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IEEE Standard for Traffic Incident Management Message Sets for Use by Emergency Management Centers

IEEE Standards Coordinating Committee 32

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Abstract: The exchange of vital traffic management data and data to support traffic management decisions, between the Traffic Management Center and other agencies involved in transportation-related events, through common incident management message sets, is addressed in this standard. Those events include incidents, emergencies, accidents, planned roadway closures, special events and disasters caused by humans or natural events. Those events include any such event that impacts transportation systems, or that causes a report to be received by an emergency management system, whether or not the event actually affects a transportation system, and whether or not a response is required. Message sets specified are consistent with the National Intelligent Transportation Systems Architecture and are described using Abstract Syntax Notation One (ASN.1) syntax. This standard comprises one companion volume of the family of incident management standards centered around a base standard: IEEE Std 1512™-2000, IEEE Standard for Common Incident Management Message Sets for Use by Emergency Management Centers. Other members of that family include a companion volume specifying incident management message sets for cargo, contents, and hazardous materials (IEEE Std 1512.3™-2002), and a forthcoming companion volume specifying message sets for public safety (IEEE P1512.2). Collectively, that family of standards shall be referred to as the "IEEE 1512 family of standards." The goal of that family of standards is to support efficient communication for the real-time, interagency management of transportation-related events.
Keywords: 911, ASN.1, ATMS, CAD, center-to-center, commercial vehicles, data exchange, EMC, emergency services, emergency response, EMS, Hazmat, incidents, incident response, incident management, incident management system, intelligent transportation systems, message sets, public safety, traffic incidents, traffic incident management, traffic management, TMC, and transportation system management

Introduction

[This introduction is not part of IEEE Std 1512.1-2003, IEEE Standard For Traffic Incident Management Message Sets for Use by Emergency Management Centers.]

The Incident Management Working Group was formed from a cross-section of Intelligent Transportation Systems (ITS) and incident management (IM) practitioners in 1997 to address the problems and concerns of dispatching traffic management centers interacting with each other and other agencies involved in the resolution of (primarily) roadway services disruptions (and certain other events on the highway)—generically referred to as incidents. The primary objective of this Working Group is to advance the greater coordination of these centers and their cross servicing over various jurisdictional boundaries.

This document is one of several related standards in this area and deals primarily with the communication of vital traffic management data and data to support traffic management decisions. It is a companion volume to a base standard: IEEE Std 1512™-2000, IEEE Standard for Common Incident Management Message Sets for Use by Emergency Management Centers. Other categories of communication, having to do with public safety, and cargo, contents, and hazardous materials, are or will be addressed in other companion volumes generated by the Working Group. The base standard, this volume, and other companion volumes together comprise what shall be known as the IEEE 1512 family of standards.

IEEE Std 1512-2000 includes more general introductory material for the IEEE 1512 family of standards, including the other companion volumes and the relationship between the family of standards, other ITS standards, and the National ITS Architecture. That material will not be repeated here. Rather, the remainder of this introduction will present a statement of the problem this standard is to address, and its goal.

Problem statement

In the course of a transportation-related event, information on traffic flows, infrastructure damage, traffic control assets, and management plans for traffic, evacuation, and infrastructure, all can figure importantly in managing the incident. That wide variety of information needs to be exchanged between the traffic management center (TMC) and the several other agencies involved in managing the incident. Yet in the course of an incident, that information may be complex, disorganized, spatially scattered, and partial. So incident management should be supported where possible by distributing and managing that information.

To restate the problem in decision-support terms: often, there are large gaps between the available information and what the incident commander and involved agencies need to know in order to best manage the incident with regard to traffic, infrastructure, and assets. In the ITS world, those gaps will often be able to be spanned by exchanges of information of five kinds:

1) Traffic-related information: collected from those other agencies for collation and analysis to support the second exchange.
2) Current and predicted traffic conditions: made available to the many agencies that may be involved in the incident—in particular, route information for routing traffic and response vehicles.
3) The need for cleanup, repair and replacement of damaged infrastructure: to support responses to carry out that cleanup, repair, and replacement.
4) Plans for traffic management, evacuation management and infrastructure cleanup, repair and replacement.
5) Asset management information: to coordinate traffic control assets between agencies.

That presents us with the basis for stating the goal of this companion volume as follows.

Goal of this companion volume

Supporting the incident commander and involved agencies with all available information concerning traffic, infrastructure, and traffic control assets will require that the TMC collect data from several agencies and its own resources, analyze that data, then disseminate plans and management information back out to perhaps several different agencies. Managing the operational complexities of collecting the data, collating and analyzing it, then disseminating the results as necessary, is a task for the local implementation. The goal of this companion volume is to provide the framework for communication among the TMC and other agencies, to provide a flexible basis for that complex decision support process.

In more detail, the purpose of this standard is to support the communication necessary to take the directly observable and sensor information concerning traffic and infrastructure, exchange that information among the data collecting agencies and the TMC, then exchange the results of the analysis of that information and corresponding traffic management, evacuation management, and infrastructure plans back out the several involved agencies, to best support the incident commander and the involved agencies in managing the event. That calls for messages to communicate whatever information is available, often quite partial, among the involved agencies, to accomplish four decision-support functions, corresponding, though not one-to-one, to the five kinds of information exchange listed previously in the problem statement:

- *Function 1:* To disseminate information about current and future traffic flows in the transportation grid, including in particular impacts of an incident and particular route information, to assist in the real-time interagency management of a transportation-related incident or event.
- *Function 2:* To support the management of traffic to assist in the real-time interagency management of a transportation-related incident or event, including establishing reverse links and the use of priority/preemption technologies.
- *Function 3:* To support the management of TMC assets and other assets, as necessary to manage traffic, to assist in the real-time interagency management of a transportation-related incident or event.
- *Function 4:* To support the cleanup, repair, and replacement of damaged infrastructure, treating that operation as part of another incident, or as a separate incident itself.

Companion volumes

This document provides information on additional messages, data frames, and data elements beyond those appearing in the base standard (IEEE Std 1512-2000). In order to make full use of this information, the base standards and other references to ITS and industry standards may also need to be employed. Particularly in the area of message set reuse where the contents of various elements have been taken from well-established practices both within and outside that of the ITS and transportation industries.

The standard and use with data registries

The standard was developed in conjunction with entries made into the ITS data registry. The following information may be useful to persons wishing to track the data structures described in this standard with those entries or in other similar registries.

In each of the data structures found in Clause 5 through Clause 7 of this standard, the following metadata fields are used and are equivalent to the named fields in the ITS registry. The mapping between these fields is as follows. The specific clause numbering and name of an entry is also the DESCRIPTIVE NAME of that entry in the registry (the part which follows after the ":" is the name used). The one or more paragraphs that then follow, headed "Use," forms the DESCRIPTION entry. The final one or more paragraphs, headed "Remarks," forms the REMARKS entry. The section headed "Used by," contains linkages to other data structures that in turn refer to this one. In the ITS registry the fields RELATED DATA CONCEPT and RELATIONSHIP TYPE may be used to convey this information along with other relationships. The section

headed by “ASN.1 Representation,” contains all the ASN.1 defining code. In the ITS registry this information is broken up among the fields: ASN.1 NAME, DATA TYPE, VALID VALUE RULE, and BODY. The ASN.1 NAME contains the formal ASN.1 Type Definition name of the object. The DATA TYPE contains the base type from which it is defined. The VALID VALUE RULE, or the BODY, then contains the various constraints, declared constants, enumerations values, and comments of the rest of the definition. In the case of data element entries, this information is found in the VALID VALUE RULE, while in the case of data frames and messages, this information is placed into the BODY field.

Other fields used in the ITS registry (such as UNITS or FORMULA) are typically not provided with content from this standard, or are self evident and constant in nature. The SOURCE field is an example of this, and its value for all entries from this standard is IEEE Std 1512.1-2003.

Acknowledgments

The Working Group wishes to acknowledge the assistance of Bancroft Scott and Paul Thorpe of Open Systems Solutions, Inc. (OSS) in providing the use of their ASN.1 tool suite compiler. The ASN.1 syntax appearing in this standard was validated using that tool suite compiler.

Participants

At the time this standard was completed, the Incident Management Working Group for Intelligent Transportation Systems had the following membership and officers:

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Contents

The IEEE 1512 family of standards is dedicated to the memory of those who lost their lives responding to the tragic events of September 11, 2001. The Working Group honors the men and women who continue to maintain vigilance in protecting freedom and security. It is our hope and expectation that these standards will enhance multi-jurisdictional communications.

IEEE Standard for Traffic Incident Management Message Sets for Use by Emergency Management Centers

1. Overview

This standard provides a framework for exchange of data in message sets for use by centers involved in transportation-related incident management, specific to traffic management communications, in particular, for exchanges of data between a traffic management center (TMC) and other involved agencies.

This standard supplements IEEE Std 1512™-2000[1], henceforth called the "base standard" for the family of incident management message sets. The overview, scope, and purpose of IEEE Std 1512-2000 will not be repeated in this standard.

In the course of managing many transportation-related incidents, there is a need for distributing and managing the often complex and partial information about the traffic flows, infrastructure, and traffic management assets involved in an incident. Often there are large gaps between the available information and what the incident commander and other involved agencies need to know in order to best manage the incident with regard to traffic management and infrastructure. In the intelligent transportation systems (ITS) world, those gaps will often be able to be spanned by exchanges of information of five kinds:

a) Traffic-related information: collected from those other agencies for collation and analysis to support the second exchange.
b) Current and predicted traffic conditions: made available to the many agencies that may be involved in the incident—in particular, route information for routing traffic and response vehicles.
c) The need for cleanup, repair, and replacement of damaged infrastructure: to support responses to carry out that cleanup, repair, and replacement.
d) Plans for traffic management, evacuation management and infrastructure cleanup, repair, and replacement.
e) Asset management information: to coordinate traffic control assets between agencies.

Managing the operational complexities of collecting the data, collating and analyzing it, then disseminating the results as necessary, is a task for the local implementation. The task for this standard is to provide the framework for communication among the TMC and other agencies to provide a flexible basis for the five types of information exchange listed here.

1.1 Scope

This standard is a companion volume for IEEE Std 1512-2000, referred to here as the "base standard." This standard specifies messages, data frames, and data elements for communicating information about traffic and infrastructure management in support of real-time interagency transportation-related incident management. The base standard specifies messages, data frames, and data elements to describe an incident and form the message infrastructure for communication involved in real-time interagency transportation-related incident management. Refer to the base standard for specification of the scope of the combination of the base standard and companion volumes such as this one. Together, the base standard and companion volumes shall be referred to as the "IEEE 1512 family of standards."

[1]Information on references can be found in Clause 2.

1.2 Purpose

This standard is part of the IEEE 1512 family of standards. The purpose of that family of standards as a whole is presented in the base standard, and will not be repeated here.

The purpose of this standard is to take the real-world, available-information situation confronting the incident commander and the several involved agencies, then support the exchange of that information among agencies, to make further information available to the incident commander and involved agencies, to best support them in managing the event. That calls for messages to communicate whatever information is available, often quite partial, among the several involved agencies, to accomplish four decision-support functions, corresponding to the five kinds of information exchange listed earlier in this clause:

— *Function 1:* To disseminate information about current and future traffic flows in the transportation grid, including in particular impacts of an incident and particular route information, to assist in the real-time interagency management of a transportation-related incident or event.
— *Function 2:* To support the management of traffic to assist in the real-time interagency management of a transportation-related incident or event, including establishing reverse links and the use of priority/preemption technologies.
— *Function 3:* To support the management of TMC assets and other assets, as necessary to manage traffic, to assist in the real-time interagency management of a transportation-related incident or event.
— *Function 4:* To support the cleanup, repair, and replacement of damaged infrastructure, treating that operation as part of another incident, or as a separate incident itself.

2. References

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 excepted.

