN> <XML>.

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

Remarks: Refer to the SAE ITIS documents for the complete (and lengthy) listing of these codes and for an XML rendering. An XML schema is also available in the "itis" namespace for this element. Note the "over the wire" format of items in these lists is a 16-bit value in some systems, hence, the use of INTEGER above, however, it is a numbered union of values and phrases in other systems such as XML.

8.27 Data Frame: EXT_Tail [ATIS]

Use: This data structure is a way to add pairs of names and associated values to a message. It typically appears at the end of a message (hence the name tail). The value carried in this portion of the message shall not be used to circumvent the structure of the messages. That said, this is an excellent way to add further meta-data to a message or to add content which a local deployment feels is needed but which is not currently in the message set.

ASN.1 Representation:

```
TailSet ::= SEQUENCE {
     set SEQUENCE {
          name     IA5String(SIZE(1..32)),
          value    IA5String(SIZE(1..10000))
          -- any internal structure of the value string is the
          -- responsibility of the data creator to manage. If the
          -- content is binary, convert to bin hex strings.
     }
     -- the order of the sets shall not be changed
}
```

XML Representation:

```
<xs:complexType name="TailSet" >
      <xs:sequence>
         <xs:element name="set" >
            <xs:complexType>
               <xs:sequence>
                  <xs:element name="name" >
                     <xs:simpleType>
                        <xs:restriction base="xs:string">
                           <xs:minLength value="1"/>
                           <xs:maxLength value="32"/>
                        </xs:restriction>
                     </xs:simpleType>
                  </xs:element>
                  <xs:element name="value" >
                     <xs:simpleType>
                        <xs:restriction base="xs:string">
                           <xs:minLength value="1"/>
                           <xs:maxLength value="10000"/>
                        </xs:restriction>
                     </xs:simpleType>
                  </xs:element>
                  <!-- any internal structure of the value string is the
                  responsibility of the data creator to manage. If the
                  content is binary,  convert to bin hex strings. -->
               </xs:sequence>
            </xs:complexType>
         </xs:element>
         <!-- the order of the sets shall not be changed -->
      </xs:sequence>
</xs:complexType>
```

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

8.28 Data Element: EXT_VerticalDatum:cd [LRMS]

Use: The underlying vertical geodetic datum for a geographic coordinate.

ASN.1 Representation:

```
VerticalDatum ::= ENUMERATED { wgs-84 (0),
  navd   (1),
  ...}   -- # LOCAL_CONTENT
```

XML Representation:

```
<xs:simpleType name="VerticalDatum" >
      <xs:annotation>
         <xs:appinfo>
            wgs 84 (0)
            navd (1)
         </xs:appinfo>
         <xs:documentation>
            # LOCAL_CONTENT
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="1"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="wgs 84"/>
               <xs:enumeration value="navd"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
```

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

8.29 Data Element: LINK_Type_code [TMDD]

Use: The designation of the Link type (Freeway, Arterial, Surface, Rail, Ferry, other modes).

ASN.1 Representation:

```
Link-type ::= BIT STRING {freeway (1),
   arterial (2),
   collector (3),
   local (4),
   service-road (7),
   tunnel (8),
   detour (9),
   dedicated-link (10),
   military-road (11),
   railroad-link (12),
   air-link (13),
   ferry (14)
   }
```

XML Representation:

```
<xs:simpleType name="Link-type-item" >
      <xs:annotation>
         <xs:appinfo>
            freeway (1)
            arterial (2)
            collector (3)
            local (4)
            service road (7)
            tunnel (8)
            detour (9)
            dedicated link (10)
            military road (11)
            railroad link (12)
            air link (13)
```

```
            ferry (14)
         </xs:appinfo>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:int">
               <xs:minInclusive value="1"/>
               <xs:maxInclusive value="14"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="freeway"/>
               <xs:enumeration value="arterial"/>
               <xs:enumeration value="collector"/>
               <xs:enumeration value="local"/>
               <xs:enumeration value="service road"/>
               <xs:enumeration value="tunnel"/>
               <xs:enumeration value="detour"/>
               <xs:enumeration value="dedicated link"/>
               <xs:enumeration value="military road"/>
               <xs:enumeration value="railroad link"/>
               <xs:enumeration value="air link"/>
               <xs:enumeration value="ferry"/>
            </xs:restriction>
         </xs:simpleType >
      </xs:union>
</xs:simpleType>
<xs:simpleType name="Link-type">
   <xs:list itemType="Link-type-item"/>
</xs:simpleType>
```

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

Remarks: V1.0 - Removed permissible values for HOV only, No Trucks, and Toll.