IEEE Std 1488™-2000, IEEE Trial-Use Standard for Message Set Template for Intelligent Transportation Systems.[2, 3]

IEEE Std 1489™-1999, IEEE Standard for Data Dictionaries for Intelligent Transportation Systems.

IEEE Std 1512-2000, IEEE Standard for Common Incident Management Message Sets for Use by Emergency Management Centers.

ISO/IEC 8824-1:1998, Information technology—Abstract Syntax Notation One (ASN.1): Specification of basic notation.[4]

[2]The IEEE products referred to in this clause are trademarks belonging to the Institute of Electrical and Electronics Engineers, Inc.

[3]IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (http://standards.ieee.org/).

[4]ISO/IEC publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse (http://www.iso.ch/). ISO/IEC publications are also available in the United States from Global Engineering Documents, 15 Inverness Way East, Englewood, Colorado 80112, USA (http://global.ihs.com/). Electronic copies are available in the United States from the American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (http://www.ansi.org/).

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.

ITE TCIP-IM, Transit Communications Interface Profiles—Standard on Incident Management Objects, NTCIP 1402v01.02, December 2000.[5]

ITE TMDD, Standard for Functional Level Traffic Management Data Dictionary (TMDD), Standard TM1.03, Amendment 1, March 2001.

SAE J2313, On-Board Land Vehicle Mayday Reporting Interface, September 1999.[6]

SAE J2353, Data Dictionary For Advanced Traveler Information Systems (ATIS), October 1999.

SAE J2354, Message Sets for Advanced Traveler Information System (ATIS), November 1999.

SAE J2369, Standards for ATIS Message Sets Delivered Over Reduced Bandwidth Media, March 2000.

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

SAE J2540-1, RDS Phrase Lists, July 2002.

SAE J2540-2, ITIS Phrase Lists (International Traveler Information Systems), February 2002.

SAE J2540-3, National Names Phrase List, January 2002.

SAE J2630, Converting ATIS Message Standards From ASN.1 To XML, Draft of July 2002.[7]

Other documents defined in IEEE Std 1512-2000 remain as cited and are included herein by reference.

3. Definitions, acronyms, and abbreviations

For the purposes of this IEEE 1512 family of standards, the following definitions, abbreviations, and acronyms apply. *The Authoritative Dictionary of IEEE Standards Terms* [B3][8] should be referenced for terms not defined in this clause. If the terms do not exist in *The Authoritative Dictionary of IEEE Standards Terms*, consult the latest edition of *Merriam-Webster's Collegiate® Dictionary* [B6].

The terms, abbreviations and acronyms cited in this clause shall be a part of the terms of the other companion volumes of this standard unless specifically cited otherwise.

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[5]ITE Standards are available from the Institute of Transportation Engineers, 1099 14th Street NW, Suite 300 West, Washington, DC 20005-3438, USA (http://www.ite.org/standards/index.html).

[6]SAE publications are available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096, USA (http://www.sae.org/).

[7]As this standard goes to press, SAE J2630 is not yet published. The draft standard is, however, available from the IEEE. Contact the IEEE Standards Department at +1 732 562 3800 for status information.

[8]The numbers in brackets correspond to those of the bibliography in Annex D.

3.1 Definitions

3.1.1 911 or 9-1-1: Pronounced “nine-one-one,” not “nine-eleven.” A telephone number providing access to a public safety access point (PSAP).

3.1.2 advanced traveler information systems (ATIS): In the context of this standard, one of the major message sets of intelligent transportation systems (ITS) which contains a number of message structures used to convey information to the public at large. This standard makes reuse of portions of this work. It is available, in several volumes, from the Society of Automotive Engineers (SAE).

3.1.3 agency data: In the context of this standard, any data which are created by the center or its assets or come under the control of the center as per local data agreements and operating practices.

3.1.4 alternate route: A route identified to the driving public with signs, traffic routing devices, flaggers and/or media announcements as an optional alternative to a congested route. Distinguished from a diversion route, which is mandatory.

3.1.5 arrow board: A large board with lights that can be lit in patterns indicating a left arrow, right arrow (arrow panels are also required to be able to display this pattern of 4 dots; for a more complete description, see section 6F-53 of MUTCD [B7]), or arrows in both direction. Used to direct traffic. Refer to Figure 1.

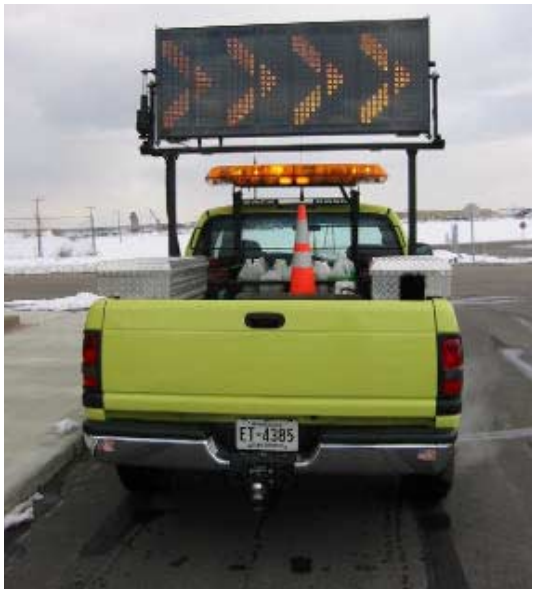

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Figure 1—Example of an arrow board

3.1.6 asset: In the context of this standard, an asset is any entity that can be dispatched or designated to fulfill a traffic management and/or incident management role. An asset can be a vehicle and its associated team of people, a team of people without a vehicle, a mobile or a fixed piece of equipment, or an individual person (see physical asset). An asset can also be a data stream or data set, such as the video feed from a closed-circuit television (CCTV) camera, or a data file containing loop data (see data asset).

3.1.7 automatic incident detection: An algorithm, or set of algorithms, designed to automatically detect and alarm the onset of highway conditions that could indicate the presence of an incident. Algorithms typically use volumes and occupancies as triggering parameters. Algorithms must be carefully tuned to avoid excessive false alarm rates, while maintaining acceptable detection rates.

3.1.8 changeable message sign (CMS): A display device, either mobile or fixed, that can display text or graphics in a large format for reading by the driving public. The text or graphics can be changed by programming signals that are either local to the sign or transmitted to the sign from a remote controller. Other such signs include variable message sign (VMS) and dynamic message sign (DMS).

3.1.9 data asset: An asset (*see:* **asset**) that is in particular a data stream or data file, as opposed to a physical asset. Examples include the video feed from a closed-circuit television (CCTV) camera, and a data file containing loop data.

3.1.10 dedicated short range communications (DSRC): A communication systems developed for use between the roadside and vehicles and between vehicles while mobile used to communicate a wide variety of intelligent transportation systems (ITS) related information. Chief among these is message content dealing with "public safety" type messages. In this context public safety is meant to cover the sending of caution and alert messages to the traveling public about the transportation network (for example: bridge icing, construction zones, train present, ambulance ahead, route diversion, etc.). Towed variable message sign (VMS) type devices are envisioned to be equipped with the ability to send these message to allow for a rapid drag and drop deployment at incidents. Motorists are expected to acquire receiver devices from a need for toll tags as well as a desire to receive this and other data sources. Technically, the modulation is a variant of the IEEE 802.11a format in a band authorized by the Federal Communications Commission (FCC) at 5.9 GHz for this application (there is a nearby "uni" band for consumer use) and the message content is derived from the Society of Automotive Engineers-Advanced Traveler Information Systems (SAE-ATIS) message set. The original stimulus to send such messages, especially in the event of an incident, is the IEEE 1512 standard of messages. Often the "header" or IDX messages can be converted directly for such use (see subsequent clauses for further details). The capacity of this band is also shared with message such as commercial business transactions, toll tag exchanges, and traveler ATIS messages. Another band at 4.9 GHz is allocated as a tactical channel for use by responding public agencies and their designated vehicles. It is envisioned that responder vehicles such as a squad car will be equipment with a multi-band device capable of transmitting warnings to the public on one band, while engaged in tactical operational exchanges on another. Refer to IEEE P1512.2 [B4] for further information in this area.

3.1.11 diversion route: A route identified to the driving public with signs, traffic routing devices, flagger and/or media announcements as a mandatory alternative to a congested or closed route. Distinguished from an alternative route, which is optional.

3.1.12 dynamic message sign (DMS): *See:* **changeable message sign.**

3.1.13 E911: Enhanced 911, implying the additional functionally over "basic" 911 to take the calling number ID and map it to a database of physical location and owner of record. E911 technology is being extending in a number of ways (both mandated and voluntary) to cover the need to determine the position/location of wireless callers.

3.1.14 egress route: A route designated for leaving an incident site or any area associated with an incident, such as a staging area.

3.1.15 emergency medical service: A system represented by one or more agencies that provide mobile emergency medical care for incidents, including both ambulances and the system of hospitals and treatment centers to which an ambulance would transport an injured person.

3.1.16 evacuation: The operation of systematically removing the public from an area for reasons of their own safety. It can involve any form of direction, including media announcements, traffic management assets, and/or public safety assets. It can include actively transporting members of the public using public vehicles. It can include local evacuation of small areas immediately surrounding an incident, or larger areas.

3.1.17 evacuation plan: A plan for managing an evacuation. It can be written and/or transmitted and displayed by electronic means. It can be a plan generated in anticipation of an incident, or it can be a plan generated in the course of an incident.

3.1.18 evacuation route: One of possibly several routes used in carrying out an evacuation.

3.1.19 flagger: Public safety or traffic management personnel assigned to direct traffic with their presence, arm signals, or other devices such as signs or flares.

3.1.20 greenwave: A centrally-directed system for granting priority to an emergency vehicle that works by timing signal lights to form a special “pulse” of green lights propagating down a route such that a vehicle can travel within that pulse and traverse a grid more rapidly than it would without the greenwave. Can be designed to minimize disruption in the rest of the grid. Distinguished from changing signal light patterns to favor a route for all vehicles.

3.1.21 highway advisory radio (HAR): A radio announcement or a series of announcements to the public advising about traffic congestion, recommending alternative routes, and/or describing diversion routes. Typically HAR is implemented as a low power AM broadcast originating from equipment mounted near the roadside and consisting of short analog recordings cyclically repeated. It is typically accompanied by a sign board telling the public where to tune. A few locations use FM broadcast technology, and a few use FM data technology [Radio Data System (RDS) modulation] to send digital messages. It is envisioned that once dedicated short range communications (DSRC) begin to be deployed that they will offer encoding messages with much broader content and that such transmission points will be often found in conjunction with HAR and changeable message sign (CMS) technologies (as well as being mounted on mobile work zone equipment).

3.1.22 incident response: In the context of this standard, the response from public safety agencies to an incident. As distinguished from the response from traffic agencies. It can include a response to a incident that occurs at a planned road closure or special event.

3.1.23 incident response vehicle: A vehicle to assist in the mitigation and clearance of incidents. Incident response vehicles may be equipped with towing capability, automatic vehicle location, a sign board, a changeable message sign (CMS), other traffic control devices and/or mobile closed-circuit television (CCTV) equipment. Typically vehicles are held at strategic locations for a specific response action. These vehicles and their associated programs go by different names in different regions. *See also:* **service patrol vehicle**.

3.1.24 infrastructure: In the context of this standard, infrastructure is any fixed piece of transportation-related road or roadside equipment, or roadway. Examples include light poles, signs and guard rails.

3.1.25 infrastructure cleanup, repair, replacement plan: A plan to clean up, repair, or replace infrastructure, generated in response to identifying infrastructure in need of cleanup, repair, or replacement.

3.1.26 ingress route: A route designated for entering an incident site or any area associated with an incident, such as a staging area.

3.1.27 international traveler information system (ITIS): The term commonly associated with the standard for incident phrases developed by the Society of Automotive Engineers (SAE) Advanced Traveler Information Systems (ATIS) Committee in conjunction with ITE TMDD TM1.01.4 and other standards. This work contains a wide variety of standard phrases to describe incidents and is expected to be used throughout the intelligent transportation systems (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, international traveler information system (ITIS) phrases are recommended for use in many areas. ITIS phrases can also be freely mixed with text and used to describe many incidents.

3.1.28 lane number: Number to identify lane. Numbered in each direction, with 1 at the median or the left-most lane if one-way in this standard. Note that this definition matches Transit Communications Interface Profiles (TCIP) and Traffic Management Data Dictionary (TMDD) usage but that some states do not follow this numbering.

3.1.29 lane percent blocked: A measure of link impedance defined as: 100 minus (current throughput as a percentage of unimpeded throughput), therefore 100 = completely blocked, 0 = completely unblocked (clear). Note that this definition matches Transit Communications Interface Profiles (TCIP) usage.

3.1.30 level of service: A standardized system of letters, A through F, defining the degree to which traffic flow matches unimpeded flow. “A” is completely unimpeded; “F” is completely impeded (“stop and go”).

3.1.31 micrometeorology: The meteorology of a small area. Used in particular for plume modeling for hazardous or visually-impeding plumes. Typically includes wind direction and speed, temperature, and relative humidity.

3.1.32 occupancy: The number of vehicles in a lane divided by the ability of that lane to carry vehicles.

3.1.33 physical asset: An asset (*see:* **asset**) that is physical as opposed to a data asset.

3.1.34 planned event: Any event that is planned in advance, as opposed to one precipitated by an unplanned event such as a roadway accident. In the context of this standard, a planned event can include either an event such as a sporting event, or a planned road closure.

3.1.35 preemption, preemption technology: A technology that forces a signal light to go green or stay green specifically in the direction of an emergency vehicle approaching an intersection. Distinguished from priority technology which changes the timing of lights in favor of a vehicle or set of vehicles, but only by increasing the priority for the direction and route of that vehicle or set of vehicles.

3.1.36 pre-planned event: *See:* **planned event**.

3.1.37 priority technology: A technology that changes the timing of signal lights in favor of a vehicle or set of vehicles, by increasing the priority for the direction and route of that vehicle or set of vehicles. Distinguished from preemption technology which forces a signal light to go green or stay green specifically in the direction of an emergency vehicle approaching an intersection.

3.1.38 private data: In the context of this standard, any data which an issuing or possessing center does not wish to share with others.

3.1.39 public data: In the context of this standard, any data suitable for release to the general public (which may not be the same as the local media or to other allied agencies inside the IEEE 1512 deployment or outside of it). This determination needs to be made in light of the data creator, the data owner, and the needs of other agencies on a local level. *See also:* **agency data** and **private data**.

3.1.40 public safety: In the context of this standard, the set of agencies that carry out incident response related to the safety of the involved persons, involved traffic, and the public surrounding an incident. Includes law enforcement, fire and rescue, and emergency medical agencies. Does not include transportation and purely traffic control agencies.

3.1.41 ramp meter system (RMS): A traffic control device that meters traffic on a freeway on-ramp according to a time-of-day or traffic-responsive algorithm. An RMS can be locally- or centrally-controlled. An RMS can be used to limit traffic upstream of an incident site as part of an incident response plan.

3.1.42 remote surveillance asset: Any asset that collects data remotely that can be used to observe an incident or traffic. Examples include closed-circuit television (CCTV) cameras and loop sensors.

3.1.43 response plan: A plan for carrying out the response to an incident. Can include a plan generated in anticipation of an incident, or a plan generated in the course of an incident.

3.1.44 reverse flow, reverse flow link: The operation of reversing the traffic flow on a traffic link, for either of two purposes: 1) to provide ingress or egress to an incident site, in which case the reverse access is only granted to emergency vehicles; or 2) to provide an alternate or diversion route, in which case the reverse access is granted to all vehicles including private vehicles.

3.1.45 sensor: A device for sensing traffic, weather or other road-related data.

3.1.46 sensor data, sensor data asset: The data generated by a sensor (see sensor).

3.1.47 service patrol vehicles: Primarily exist to assist motorists, typically constantly patrolling a given roadway network, but typically also have some incident clearance capability such as push bumpers and basic traffic control devices such as arrow boards and cones—they constantly patrol, looking for motorists who have problems. These vehicles and their associated programs go by numerous names in different regions. *See also:* **incident response vehicle**. Refer to Figure 2.

Reprinted with permission from the Minnesota Department of Transportation.

Figure 2—Example of a service patrol vehicle

3.1.48 stringify: The process of converting an internal computer value used to reference a data object to a human readable-printable string which can be viewed and exchanged. A term common in common object request broker architecture (CORBA) and other object referencing systems. Often used to exchange a reference between different types of systems.

3.1.49 traffic channelization devices: Devices such as cones, barriers, barrels, and arrow trucks and changeable message signs (CMSs) to force or guide traffic into particular temporary channels or routes.

3.1.50 traffic control plan: In the context of this standard, a plan for traffic control and routing as part of incident management. From section 6B.01 of the Manual on Uniform Traffic Control Devices (MUTCD) [B7], the control of road users through a temporary traffic control zone shall be an essential part of highway construction, utility work, maintenance operations, and incident management.

3.1.51 traffic incident: An incident where the primary impacts are on road traffic. A traffic incident may have a traffic-related cause or it may not. For example, a building fire that causes significant road traffic congestion is a traffic incident.

3.1.52 traffic incident management: The process of real-time command and control of a traffic incident response, including asset management, the assignment of tasks to those assets, and the monitoring and communication of situation status.

3.1.53 traffic management: The process of real-time control of traffic flows by means of traffic monitoring devices and traffic control devices such as traffic signals, metering lights, variable message signs, arrow trucks, barriers, cones, flares and traffic direction personnel. Traffic management can include the management of routine traffic as well as traffic related to an event, i.e., an incident, a planned road closure, or a special event. It can include traffic in the vicinity of an event as well as traffic at some distance from an event. It can include detours and evacuations.

3.1.54 traffic management data dictionary: In the context of this standard, one of the major message sets of intelligent transportation systems (ITS) which contains a number of message structures used to convey information to the transportation professionals and to control roadside devices. This standard makes reuse of portions of this work. It is available, in several volumes, from the Institute of Transportation Engineers (ITE) and the American Association of State Highway and Transportation Officials (AASHTO).

3.1.55 traffic management plan: *See:* **traffic control plan**.

3.1.56 traffic routing devices: *See:* **traffic channelization devices**.

3.1.57 transportation grid: A common alterative term for the transportation network.

3.1.58 transportation system management: The management of the transportation system, as opposed to traffic itself. It primarily involves the planning, deployment, monitoring, and maintenance of traffic infrastructure, including traffic control infrastructure.

3.1.59 transportation-related incident: Either one of two types of events: 1) a non-recurring event, such as a motor vehicle accident, other unplanned road closure, planned road closure, or planned special event (such as a parade, sporting event, or demonstration) that affects transportation services (and so, e.g., could be a structural fire, because the incident response affects the traffic grid); or 2) any transportation-related event reported to a public safety access point (PSAP) (where 9-1-1 and other incident-reporting calls are received), whether or not a response is required, and whether or not the event actually affects transportation services.

3.1.60 variable message sign: *See:* **changeable message sign (CMS)**.

3.1.61 vehicle detection system: A sensor, or set of sensors, that detect the flow of vehicles past a fixed point, either along freeway mainlines, freeway connectors, or arterial highways.

3.1.62 work zone: An area where infrastructure maintenance and/or construction work is being conducted, where that work impacts the transportation system.

3.1.63 XML (eXtendable markup language): 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 hypertext transfer protocol (HTTP). XML is a markup language, a clearly defined way to structure, describe, and interchange data. It is a subset of standard generalized markup language (SGML). It uses user-defined tags. With a document type definition (DTD) or a schema to define the data, XML is designed to be self-descriptive. XML has a growing number of supporters due to its ability to be implemented in the types of heterogeneous systems often found in public safety. It is possible to express and exchange the IEEE Std 1512-2000 message set using this method. Commentary on the implementation of IEEE 1512 using this methodology is provided in Annex C of this standard.

3.2 Acronyms and abbreviations

AASHTO	American Association of State Highway and Transportation Officials
AID	automatic incident detection
AVL	automatic vehicle location
BS	base standard, in this case IEEE Std 1512-2000
CMS	changeable message sign
CORBA	common object request broker architecture
DMS	dynamic message sign
DSRC	dedicated short range communications
ERM	event reporting message
ETA	expected time of arrival
HAR	highway advisory radio
IC	incident commander
ID	identification
ICP	intelligent clearance practices
IEEE	Institute of Electrical and Electronics Engineers, Inc.
ISO	International Standards Organization
ITE	Institute of Transportation Engineers
ITIS	international traveler information systems
LOS	level of service
MUTCD	Manual on Uniform Traffic Control Devices
POC	point of contact
RMS	ramp meter system
SAE	Society of Automotive Engineers
VDS	vehicle detection system (or station)
VMS	variable message sign
WZ	work zone
XML	extendable markup language

4. Structure of the standard

4.1 Requirements

4.1.1 Scope of requirements

The scope of these requirements, and so of IEEE Std 1512.1-2003, shall extend to the exchange of information supporting real-time interagency transportation-related incident management, between transportation agencies, and between any of those agencies and any other agencies or centers included in incident-management communications. This standard is intended for interagency aspects of that exchange, though that does not prevent its use in information exchange within any one agency.

The term *transportation-related incident,* for purposes of defining the scope of these requirements, includes, and only includes, the following two types of events:

a) A non-recurring event, such as a motor vehicle accident, other unplanned road closure, planned road closure, or planned special event (such as a parade, sporting event or demonstration), or any other event that affects transportation services. For example, a structural fire could be a transportation-related incident, since the response to that fire could affect the traffic grid;
b) Any transportation-related event reported to a public safety access point (PSAP) (where 9-1-1 and other incident-reporting calls are received), whether or not a response is required, and whether or not the event actually affects transportation services.

For convenience, the term *transportation-related incident* will be shortened to *incident* in this standard.

4.1.2 Conformance with this standard

Communications systems in conformance with this standard shall:

a) When sending information specified in this standard, send that information using the formats specified in this standard, as extended by local agreement as specified in this standard.
b) Be able to receive any of the information specified in this standard, using the formats specified in this standard, without impairing other communications.
c) Comply with the ASN.1 productions found in this standard, in accordance with ASN.1:1997 [B1].

In addition, for any communications systems in conformance with this standard, any data element defined in this standard with the ASN.1 term “OPTIONAL” shall be determined to be optional or mandatory depending on the functional requirements specified in this standard.

This standard is specified using ASN.1:1997 syntax, independent of the underlying communication protocols.

In cases where a conflict exists between the textual description of a message and the ASN.1 syntax of the message, the ASN.1 syntax shall take precedence.

4.1.3 Structure of the remainder of this requirements clause

In 4.2 through 4.9 of this standard, the specific requirements are presented in the form of explanatory text and tables. The requirements and tables are arranged so that each table corresponds to a message, and each row in a table corresponds to a data element or data frame within that message.

Subclauses 4.2 through 4.9 are summarized in Table 1. Table 1 introduces acronyms for each of the following tables. Those acronyms provide a summary way to refer to each table and any corresponding message.