V1.2 - Changed ASN1 Data Type to Bitstring. Added Frontage Road, Service Road, and Other to Valid Value List. Removed "not open for approved under construction" from the list.

V1.3 - Revised Valid Value Rule.

V1.7 - Added FADD_ID attribute; revised Class Name, Classification Scheme Name/Version, Data Concept Identifier/Version to reflect harmonization with ITS Data Registry.

9. COMING ATTRACTIONS, DATA CONCEPTS

The following data frames and data elements are still in development in this edition of the standard. They are not recommended for use in new systems and are presented here for reference because there may be deployed systems which make use on of them or which depend on them (both in deployments of DSRC and in other ITS standards). These entries may in turn use definitions taken from other standards that were taken from the then current adopted standards of these organizations. The referenced standards shall be consulted for further information regarding their proper use. Unless otherwise noted in each entry, the below ASN.1 and XML definitions shall be taken as the governing definition when used in this standard, even when a more current revision of the standard is adopted by the issuing organization. In subsequent editions of this standard, these entries may not longer be present.

9.1 Data Element: DE_ApplicationID

Use: The general application category (ID) of the message or application in question.

ASN.1 Representation:

```
ApplicationID ::= ENUMERATED {
     cruiseAssistHighwaySystem    (0),
     automaticFeeCollection       (1),
     freightFleetManagement       (2),
     publicTransport              (3),
     trafficTravellerInformation  (4),
     trafficControl               (5),
     parkingManagement            (6),
     geographicRoadDatabase       (7),
```

```
    mediumRangePreinformation    (8),
    manMachineInterface          (9),
    intersystemInterface         (10),
    automaticVehicleID           (11),
    emergencyWarning             (12),
    private                      (13),  -- Move to range of >127
    multiPurposePayment          (14),
    dsrcResourceManager          (15),
    afterTheftSystems            (16),
    cruiseAssistHighwaySystem    (17),  -- DUPE Entry!
    multiPurposeInfoSystem       (18),
    publicSafety                 (19),
    vehicleSafety                (20),
    generalPurposeInternetAccess (21),  -- This would never go over WSM!

    ... -- # LOCAL_CONTENT
    }
    -- values to 127 reserved for std use
    -- values 128 to 255 reserved for local use
```

XML Representation:

```
<xs:simpleType name="ApplicationID" >
      <xs:annotation>
         <xs:appinfo>
            cruiseAssistHighwaySystem (0)
            automaticFeeCollection (1)
            freightFleetManagement (2)
            publicTransport (3)
            trafficTravellerInformation (4)
            trafficControl (5)
            parkingManagement (6)
            geographicRoadDatabase (7)
            mediumRangePreinformation (8)
            manMachineInterface (9)
            intersystemInterface (10)
            automaticVehicleID (11)
            emergencyWarning (12)
            private (13) -- Move to range of &gt;127
            multiPurposePayment (14)
            dsrcResourceManager (15)
            afterTheftSystems (16)
            cruiseAssistHighwaySystem (17) -- DUPE Entry!
            multiPurposeInfoSystem (18)
            publicSafety (19)
            vehicleSafety (20)
            generalPurposeInternetAccess (21) -- This would never go over WSM!
         </xs:appinfo>
         <xs:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="21"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="cruiseAssistHighwaySystem"/>
               <xs:enumeration value="automaticFeeCollection"/>
               <xs:enumeration value="freightFleetManagement"/>
               <xs:enumeration value="publicTransport"/>
               <xs:enumeration value="trafficTravellerInformation"/>
               <xs:enumeration value="trafficControl"/>
               <xs:enumeration value="parkingManagement"/>
               <xs:enumeration value="geographicRoadDatabase"/>
               <xs:enumeration value="mediumRangePreinformation"/>
               <xs:enumeration value="manMachineInterface"/>
               <xs:enumeration value="intersystemInterface"/>
               <xs:enumeration value="automaticVehicleID"/>
               <xs:enumeration value="emergencyWarning"/>
               <xs:enumeration value="private"/>
               <xs:enumeration value="multiPurposePayment"/>
               <xs:enumeration value="dsrcResourceManager"/>
               <xs:enumeration value="afterTheftSystems"/>
               <xs:enumeration value="cruiseAssistHighwaySystem"/>
```

```
            <xs:enumeration value="multiPurposeInfoSystem"/>
            <xs:enumeration value="publicSafety"/>
            <xs:enumeration value="vehicleSafety"/>
            <xs:enumeration value="generalPurposeInternetAccess"/>
         </xs:restriction>
      </xs:simpleType >
      <xs:simpleType>
         <xs:restriction base="local:ApplicationID" />
      </xs:simpleType>
   </xs:union>
</xs:simpleType>
```

Remarks: Is the rest of this byte defined in IEEE somewhere? Who is the authority for this information, SAE or IEEE or someone else? This is probably an external (foreign) data element because is comes from IEEE. Which of these is for the probe application?