Table 1—Subclauses and tables specifying requirements

Subclause	Table	Acronym	Requirement
4.2			Request and share information about work zones
4.2.1	2	RZD	Request work zone description
4.2.2	3	WZD	Work zone description
4.3	4	RTC	Request local traffic control
4.4	5	DTC	Describe local traffic control plan
4.5			Share information about ingress/egress routes, and request route services
4.5.1	6	RRA	Request route advice/services
4.5.2	7	ORA	Offer route advice/services
4.6			Share location/priority/preemption information on a response vehicle
4.6.1	8	RLP	Request location/priority/preemption information on a response vehicle
4.6.2	9	SLP	Share location/priority/preemption information on a response vehicle

Table 1—Subclauses and tables specifying requirements *(continued)*

Subclause	Table	Acronym	Requirement
4.7			Information on cleanup or infrastructure repair: the need for it and plans
4.7.1	10	NCI	Need for cleanup/infrastructure repair
4.7.2	11	CRP	Cleanup/infrastructure repair plan
4.8	12	RNC	Request information on network conditions or route status
4.9			Share information on asset management
4.9.1	13	AFA	Ask for assets
4.9.2	14	RPA	Respond to poll for assets
4.9.3	15	RAS	Request asset status
4.9.4	16	AST	Asset status

4.2 Request and share information about work zones

Work zones can be an important consideration in the management of incidents nearby. Work zones close to another incident can impact local traffic, and may be taken into account in managing the incident because of their impacts on local traffic, and implications for routes associated with the incident: ingress, egress, detour, alternative, and evacuation routes. Requesting and sharing information about work zones facilitates improved coordination of incident management activities and helps prevent conflicts. To better define the requirements for the information to be requested and shared, 4.2.1 and 4.2.2 describe the operational activities of requesting, then sharing, information about work zones.

4.2.1 Request information about work zones

Any agency involved in managing an incident shall be able to ask if there are any work zones that might affect the management of the incident, and if so, that they be described. The requester shall be able to specify the area of interest: circle, polygon or route. The requester shall be able to broadcast the request, or direct it to one or more specific agencies.

The information that is shared when requesting information about work zones shall include the following:

— Message name, acronym: Request work zone description, RZD

Table 2—Information for requesting information about work zones

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Area of interest	Area within which the requester is interested in hearing about work zones. Can be a circle around the incident, a polygon or a route, using Location Reference Message Set (LRMS) profiles.

4.2.2 Describe work zones

An agency that has information about one or more work zones that may be significant for managing an incident shall be able to describe those work zones to other agencies involved in managing that incident. The agency may describe a work zone in response to a request such as the one specified in 4.2.1, or it may choose to broadcast or send the description on its own initiative, either in response to an incident, or simply according to a schedule.

The information that is shared when describing a work zone shall include the following:

— Message name, acronym: Work zone description, WZD

Table 3—Shared information describing a work zone

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
ID of work zone	Unique identifier of the work zone, which could be a previously-assigned identifier for the zone as a planned road closure.
Work zone description	Physical description of the zone in terms of a local traffic plan: lane-by-lane closures/restrictions (including ramps and side streets), length of each closure/restriction, detour route. Beginning and ending times for each closure/restriction/detour. This could simply be the local traffic plan information described in 4.4, which would also cover all the information in the remaining rows of this table. This could also simply be a previously broadcast description of the zone as a planned road closure.
Restrictions	Vertical, horizontal and/or weight restrictions to passage of vehicles through the work zone.
Descriptive text	Freetext description of the work zone, to cover cases not adequately described by other data items, and to provide an alternative means to describe the work zone.
Descriptive graphic	Link to a graphic, perhaps generated during the incident, to illustrate the work zone. For example: computer-aided dispatch (CAD) plots, layout plots, though take care that layout plot is as-built-that-day, as opposed to simply as-planned.
Descriptive image	Link to a digital image of the work zone, or parts of the work zone.

4.3 Request local traffic control

An agency involved in managing an incident shall be able to request local traffic control services of another agency, such as a TMC or local law enforcement. That request shall include both a request for local traffic control services and a description of the traffic control plan the traffic control agency intends to execute.

The information that is shared when requesting local traffic control, and a description of a local traffic control plan, shall include the following:

— Message name, acronym: Request local traffic control, RTC

Table 4—Information for requesting local traffic control

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Special instructions	Freetext description of special instructions: can range from "I'm closing the right lane on link EBxyz," to "Close the right lane on link EBxyz," to "Stop all traffic on link BothWaysxyz," to "Close ramp z," to "Reverse link EBxyz." If this entry is blank, it means "Do whatever is called for based on the incident as described in the incident description (IDX) message specified in the base standard."
Constraints	Freetext description of constraints. Examples: "Leave Route 85 open," "Leave at least one lane open," "avoid routes past the school at xxx."
Pre-planned plan	Pre-planned incident management plan name(s).
Descriptive graphic	Link to a graphic to illustrate the incident and/or local traffic situation.
Descriptive image	Link to a digital image of the incident and/or local traffic situation.

4.4 Describe Local Traffic Control Plan

An agency involved in providing local traffic control services for an incident shall be able to describe the local traffic control plan that it intends to execute. That description may be sent or broadcast in response to a request for local traffic control as presented in 4.3, or it may be sent or broadcast on the agency's own initiative.

The information that is shared when describing a local traffic control plan shall include the following:

— Message name, acronym: Describe local traffic control plan, DTC

Table 5—Shared information describing a local traffic control plan

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Lane-by-lane description	Lane-by-lane (and shoulders and ramps) description of: whether or not closed, where closed, distance closed, when closed, for how long closed, and/or criteria by which will be reopened, how closed (taper, merge, cones, flares, barrels, arrowboard, staffed/unstaffed, if staffed, by whom, etc.); same list of parameters for section of alternating traffic; same list of parameters for section of reversed traffic (plus reason for reversal—ingress/egress vs diversion/detour); same list of parameters for section where lane is restricted, plus parameters of restriction (vertical clearance, horizontal clearance, weight, speed, vehicle type, e.g., truck); and point of contact (POC)—who is in charge.
Detour routes	When routine route is blocked or restricted, so traffic must take the detour route. For each route: route; estimated time to establish the route; estimated duration route will be in place; units assigned to establish it; and POC—who is in charge.
Alternate routes	When routine route is not blocked or restricted, but use of the alternate route is advised. For each route: route; estimated time to establish the route; estimated duration route will be in place; units assigned to establish it; and POC—who is in charge.

Table 5—Shared information describing a local traffic control plan *(continued)*

Data items	Description
Evacuation routes	A managed route to facilitate evacuation. For each route: route; estimated time to establish the route; estimated duration route will be in place; units assigned to establish it; upon whose authority the evacuation would be initiated; and POC—who is in charge.
Variable message sign (VMS) information	For each VMS: location; message; when message placed; duration of message, or on what criterion it is to be taken down; what unit assigned; what organization is in charge. Note that VMSs are managed as assets with asset management messages specified later in this clause, and they are controlled by Traffic Management Data Dictionary (TMDD) messages. This data item specifies how VMSs are to be used as part of the description of the traffic control plan.
Highway advisory radio (HAR) information	For each HAR: broadcast range; message; when message placed; duration of message, or on what criterion it is to be taken down; what organization is in charge. As with VMSs, this data item is part of the description of the traffic control plan.
Special tasks	Freetext to specify special tasks.
Pre-planned IM plan ID	Pre-planned incident management plan name and/or ID number.
IM plan text	Freetext plan description instead of or to supplement pre-planned IM plan.
Pre-planned traffic management plan ID	Pre-planned local traffic management plan name and/or ID number.
Traffic management plan text	Freetext plan description instead of or to supplement pre-planned local traffic management plan.
Descriptive graphic	Link to a graphic to illustrate the incident, the local traffic situation, and/or the traffic control plan.
Descriptive image	Link to a digital image of the incident and local traffic situation.
Video of incident	Link to a video of the incident site.
Pre-planned IM plan	The actual incident management plan, as opposed to simply its name and/or ID number.
Pre-planned traffic control plan	The actual local traffic management plan, as opposed to simply its name and/or ID number.

4.5 Share information about ingress/egress routes, and request route services

Ingress and egress routes are important considerations in incident management. Different agencies involved in incident management may seek advice from other agencies as to the best ingress and egress routes—while other agencies, primarily TMCs, provide that advice. Other route information involves asking for a reverse-direction link for ingress, egress or other uses, sharing the fact that such a link has been set up, asking for priority or preemption for particular vehicles and routes, and sharing the fact that such priority or preemption has been set up. Some agencies, in particular law enforcement, do not wish to seek advice on routes or use routes selected by another agency, and in fact want to keep route information about their vehicles from being disseminated. Nothing in this standard forces those agencies to seek advice or disclose route information. To better define the requirements for the information to be requested and shared, and route services to be requested, 4.5.1 and 4.5.2 describe the operational activities of requesting information and services concerning ingress and egress routes, then sharing information about those routes.

4.5.1 Request advice and services concerning ingress and egress routes

Any agency involved in managing an incident shall be able to:

a) Request advice as to the best ingress and egress routes to use with an incident.
b) Request that a reverse-direction link be set up for ingress, egress or other uses.
c) Request priority or preemption for one or more vehicles for any route or a particular route.

Requesting the information and services just listed shall include the following:

— Message name, acronym: Request route advice/services, RRA

Table 6—Information and services concerning ingress and egress routes

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Vehicle for which request is made	Specifies the vehicle(s) for which the request is made. That can be: —a single response vehicle, —a list of response vehicles requesting the same route/services (e.g., several vehicles from one fire station); or —all public vehicles, for which an agency is requesting the best detour route, and/or signal-light priority for an or any recommended detour route. For either of the two explicitly-identified response vehicle cases, each response vehicle is specified with four attribute types: —ID character string, —vehicle type and subtype, —vehicle limitations on turning radius, height, width, weight, and speed, and —reason for requesting the route for that vehicle (approaching site, removing injured to hospital, etc.), including freetext.
Origin	Unit’s base, incident site, staging area, etc.
Destination	Unit’s base, incident site, staging area, care facility, etc.
Time needed	When the route is needed.
Duration needed	Estimation of how long the route will be needed.
Request reverse flow	Request to establish a reverse flow link, including the reason, a description of that link, and beginning and ending times. Reasons can include ingress, resolving gridlock.
Request priority	Request for priority treatment/preemption, including the reason/justification. Either the TMC may ration use without physically controlling priority/preemption, or it may enable/disable vehicle-roadside systems or, for the detour case, reset signal timing to favor the detour route.
Priority route desired	Description of route for which priority treatment/preemption is being requested. If no route specified, assume the request is for a recommended route, whether or not priority/preemption is requested.
Plan names	Related pre-planned IM plan or local traffic management plan names.
Descriptive graphic	Link to a graphic to illustrate the route situation.

4.5.2 Offer ingress/egress route advice and/or notify that route services have been set up

An agency that has information about the best ingress or egress routes shall be able to describe those routes to agencies requesting route advice, or to broadcast those routes to all involved agencies. An agency that can set up priority or preemption for a route, or a route/vehicle combination, shall be able to notify the agency requesting that priority or preemption that service has been set up, and for what time period, or that the request was denied. An agency that can set up a reverse-flow link shall be able to notify all involved agencies that the reverse-flow link has been set up, and for what time period, or to notify the requesting agency that the request was denied. It shall also be able to notify other agencies that reverse-flow link has been set up (and for what time period).

The information that is shared when offering ingress/egress route advice and/or notifying that ingress/egress route services have been set up shall include the following:

— Message name, acronym: Offer route advice/services, ORA

Table 7—Information for ingress/egress route advice, and/or notifying about route services

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Requesting message	ID of requesting message this message is in response to (known to the communication system, so no need for an explicit data element). Note that vehicle ID information is contained in the requesting message.
Route	ID, description of route that is the advised route.
Start time	Start time when route service is to be active, or when route advice applies.
Duration	Duration of time when route service is to be active, or when route advice applies.
Reverse-flow link grant/deny	Flag designating that request for reverse-flow link has been granted or denied.
Priority/preempt grant/deny	Flag designating that request for priority/preemption has been granted or denied.
Priority/preempt route	Route for which priority/preemption granted, if different from the requested route.
Priority/preempt technology	Priority/preemption technology being used, along with any codes necessary to use that technology.
Plan names	Related pre-planned IM plan or local traffic management plan names.
Current IM plan	IM plan being generated in real time in the course of managing the current incident.
Descriptive graphic	Link to a graphic to illustrate the route situation.

4.6 Share location/priority/preemption information on a response vehicle

In incident management, it can be important to keep track of what vehicles are using what priority/preemption technologies, where and on what routes. While the current base standard supports the communication of which vehicles are dispatched to which incidents on what routes, that information is sourced from the dispatching agency. The additional requirements specified here are to support the requesting and sharing of

location/priority/preemption information, with the capability of that information being sourced from a TMC, based on information from its network of sensors, including in particular its capability to detect where a vehicle is and what priority/preemption technology it is using by monitoring signals received by roadside devices. In addition, requirements specified in this subclause include the sharing of automatic vehicle location (AVL) information from response vehicles en route to and from an incident. To restate a point made previously: some agencies may not want location information on their vehicles to be disseminated. Nothing in this standard forces those agencies to have that information disseminated—local implementations can decide to not disseminate that information.

Four functions are supported by the requirements specified in 4.6:

a) Interagency exchange of detected location information for response vehicles en route.
b) Interagency exchange of detected location information for response vehicles not associated with an incident.
c) Interagency tracking of use of priority/preemption technologies.
d) Interagency tracking of unauthorized use of priority/preemption technologies.

The last two of those functions are of use to TMCs for flow management and so are part of real-time incident management.

4.6.1 Request location/priority/preemption information on a response vehicle

Requests for location/priority/preemption information on a response vehicle can originate from the owner of the vehicle, the IC, or any other agency.

The information that is shared when requesting the information and services just listed shall include the following:

— Message name, acronym: Request location/priority/preemption information, RLP

Table 8—Information for requesting response vehicle location/priority/preemption information

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Password	Local implementations could restrict the dissemination of location/priority/preemption information to agencies having a password, which could be reset for each incident.
Vehicle ID	ID of the vehicle that is the subject of the request.
Assigned-resource submessage	The base standard defines an assigned-resource submessage that can be included in this request. That submessage specifies the currently-known information about the vehicle dispatch, including dispatch details, response unit ID and type, status, location, estimated time of arrival (ETA), estimated time of departure from scene, route, and response plan information. This data item is not necessary if the receiver has already received the current version of that submessage.

4.6.2 Share location/priority/preemption information on a response vehicle

Location/priority/preemption information can originate from the TMC, based on location information it has detected, or it could originate from the vehicle's agency, based on AVL or any other source.

Location/priority/preemption information shall include the following:

— Message name, acronym: Share location/priority/preemption information, SLP

Table 9—Shared location/priority/preemption information

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Requesting message	ID of requesting message this information is in response to (known to the communication system, so no need for an explicit data element). Note that vehicle ID information is contained in the requesting message.
Vehicle ID	ID of the vehicle that is the subject of this information. Not necessary if the requesting message is specified
Assigned-resource submessage	The base standard defines an assigned-resource submessage that can be included here. That submessage specifies the currently-known information about the vehicle dispatch, including dispatch details, response unit ID and type, status, location, ETA, estimated time of departure from scene, route, and response plan information. This data item is not necessary if the receiver has already received the current version of that submessage.
Vehicle location	Vehicle location, including confidence area (the area within which the vehicle could be expected to actually be with a specified probability, e.g., circle with radius 300m at 80%), and technology used to ascertain that location.
Technology	What priority/preemption technology is being used for that vehicle, if any.
Associated incident	Denotes that this vehicle is not associated with any currently active incident, or if it is associated with an incident, that incident number. This is as known to the center creating this information. So if that center has no records matching that vehicle ID to an incident, this data item specifies that fact.
Authorization	A flag denoting that this vehicle is not authorized to be using the priority/preemption technology it is using. This flag would be set if the center creating this information has access to who has been "granted" use of the priority/preemption technology detected on the route detected, and finds that vehicle ID has not been granted use of that technology. A center equipped to set this flag may be a different center than the originator of most of this information. In that case the authorization-checking center could simply be included in the exchanges of location/priority/preemption information, and remain silent until an unauthorized use is detected.

4.7 Information on cleanup or infrastructure repair: the need for it and plans

Cleanup and infrastructure repair is an important part of incident management. Cleanup or infrastructure repair caused by an incident is part of that incident. An instance of need for cleanup or infrastructure repair is itself an incident, whether or not it is associated with a traffic incident. TMCs often try to repair infrastructure while lanes are still closed for an incident, to minimize total time of closure, so there is a tendency to

start that repair as soon as possible, while the incident is still active. This subclause concerns sharing that information between agencies, for example: a non-TMC agency reporting in to a TMC on the need for infrastructure repair, then that TMC reporting its corresponding infrastructure repair plans out to other agencies. While the goal of this standard is to support that information sharing between agencies, there is nothing to prevent its use supporting that information sharing within agencies as well. Examples of infrastructure that might be involved: signals, signs, guard rails, bridge abutments, illumination, malfunctioning equipment.

4.7.1 Report on the need for cleanup or infrastructure repair

This information would be reported to a TMC by an agency on an incident scene, or by an agency discovering a need for cleanup or infrastructure damage or failure. This information is focused on describing the need for cleanup and/or infrastructure repair. If there is a need to also request traffic control associated with that cleanup/infrastructure repair, it shall be handled by a separate message as specified in 4.3.

The information that is shared when reporting the need for cleanup and/or infrastructure repair shall include the following:

— Message name, acronym: Need for cleanup/infrastructure repair, NCI

Table 10—Information for reporting on the need for cleanup or infrastructure repair

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Cleanup needs	A list: a location (location data items for a point or an area, with freetext supplement) and for each location: the cleanup operation needed (enumerated list with freetext supplement), current status (impeding traffic, etc.) and the estimated time duration of that cleanup.
Infrastructure repair needs	A list: a location (location data items with freetext supplement) and for each location: the infrastructure unit needing repair/replacement (enumerated list with freetext supplement), its current status (operational or not, etc.), and the desired time for that repair/replacement to be completed.
Time observed	The time the problem was observed, as that can differ from the timestamp of a communication.
POC	Point-of-contact information on the person reporting this information.
Urgency	Freetext description of the effects of the cleanup or infrastructure situation, indicating the urgency that should be applied in resolving it.

4.7.2 Share information on a cleanup plan and/or an infrastructure repair plan

This information shall originate from a TMC. It may be in response to one or more reports on the need for cleanup or infrastructure repair, or it may be initiated by the TMC. This information is focused on describing a cleanup and/or infrastructure repair response. If there is a need to describe a traffic control operation associated with that cleanup and infrastructure repair response, it shall be handled by a separate message as specified in 4.4.

The information that is shared in specifying a cleanup plan or infrastructure repair plan shall include the following:

— Message name, acronym: Cleanup/infrastructure repair plan, CRP

Table 11—Shared information on a cleanup plan and/or infrastructure repair plan

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Cleanup plan	A list: a location (location data items for a point or an area, with freetext supplement) and for each location: what cleanup units have been dispatched to that location (enumerated list with freetext supplement), ETAs and the estimated time duration of that cleanup.
Repair plan	A list: a location (location data items with freetext supplement) and for each location: what infrastructure repair/replacement units have been dispatched (enumerated list with freetext supplement), ETAs and the estimated time duration of that repair/replacement operation.
POC	Point-of-contact information on the person in charge of the cleanup and/or infrastructure repair response.

4.8 Request information on network conditions or route status

Incident management often needs to be informed of the network conditions on the broader traffic network surrounding the incident. That information is useful for designating ingress, egress, alternative and diversion routes, and for planning and executing traffic control. While messages specified in a TMDD standard (specified in Clause 2) will share information on network conditions and route status, there are significant communication and information processing benefits to being able to request subsets of the entire computer file of network conditions. Those subsets can include geographic areas, summary parameters, and subsets of the complete set of parameters available. Some areas can be designated and named, such as the area around a hospital. Other geographic areas and routes can be designated and named specific to an incident, such as the area within a specified radius of the incident, and routes (ingress, egress, alternative, diversion, evacuation) specified for that incident. Also, in anticipation of cases where photo stills and video will be available from the TMC, requests for that information shall be accommodated, also.

The information that is shared when requesting information on network conditions or route status shall include the following:

— Message name, acronym: Request network conditions, RNC

Table 12—Information for requesting information on network conditions or route status

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Changes only	Flags requesting that only changes from previous network conditions be sent, or only unusual road conditions (e.g., construction, not unusual traffic) be sent, or only unusual traffic be sent, or any combination of those conditions be sent, all as screened by the focus data item that follows.
Focus	Area of interest and/or routes of interest, including pre-designated areas and routes of interest such as ingress/egress route.
Summary	Network summary requested, e.g., travel-time map, speed map, road closures and route diversions, any locally-identified network summaries that have been pre-specified and named.
Parameters	Parameters of interest. All available parameters or a subset: —lane-by-lane: LOS, speed, lane occupancy, traverse time, veh/hr volume, actual/theoretical capacity, pavement condition (traction—wet, frozen, salted), restrictions (height, width, weight, speed); —all lanes in one direction on a link: all the above parameters applied to all lanes taken together, and static information such as number of lanes/lane configuration/dimensions and weight and speed restrictions on that link. —weather: visibility (fog), wind speed and direction, precip/snow, temp, dew point, light, traction, icing alarms, flooding, local plumes (smoke, hazardous material).
Period	Time period for which request is made.
Photos	Request photo stills, with what they would be stills of, format.
Videos	Request video, with what it would be a video of, format.

A message sent in response to a Request Network Conditions message, i.e., a Network Conditions message, relies heavily on data structures defined and controlled in the TMDD standards effort as well as ones found in the Advanced Traveler Information Systems (ATIS) and Transit Communications Interface Profiles (TCIP) standards.

4.9 Share information on asset management

Asset management is a key operation in many incident management situations. Subclauses 4.9.1 through 4.9.4 specify an information vocabulary for physical asset management. Data asset management shall be supported by TMDD messages. That vocabulary is predicated on a very general view of a range of asset management concepts of operations. Subclauses 4.9.1 and 4.9.2 concern a physical-asset management dialog that can take place in four steps or two steps. The four-step version is as follows:

— *Step 1:* An agency polls other agencies to find out the availability of an asset it is interested in using (4.9.1).
— *Step 2:* Other agencies respond to that poll with availability information for that asset (4.9.2).
— *Step 3:* The requesting agency then requests that one particular supplying agency dispatch that asset (4.9.1).
— *Step 4:* The supplying agency confirms that dispatch will take place or has taken place (4.9.4).

In the two-step version, only the last two steps are carried out, based on static information the requesting agency has on asset availability. Any discrepancies between the static asset-availability information and current reality can be managed by repeating, "trial and error," cycles of the third and fourth steps. Subclauses 4.9.3 and 4.9.4 concern the dialog on requesting and providing information on physical-asset status. Note that 4.9.4 specifies information for two functions: 1) to respond to a request to dispatch an asset, and 2) to respond to a request for information on asset status.

The information specified here for asset management applies to all agencies in an incident management communications network using this standard, including public safety agencies. This standard specifies the information requirements and asset lists particular to traffic management. A forthcoming companion volume concerning public safety, IEEE P1512.2 [B4], will specify asset lists particular to public safety.

4.9.1 Request information on physical-asset availability

As explained above, this information covers both the situation where a requesting agency is polling for availability of an asset, and also where that agency is specifically requesting the dispatch of an asset. Portable VMSs are treated here as physical assets, as portable equipment that has to be moved and installed, though the management of them as traffic information devices shall be supported by TMDD messages.

The requestor shall be able to specify a desired asset in terms of the function that is desired. For example, if a requestor simply knows that vehicles are losing traction due to slippery conditions, but does not have the expertise to be able to specify whether a sand truck or a salt truck is the best way to manage that situation, the requestor shall be able to specify simply that, e.g., "traction control" is called for, perhaps with other descriptive data concerning temperature, precipitation, etc. The agency receiving that message can then exercise its informed judgment as to what asset(s) should be dispatched to control traction. In Table 13, this requirement appears as the last entry under "Asset type."