9.2 Data Element: DE_DDuration

Use: The DSRC style Duration element is a simple value consisting of the number of milliseconds from some known starting time. A 3 byte value.

ASN.1 Representation:

```
DDuration ::= INTEGER (0..1200000) -- up to 20 minutes of elapssed time
```

XML Representation:

```
<xs:simpleType name="DDuration" >
   <xs:annotation>
      <xs:documentation>
         up to 20 minutes of elapssed time
      </xs:documentation>
   </xs:annotation>
   <xs:restriction base="xs:unsignedInt">
      <xs:maxInclusive value="1200000"/>
   </xs:restriction>
</xs:simpleType>
```

9.3 Data Element: DE_DOffset

Use: The DSRC style (time zone) offset is a simple value consisting of a signed integer representing an hour and minute value set from -14:00 to +14:00 representing all the worlds local time zones in units of minutes. The value of zero (00:00) may represent an unknown value. Note some time zones are do not align to hourly boundaries.

ASN.1 Representation:

```
DOffset ::= INTEGER (-340..340) -- units of minutes from UTC time
```

XML Representation:

```
<xs:simpleType name="DOffset" >
   <xs:annotation>
      <xs:documentation>
         units of minutes from UTC time
      </xs:documentation>
   </xs:annotation>
   <xs:restriction base="xs:short">
      <xs:minInclusive value="-340"/>
      <xs:maxInclusive value="340"/>
   </xs:restriction>
</xs:simpleType>
```

9.4 Data Element: DE_MessageType

Use: The basic type of message that follows. This value describes not only the specific message type but the implicitly defined encoding of the bytes that follow in the message.

ASN.1 Representation:

```
MessageType ::= ENUMERATED {
   -- Safety System messages
   item_1      (0),  -- Basic
   -- Safety Vehicle messages
   item_2      (1),  -- Basic
```

```
item_3      (2),  -- Common
item_4      (3),  -- Connect
item_5      (4),  -- Identify
item_6      (5),  -- Notice
item_7      (6),  -- Synchronize
item_8      (7),  --
item_9      (8),  --
item_10     (9),  --
item_11     (10), --
item_12     (11), --
item_13     (12), --
item_14     (13), --
item_15     (14), --
item_16     (15), --

-- Safety Infrastructure messages
item_xx     (16), -- Basic
item_xx     (17), --
item_xx     (18), --
item_xx     (19), --

-- Safety Environment messages
item_xx     (20), -- Local Basic
item_xx     (21), --
item_xx     (22), -- Global Basic
item_xx     (23), --

-- Rest to be defined later,
-- will there by any 'local' types here?
...
}
```

XML Representation:

```
<xs:simpleType name="MessageType" >
      <xs:annotation>
         <xs:appinfo>
             -- Safety System messages
            item_1 (0) -- Basic
             -- Safety Vehicle messages
            item_2 (1) -- Basic
            item_3 (2) -- Common
            item_4 (3) -- Connect
            item_5 (4) -- Identify
            item_6 (5) -- Notice
            item_7 (6) -- Synchronize
            item_8 (7)
            item_9 (8)
            item_10 (9)
            item_11 (10)
            item_12 (11)
            item_13 (12)
            item_14 (13)
            item_15 (14)
            item_16 (15) -- Safety Infrastructure messages
            item_xx (16)    Basic
            item_xx (17)
            item_xx (18)
            item_xx (19) -- Safety Environment messages
            item_xx (20) -- Local Basic
            item_xx (21)
            item_xx (22) -- Global Basic
            item_xx (23) -- Rest to be defined later ,
             -- will there by any &apos;local&apos; types here?
         </xs:appinfo>
         <xs:documentation>
            Encoded as an 8 bit value
         </xs:documentation>
      </xs:annotation>
      <xs:union>
         <xs:simpleType>
            <xs:restriction base="xs:unsignedInt">
               <xs:minInclusive value="0"/>
               <xs:maxInclusive value="23"/>
            </xs:restriction>
         </xs:simpleType>
         <xs:simpleType>
            <xs:restriction base="xs:string">
               <xs:enumeration value="item_1"/>
               <xs:enumeration value="item_2"/>
```