The information that is shared when requesting asset availability information shall include the following:

— Message name, acronym: Ask for assets, AFA

Table 13—Information for requesting physical-asset availability information

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Poll/request	Specifies that this message is asking only for availability, or if the asked agency should dispatch in response to this message.
Asset type	Asset type requested, including: —physical assets: code list for vehicle, team, equipment including portable VMSs, and material. Several notes: —portable VMSs to be controlled via TMDD messages; —can include towing, rotator, and size requirements for either one; —can include Freeway Service Patrol; —a need or function desired: e.g., traction control, with a description of temperature, precipitation, etc.
Asset	Which asset in particular (specified by asset ID or location/area), if the requester has some reason to restrict the request in that way.

Table 13—Information for requesting physical-asset availability information *(continued)*

Data items	Description
Intended use	Intended use, and specifications re what is required that is not already specified in "asset" data item, e.g., training/certification/equipment required for a team, how heavy a truck needs to be towed. While this can include the intended use of a VMS, and could actually include the message(s) desired, the actual control of a VMS shall be handled by TMDD messages.
Time of use	Intended time of use, start and estimated finish. Note that could be for a planned closure/event, and so could be for a start time other than as soon as possible.
Location of use	To what location: which incident, where, the staging area there, or another area, or the precise location, e.g., of a VMS;
Management	Whether or not the requesting agency desires management of the asset.
Logistics	Any logistical details of how the asset and/or the management of the asset would be transferred (freetext).

4.9.2 Share information on physical-asset availability

As explained above, this information covers the situation where an asset-supplying agency is responding to a poll for availability of an asset.

The information that is shared concerning physical-asset availability shall include the following:

— Message name, acronym: Respond to poll for assets, RPA

Table 14—Shared information on physical asset availability

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Requesting message	ID of requesting message this information is in response to, if any (known to the communication system, so no need for an explicit data element).
Asset ID	Particular ID, description, and location if different from or more specific than what polled for.
Availability	Whether or not it is available, ETA, for what time duration.
Management	Whether or not the source agency will transfer management of the asset to the requester, independent of what the requester asks regarding who manages the asset.
Logistics	Logistical details of transfer if different from or more specific than the polled-for or requested logistics.

4.9.3 Request information on physical-asset status

This information may be requested by an agency owning, managing, or awaiting the arrival of an asset, from whatever agency would know the asset status.

The information that is shared when requesting physical-asset status information shall include the following:

— Message name, acronym: Request asset status, RAS

Table 15—Information for requesting physical-asset status

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Key	Security string, establishing that the requesting center is authorized to receive this information.
Asset ID	Description of the asset of interest. Could be simply an ID number, or since the current state of practice may involve asset designations such as “the truck you dispatched to us,” this could simply cite the message that finalized the dispatch. That would apply whether the center sending this request is the source or the requester of the asset.

4.9.4 Share information on physical-asset status

This information can be generated in response to a request for asset status or a request that an asset be dispatched, or it can be sent or broadcast periodically.

The information that is shared concerning physical-asset status shall include the following:

— Message name, acronym: Asset status, AST

Table 16—Shared information on physical-asset status

Data items	Description
Header	Header information specified in the base standard, including the ID of the incident concerned.
Requesting message	ID of requesting message this information is in response to, if any (known to the communication system, so no need for an explicit data element).
Key	Security string, as part of an encryption process.
Asset ID	Description of the asset of interest. Could be simply an ID number, or since the current state of practice may involve asset designations such as “the truck you dispatched to us,” this could simply cite the message that finalized the dispatch. That would apply whether the center sending this request is the source or the requester of the asset. Optionally expanded to include other ID information the center sending this information may have. If message is broadcast (not in response to a request), it shall use some universally-known ID.

Table 16—Shared information on physical-asset status *(continued)*

Data items	Description
Location status	Specifying status such as: at its base station, en route with ETA, on scene and involved, on scene and available, returning to base.
Location	Geographic location, if available.
Plan	Operational plan: what it intends to do, starting when, completing by when.
Current op	Current operation: What it is doing now, whether functioning or malfunctioning.
POC	Contact information of team manager.

5. Message sets and data frames

Incident management (IM) message sets for this TRANSPORTATION volume use shall consist of the following message sets and data frames as well as those messages found in the base standard and other volumes as provided below. Each shall be further divided into specific messages and elements as defined in this clause. Typically, these messages shall be made up of message content internal to this document (made up of DEs 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 5.1 through 5.26. The specifications shall be expressed in ASN.1 syntax as per ISO/IEC 8824-1:1998 and ISO/IEC 8824-2:1998. One style change in the ASN.1 listing should be noted. In former documents of the IEEE 1512 family of standards it was common to add a comment line stating where a foreign data element was taken from. This has been superseded by the use of module definitions where groups of elements taken from a single standard are all placed in a similar module. For example, in the listing that follows the concept of date and time is taken from the ATIS work. Citations of these elements have the phrase “ATIS.” before them, as in “ATIS.DateTimePair” in the code. Similar abbreviations are used for TMDD and TCIP. In addition, the ASN is presented in a section called “ASN.1 Representation;” formally this section was called “Format.” In a similar manner, the equivalent eXtendible markup language (XML) expression is presented in a section called “XML Representation” which follows the translation rule set cited in SAE J2630.

5.1 Message: MSG_RequestWorkZoneData

Use: This message can be sent to another center to request a reply with all known events that meet the search criteria. In this context, “work zone” is used to indicate any event on or nearby the roadway that is preplanned or known to the center receiving the request. It is typically used to gather information about preplanned events, categorized using ITIS codes. It may be used in routine operations to understand another center’s current plans, or as needed (such as when an incident occurs and there is a need to learn about possible roadwork in the area nearby).

If no date-time values are provided, the reply message should return all known events from the time of the query forward to a locally established period in the future (such as 6 months). Note that no incident number is used in the header section of the message when sending this message.

This structure is used to meet the requirements outlined in 4.2.1 and Table 2.

ASN.1 Representation:

```
RequestWorkZoneData ::= SEQUENCE {
   header      Header,
   basics      Basics                OPTIONAL,
   types       SEQUENCE (SIZE(1..16)) OF ITIS.ITIScodes,
               -- the type of events desired,
               -- made up of ITIS codes
               -- such as roadwork, parades, etc...
   onlyActive  BOOLEAN               OPTIONAL,
               -- is set to true return only currently active events
   whenStart   ATIS.DateTimePair      OPTIONAL,
               -- the beginning time period to search over
   whenStop    ATIS.DateTimePair      OPTIONAL,
               -- the ending time period to search over
   where       LRMS.LocationReference OPTIONAL,
                -- the geographical area to search
   ...
   }
```

Remarks: Note that this message allows users to create rather complex searching keys (such as: all parades and bridge repairs occurring between 3PM next Wednesday and Midnight Dec 31, 2010 located with 500 meters of Town Hall). Local deployments may need to limit by mutual local agreements of the level of such complexity supported. Local deployments may also wish to limit how far backward from current time they will allow a search to request, if at all.

5.2 Message: MSG_WorkZoneData

Use: This message contains information on pre-planned events such as but not limited to a work zone. It may occur because the issuing center wished to send it, or (more likely) as a reply to a request for such data after a MSG_RequestWorkZoneData was received. A sequence of these messages is likely to be sent, representing all such events that meet the requested criteria.

This structure is used to meet the requirements outlined in 4.2.2 and Table 3.

ASN.1 Representation:

```
WorkZoneData ::= SEQUENCE {
   -- this is in sync with recent SAE changes which provide a
   -- strong "consumer" work zone message to start from
   header           Header,
   basics           Basics OPTIONAL,
   eventID          IncidentRef OPTIONAL,
                    -- a number for the event itself used in the CAD
   currentlyActive  BOOLEAN OPTIONAL,
                    -- when true the event is currently taking place
                      -- the precise meaning of this may require local agreements
   currentEventID   SubMessageRefNum  OPTIONAL,
                    -- some CAD use a dual numbering system for
                    -- active events, if this is the case this field will
                    -- hold the active value, while the above will hold the
                    -- the long-term value
   description      ATIS.EventInformation,
                    -- a complex summary of the event from SAE
                    -- note that it also includes the complex lane description
                    -- frame taken from this std
```

```
   restrictions     RestrictionSet OPTIONAL,
                    -- a sequence of various link restrictions, which
                    -- exist over the links of the event
   descriptiveText  FreeText  OPTIONAL,
                    -- other data that needs to be conveyed in a free text format
   liveImage        URL-Link  OPTIONAL,
                    -- a URL/URI for any live image data feeds
   graphicOverview  URL-Link  OPTIONAL,
                    -- link to a file or to a URI/URL to carry any
                    -- explanatory graphic file for this message
   ...
   }
```

5.3 Message: MSG_ReqTrafficCntrlPlan

Use: The sender of this message may be requesting of the receiving center either that a traffic control response plan be created incorporating the given details about the event they are sending, or it may be requesting to be informed about an event they know little about (in which case they are not likely to be providing details on items such as lane conditions). The header will contain links to the active incident (if one is present).

If no incident is present (and no event details) this message may be used to request pre-established response plans from the other center by name or number. Note that the ability to send things like images or current lane blockage conditions can also be sent in the IDX message for any established incident. If these fields are blank (and formulating a response plan is required), the most recent IDX message data should be considered.

The response to this message will be a traffic control plan message. However, many details of that plan and the actual status of various assets during its execution, will be contained in IDX messages related to the event. If the incident was not declared and given a set of assigned numbering values in the CAD, then this will likely occur if needed. Over the course of the event, the IDX message will have updates to such information. This message would not be updated in a similar way unless another request for it was received.

This structure is used to meet the requirements outlined in 4.3 and Table 4.

ASN.1 Representation:

```
ReqTrafficControlPlan ::= SEQUENCE {
   header         Header,
   basics         Basics                              OPTIONAL,
   planName       TMDD.Event-response-plan            OPTIONAL,
   planText       TMDD.Event-ResponsePlanText         OPTIONAL,
   planNumber     TMDD.Event-response-plan-identifier OPTIONAL,
   conditions     FreeText                            OPTIONAL,
   sceneSketch    URL-Link                            OPTIONAL,
                  -- descriptive graphic by way of a url
   sceneImage     URL-Link                            OPTIONAL,
                  -- scene image by way of a url
   laneConditions SEQUENCE (SIZE(1..24)) OF SEQUENCE {
                  laneLocation LRMS.LocationReference OPTIONAL,
                  -- the LRMS within the event when the next lane pertains to
                  lane LaneDescription                OPTIONAL
                  -- note that this lane description is what is wrong ,
                  -- not what we will do about it (which is in the reply)
                  -- restrictions (axle, size, weight, etc...) from event
                  },
   vehicleTypes   TMDD.Event-IncidentVehiclesInvolved OPTIONAL,
```



```
   vehicleCount   TMDD.Event-IncidentVehiclesInvolvedCount OPTIONAL,
   onSceneContact UTF8String(SIZE(1..200))            OPTIONAL,
                  -- on scene personnel contact data (may be the IC)
   radioContact   UTF8String(SIZE(1..200))             OPTIONAL,
                  -- preliminary radio contact data
   ...
   }
```

5.4 Message: MSG_TrafficCntrlPlan

Use: The traffic control plan message is sent in reply to a request for a traffic control plan. Local embodiments may decide to reply with an IDX message containing the same information in its various submessages, if such information is in fact known in a very short period of time and an incident had been previously declared for the event. This would typically be the case if the request message was being employed to ask about pre-planned responses. This message is a one-time event, that is, it would not be updated and resent unless another request for it was received.

This structure is used to meet the requirements outlined in 4.4 and Table 5.

ASN.1 Representation:

```
TrafficControlPlan ::= SEQUENCE {
   header         Header,
   basics         Basics                                    OPTIONAL,
                  -- the header/basics will have the normal IDX numbering
                  -- and summary codes for the event and location
   -- the incident plan
   imPlanName     TMDD.Event-response-plan                  OPTIONAL,
   imPlanType     TMDD.Event-response-plan-type             OPTIONAL,
   imPlanNumber   TMDD.Event-response-plan-identifier       OPTIONAL,

    -- the traffic plan
   trafficPlanName   TMDD.Event-response-plan               OPTIONAL,
   trafficPlanType   TMDD.Event-response-plan-type          OPTIONAL,
   trafficPlanNumber TMDD.Event-response-plan-identifier    OPTIONAL,

   -- various further information
   currentStaus   Event-IncidentStatus                      OPTIONAL,
   conditions     FreeText                                  OPTIONAL,
   specialInstructions FreeText                             OPTIONAL,
   constraints    FreeText                                  OPTIONAL,
   sceneSketch    URL-Link                                  OPTIONAL,
                  -- Descriptive graphic by way of a url
   sceneImage     URL-Link                                  OPTIONAL,
                  -- Scene image by way of a url
   laneConditions SEQUENCE (SIZE(1..24)) OF SEQUENCE {
                  laneLocation LRMS.LocationReference       OPTIONAL,
                   -- the LRMS within the event when the next lane pertains to
                  lane LaneDescription                      OPTIONAL
                  -- Note that this lane description is from the
                  -- perspective of the center sending out the plan
                  -- it may have aspects of what will be done about the
                  -- event (such as determining to close lanes)
                  },
   vehicleType    TMDD.Event-IncidentVehiclesInvolved       OPTIONAL,
   vehicleCount   TMDD.Event-IncidentVehiclesInvolvedCount  OPTIONAL,
```

```
   onSceneContact FreeText                                    OPTIONAL,
                  -- on scene personnel contact data (may be the IC)
                  -- on behalf of the center sending this message
                  -- this person may be on the way to the event
                  -- rather than on scene in some cases
   radioContact   FreeText                                    OPTIONAL,
                  -- Preliminary radio contact data for above
   impactSummary  SEQUENCE (SIZE(1..32)) OF Impact            OPTIONAL,
                  -- The IDX submessage from the base standard which
                  -- conveys lane data as sell as multiple route sets
                  -- for detour and alt route use
   evacuations    SEQUENCE (SIZE(1..32)) OF Evacuation        OPTIONAL,
                  -- The IDX submessage from the base standard which
                  -- conveys evacuation information including routes
   staging        SEQUENCE (SIZE(1..32)) OF Scene-Staging     OPTIONAL,
                  -- The IDX submessage from the base standard which
                  -- conveys staging area locations and use directions
   vmsUse         VMS-UsePlan                                 OPTIONAL,
   dsrcUse        DSRC-UsePlan                                OPTIONAL,
   harUse         HAR-UsePlan                                 OPTIONAL,
   additionalText FreeText                                    OPTIONAL,
   relatedMsgs    SEQUENCE (SIZE(1..32)) OF SubMessageRefNum OPTIONAL,
   ...
   }
```

Remarks: This message should be viewed as the “opening game” response to a request and need for a traffic control plan. It relates to the other center everything that can be quickly known about the response. As the event develops and is managed, the IDX submessages provides the preferred means to update and add information on the individual sections of this message (staging, routes, TMDD devices). The IDX structure also provides a means to update individual asset status for personnel and mobile devices responding to the event.

5.5 Message: MSG_RequestRouteAdvice

Use: This message is used to request a route over the surface transportation grid (including various signal preemptions and potentially reversed lanes flows) for one or more vehicles with various restrictions. It is typically used to establish a route for time critical equipment to reach the location of an incident or a nearby staging scene. The estimated duration of the requested route, the need for on-scene personnel to flag traffic and control access, and provisions for credentialing vehicles for signal preemptions are provided.

This structure is used to meet the requirements outlined in 4.5.1 and Table 6.

ASN.1 Representation:

```
RequestRouteAdvice ::= SEQUENCE {
   header           Header,
   basics           Basics         OPTIONAL,
   vehicleID        VehicleId,
                    -- requesting vehicle or group
   vehicleMakeup    VehicleSummary OPTIONAL,
                    -- some very complex ways to describe all the restrictions
                    -- such as weight, width, axle as well as
                    -- agency type (police, tow, local LE, ITIS list)
                    -- preempt technology it/ they have
                    -- sequence of vehicle ID to link to IDX resources messages
   rational         FreeText OPTIONAL,
                    -- reason for the requested route
```



```
   origin           LRMS.LocationReference OPTIONAL,
                    -- if known
   destination      LRMS.LocationReference OPTIONAL,
                    -- link to staging areas or event if so desired
   whenStart        ATIS.DateTimePair   OPTIONAL,
   whenEnd          ATIS.DateTimePair   OPTIONAL,
   reqReverseFlow   BOOLEAN OPTIONAL,
                    -- the requester would like to use reversed lane
                    -- flow for ingress or egress if this is possible and
                    -- saves time
   reqPriority      INTEGER (0..5) OPTIONAL,
                    -- relative priority of this request over others in the event
   priRational      FreeText OPTIONAL,
                    -- reason for the requested priority
   suggestedRoute   ATIS.Route  OPTIONAL,
                    -- a suggestion of the major route point that
                    -- the requester would like to use
   planId           TMDD.PlanID OPTIONAL,
                    -- event pre-planned name if applicable
   planName         TMDD.PlanName OPTIONAL,
                    -- event pre-planned name if applicable
   graphicOverview  URL-Link OPTIONAL,
                    -- link to a file or to a URI/URL to carry any
                    -- explanatory graphic file for this message
   ...
   }
```

5.6 Message: MSG_RouteAdvice

Use: This message provides a complex set of routing instructions suitable for use in public safety response. Besides the turn-by-turn directions of the recommended route itself, this message also provides data on the unusual conditions often needed in the response to an incident. These include routing down the wrong side of street, right of ways, data regarding height and weight restrictions of the links (needed for oversize equipment), and priority and preemption issues effecting the roadside signal control devices.

This structure is used to meet the requirements outlined in 4.5.2 and Table 7.

ASN.1 Representation:

```
RouteAdvice ::= SEQUENCE {
   header           Header,
   basics           Basics                                OPTIONAL,
   requestorIdent   RequestIdent                          OPTIONAL,
                    -- message, center, and seat
   routeName        RouteName                             OPTIONAL,
                    -- the id by which this offered route will be known
   route            ATIS.Route,
                    -- the route itself , as per SAE work
   whenStart        ATIS.DateTimePair                     OPTIONAL,
   whenEnd          ATIS.DateTimePair                     OPTIONAL,
   linkFlow         SEQUENCE (SIZE(1..16)) OF FlowType    OPTIONAL,
                    -- enum of flow type data here, such as reversed lanes
   requestGrant     SEQUENCE (SIZE(1..16)) OF PreemptGrant OPTIONAL,
                    -- note that preempt and priority uses are both allowed here
   signalTechnology SEQUENCE (SIZE(1..16)) OF PreemptTech  OPTIONAL,
                    -- an enum of the technology to be used.
   secString        SecString                             OPTIONAL,
```

```
                    -- any password or security string to be used in this route
   prePlanName      PlanName                              OPTIONAL,
                    -- if this route is related to a pre-plan, link it here
   planName         PlanName                              OPTIONAL,
                    -- current (active) plan this route is related to
   graphicOverview  URL-Link                              OPTIONAL,
                    -- link to a file or to a URI/URL to carry any
                    -- explanatory graphic file for this message
   routeStatus      RouteStatus                           OPTIONAL,
                    -- status of route
                    -- (enum or proposed,planned,setting up, active, teardown, close
                      closed)
   relatedMsgs      SEQUENCE (SIZE(1..32)) OF SubMessageRefNum OPTIONAL,
   ...
   }
```

Remarks: The actual turn-by-turn route information structures are shared with that used by the ATIS message set for consumer routing. However, for the most part the routing messages found in ATIS presume “safe and sane” driving on the streets in a normal fashion, and also support multi-modal trip planning uses. Commercial routing databases do not normally support reversed lane driving and may not be able to reflect the link restrictions needed here. Many states have such information on major roadways for their permitting databases to handle processing commercial oversized load permits. Consider integrating these functions. If your deployment requires supporting people evacuation, such as mass busing services, then the other routing and scheduling messages found in TCIP and ATIS should be considered as well.

5.7 Message: MSG_RequestPreemptionUserData

Use: This message is used to request information about a vehicle engaged in using the local priority/preemption network. It may be sent by the vehicle’s owning center or by the owner of a priority/preemption network. The essential purpose of this message is to ask for the status of the subject vehicle. The owner of a priority/preemption network may reply with various information regarding if the subject vehicle is authorized to use the system (which may be further limited to certain places and times) and the vehicle’s last known location in the network. The vehicle’s owning center will reply with a message containing the current resource assignment for the vehicle. Other centers requesting this information from either center may or may not receive any information (or a subset of the information) depending on the local data sharing agreements.

This structure is used to meet the requirements outlined in 4.6.1 and Table 8.

ASN.1 Representation:

```
RequestPreemptionUserData ::= SEQUENCE {
   header       Header,
   basics       Basics                      OPTIONAL,
   password     FreeText                    OPTIONAL,
   vehicleID    VehicleId,
                -- a reference to the vehicle
   assignedResoureSubMessage   Asgn-Resrc    OPTIONAL,
                -- this definition of the resource (vehicle)
                -- comes from the base std
   ...
   }
```

Remarks: A priority/preemption network owner may wish to exchange passwords and other use credentials between the two centers. The method used to convey these and how (as needed) they are sent to the using vehicle is not covered in this standard. However, it is acceptable to use the message structures of the IEEE 1512 family of standards to perform such exchanges.

5.8 Message: MSG_PreemptionUserData

Use: This message is used to relate information about a vehicle engaged in using the local priority/preemption network. It may be sent by the vehicle's owning center to relate current information about the vehicle (such as its location or intended plan of action when it arrives, or its current ETA). It may be sent by the owner of a priority/preemption network to indicate that the vehicle has just entered or attempted to use such a network. It may be sent as a reply to the MSG_RequestPreemptionUserData message.

By exchanging this message between centers the monitoring and validation of use of the priority/preemption network can be achieved. Note that this does not address the technologies employed to build such a network. If the overall systems design concept involves using this message as a part of a request/grant dialog to gain access to actually authorize the preemption of a signal system, then the overall latencies of message traffic should be considered as well. Note that while this message was intended to be used with a vehicle, it can also be used as a means for tracking the access of individuals and other objects.

This structure is used to meet the requirements outlined in 4.6.2 and Table 9.

ASN.1 Representation:

```
PreemptionUserData ::= SEQUENCE {
   header              Header,
   basics              Basics                    OPTIONAL,
   password            FreeText                  OPTIONAL,
   vehicleID           VehicleId,
                       -- the reference of the vehicle object
   assignedResourcesSubMessage  Asgn-Resrc       OPTIONAL,
                       -- defined from base std
   technology          SEQUENCE (SIZE(1..16)) OF PreemptTech OPTIONAL,
                       -- this is the tech used by the vehicle over the route
   relatedEvent        IncidentRef               OPTIONAL,
                       -- the IDX incident number of the incident the
                       -- vehicle is assigned to
   authorizationValue PreemptAuthorization       OPTIONAL,
                       -- an enum or yes/no/not here/ not present, etc
   ...
   }
```

5.9 Message: MSG_InfrastructureReport

Use: This message can be used to send information to another center regarding its infrastructure and report damage or otherwise out of normal operations. The report is received by another center who may do anything with it as they wish (including discard it entirely). It is intended to be used during the course of an incident event to report damage to another center. In this capacity, the message can be very helpful in starting the repair and restoration process early.

Some deployments may find it useful to restrict the use of this message to only other centers who can reasonably be expected to provide "quality" information, while others may determine that they will allow reports of such things as tires in the median and malfunctioning signal lights to be input to the system from unverified public callers. This is another deployment subject for local implementations to decide on a group. The quality metrics in the reporting person section allows a range of qualifications regarding the reporting person. Privacy of the public can also be preserved in these fields.

This structure is used to meet the requirements outlined in 4.7.1 and Table 10.

ASN.1 Representation:

```
InfrastructureReport ::= SEQUENCE {
   header         Header,
   basics         Basics                   OPTIONAL,
   cleanUpNeeds   SEQUENCE OF CleanUpItems OPTIONAL,
                  -- list of items to report
   cleanUpText    FreeText                 OPTIONAL,
                  -- free text when above list does not serve
   restoreNeeds   SEQUENCE OF InfrastructureRestorationList OPTIONAL,
                  -- list of items to restore in infrastructure
   restoreText    FreeText                 OPTIONAL,
                  -- free text when above list does not serve
   repairNeeds    SEQUENCE OF CleanUpItems OPTIONAL,
                   -- list of items to report
   repairText     FreeText                 OPTIONAL,
                  -- free text when above list does not serve
   reportID       MessageID                OPTIONAL,
                  -- some form of index to link back to this message
   where          LRMS.LocationReference,
                  -- location of report
   timeObserved   ATIS.DateTimePair,
                  -- time of the reported sighting
   reportedBy     WitnessStatement,
                  -- summary of the person / role / reliability estimate
   quality        Qual                     OPTIONAL,
   pointOfContact FreeText                 OPTIONAL,
                  -- follow up point of contact
   urgency        Urgency                  OPTIONAL,
                  -- reporting person or CAD operators assessment, 0 as least
   ...
   }

infrastructureReport IDX-PART-MESSAGE ::= {
-- a submessage of IDX for reporting Infrastructure damage
   &name "Infrastructure damage report message",
   &id      101,
   &Type InfrastructureReport
   }
```

Remarks: Note that this message is both a stand alone message and a submessage of IDX. In the IDX use, the message is required to be dealing with events related to the subject incident. Much of the same information contained here can be related in the “witness statement” portions of the description submessage of IDX. If the substance of the witness report deals with such damage, this message should be used. In cases where ad hoc reports of items are allowed independent of a specific incident (consider a 911 caller informing you that there is an obstacle in the roadway) then the stand alone message should be used. If local practices are to declare and establish an open incident on an unverified call, then the information would be issued as part of the IDX message for that incident (presumably accompanied by other IDX submessages indicating the action to be taken, such as deploying a vehicle for on-scene verification).

5.10 Message: MSG_ClearOrRepairPlan

Use: This message is used to inform other centers of a plan of action to repair or cleanup an infrastructure related issue (typically damage to some part of the roadway infrastructure or some other repair/restore action). It represents an indication of what the issuing center expects to do. It is not a commitment to do so, nor does it take the place of a pre-planned event. The time frame in which the repair will occur may also be vague or nonexistent. This message is mostly of use when immediate action is to be taken and coordination with other centers is useful, such as in an incident causing such damage to the roadway that it must be restored to maintain a level of service. This message is not intended to replace the reporting of long-term scheduling of repair work (which is likely to be reported in the pre-planned event messages). Because the expected duration of the cleanup portion is also covered, other centers providing services (such as traffic control) can determine the amount of time and resources they will need to maintain a supporting posture.

This structure is used to meet the requirements outlined in 4.7.2 and Table 11.

ASN.1 Representation:

```
ClearOrRepairPlan ::= SEQUENCE {
   header               Header,
   basics               Basics                              OPTIONAL,
                        -- the header and below relates this to a sequence of
                        -- reportIds with center / seat data
   responsePlanID       TMDD.Event-response-plan-identifier,
   responsePlanType     TMDD.Event-response-plan-type       OPTIONAL,
   responsePlan         TMDD.Event-response-plan            OPTIONAL,
   responsePlanText     TMDD.Event-ResponsePlanText         OPTIONAL,
   responsePlanAuthor   UTF8String(SIZE(1..200))            OPTIONAL,
   issuingCenter        TCIP.IM-ResponseAgencyID            OPTIONAL,
   eventID              IncidentRef                         OPTIONAL,
                        -- the id of the IDX this relates to
   clearPlan            CleanUpPlan                         OPTIONAL,
                        -- the current clearance plan, with duration values
   repairPlan           RepairPlan                          OPTIONAL,
                         -- the current repair plan, with duration values
   pointOfContact       UTF8String(SIZE(1..200))            OPTIONAL,
   ...
   }
```

Remarks: In this message, “cleanUpPlan” can be differentiated from “repairPlan” as follows. Cleanup is that level of effort needed to clear the incident and allow the roadway network to resume operations (perhaps at a reduced level of service). Repair is that additional (typically later in time) effort needed to fully restore the roadway network to its former state. In some events, these two steps cannot be separated. Consider a damaged guard rail protruding into the roadway. Under some circumstances this would be a two-step process, first to remove the damaged guard rail to again make the roadway safe. This is likely to conclude the cleanup portion. At some later date, restoration of the rail may occur. In some other event, it may be judged too dangerous not to restore the rail immediately.

5.11 Message: MSG_RequestNetworkConditions

Use: This message can be sent to another center to request a reply containing current network conditions of various kinds that meet the passed search criteria. It is typically used to gather current information about the transportation network status. Typically this message will result in the then-current network conditions being returned. If various summaries or predicted information (travel times, local weather, etc.) are available, these may be returned as well. The time interval can be used to control responses that extend over such time periods. If an event is active at all during the requested time period (and meets the other criteria) then it should

be returned. For example, in requesting information about a road between 5 PM and midnight for which road work was planned for 11 PM, then information about that road work would be sent back.

Note that various items in the message allow establishing a simple “subscription” between the center where only updated conditions to prior request messages are requested to be sent. Also be aware that such messages will result in a complete resending of the response message, rather than only the changed elements. The time interval is used to establish the length of such a subscription and the message must be sent again after that time. The rate at which reply messages are sent is determined by the sending center and local practices.

The filtering which occurs can be reduced to a natural language form of requesting all ITIS events of the following types, with the following TMDD data to be returned occurring within either the following polygon or on the following link ids, and occurring within the following interval of time.

This structure is used to meet the requirements outlined in 4.8 and Table 12.

ASN.1 Representation:

```
RequestNetworkConditions ::= SEQUENCE {
   header        Header,
   basics        Basics OPTIONAL,
   eventTypes    SEQUENCE (SIZE(1..64)) OF ITIScodes,
                 -- various roadway event codes which are wanted
                 -- a value of zero indicates no code filtering
   conditionTypes SEQUENCE (SIZE(1..64)) OF ConditionTypes OPTIONAL,
                 -- list of what type of data to be sent
                 -- area of interest follows, by named routes or by LRMS
   focus  CHOICE
        {
        routes  SEQUENCE (SIZE(1..128)) OF TMDD.Route-IDs,
        lrms    LRMS.LocationReference,
        ...
        },
   summary      BOOLEAN OPTIONAL,
                -- if set to true the requestors would like any summary of
                -- information covering the above location as well
   videoRequest BOOLEAN OPTIONAL,
                -- if true the requester would like multi media feeds
                -- if they are available, returned by URIs
   whenStart    ATIS.DateTimePair  OPTIONAL,
                -- the time period to start the request over
                -- use current time is not sent
   whenEnd      ATIS.DateTimePair  OPTIONAL,
                -- the ending time interval to search over
   subscribeMe  BOOLEAN,
                -- if set to true then the requestor wants the center to
                -- send updates for the interval described below
                -- for network conditions relating to this message
   subscribeLength  ATIS.TimeInterval  OPTIONAL,
              -- the length in minutes for the subscription to last
   ...
   }
```

Remarks: The subscription abilities offered by the Center to Center (C2C) work in its DATEX and common object request broker architecture (CORBA) system models can be used to achieve a better subscription system than this message alone. These messaging environments should be strongly considered if the deployment is able to have all centers participate in such a system. In cases where this is not possible, provisions for the less featured centers in the deployment to request this information should be considered. Similar

information with less TMDD-centric content can also be sent to centers using messages found in the SAE ATIS message set work. Local deployments may need to limit, by mutual local agreements, the level of search complexity supported. Local deployments may also wish to limit how far backward from current time they will allow a search to request, if at all.

5.12 Message: MSG_NetworkConditions

Use: This structure is used to meet the requirements for the reply data from a message. It returns data structures defined and controlled in the TMDD standards effort as well as ones found in ATIS and TCIP. To some degree, it is a general-purpose way to recover a message from the other major message sets which cover or concern a given area of the network within the IEEE 1512 framework. In the case of TMDD requests, very specific data elements can be returned. It is not likely that all possible messages will be allowed in any given deployment, so local tailoring should be employed to remove messages not supported.

Note: Exactly what some of the data structures will look like at a lower level is likely to change given the current state of revision of the TMDD work. The higher-level named structures included here are defined in detail in TMDD standards and the IEEE ITS data registry. Builders should check to confirm details of each message with each standards developing organization (SDO), as the ongoing harmonization process is likely to continue such changes.

ASN.1 Representation:

```
NetworkConditions ::= SEQUENCE {

  bundledATIS SEQUENCE {
     -- Various ATIS based response messages
     weather          SEQUENCE (SIZE (1..32)) OF ATIS.WeatherInformation        OPTIONAL,
     pollution        SEQUENCE (SIZE (1..32)) OF ATIS.PollutionInformation      OPTIONAL,
     traffic          SEQUENCE (SIZE (1..32)) OF ATIS.TrafficInformation        OPTIONAL,
     incidents        SEQUENCE (SIZE (1..32)) OF ATIS.IncidentInformation       OPTIONAL,
     events           SEQUENCE (SIZE (1..32)) OF ATIS.EventInformation          OPTIONAL,
     roads            SEQUENCE (SIZE (1..32)) OF ATIS.RoadAdditionalInformation OPTIONAL,
     flights          SEQUENCE (SIZE (1..32)) OF ATIS.AirlineTravelInformation  OPTIONAL,
     wideareatravels SEQUENCE (SIZE (1..32)) OF ATIS.WideAreaTravelInformation OPTIONAL,
     routes           SEQUENCE (SIZE (1..32)) OF ATIS.TransitRoute              OPTIONAL,
     ...
     },

  -- bundledTMDD SEQUENCE {
     -- item   SEQUENCE (SIZE (1..32)) OF TMDD.AnyMessage      OPTIONAL,
     -- insert each major TMDD messages here in next revision
    -- ...
     -- },
  -- bundledTCIP SEQUENCE {
     -- item   SEQUENCE (SIZE (1..32)) OF TCIP.AnyMessage      OPTIONAL,
     -- insert each major TCIP messages here in next revision
    -- ...
     -- },

  rawTMDD   SEQUENCE {
     linkID               LinkID,
     -- link to which the below data pertains
     -- Information taken from TMDD network conditions messages here
     -- a sequence of various TMDD data elements meeting the list the
     -- user asked for in his request message
     lanesblockedorclosedcount  TMDD.Event-LanesBlockedOrClosedCount OPTIONAL,
     type                 TMDD.Incident-Type              OPTIONAL,
     laneclosedlist       TMDD.LaneClosedList             OPTIONAL,
     laneconfigurationlist TMDD.LaneConfigurationList      OPTIONAL,
```

```
      capacity              TMDD.Link-Capacity              OPTIONAL,
      delay                 TMDD.Link-Delay                 OPTIONAL,
      density               TMDD.Link-Density               OPTIONAL,
      lanesminimumnumber    TMDD.Link-LanesMinimumNumber    OPTIONAL,
      lanesnumberopen       TMDD.Link-LanesNumberOpen       OPTIONAL,
      length                TMDD.Link-Length                OPTIONAL,
      levelofservice        TMDD.Link-LevelOfService        OPTIONAL,
      mediantype            TMDD.Link-Median-Type           OPTIONAL,
      name                  TMDD.Link-Name                  OPTIONAL,
      occupancy             TMDD.Link-Occupancy             OPTIONAL,
      pavementtype          TMDD.Link-PavementType          OPTIONAL,
      restrictionaxlecount  TMDD.Link-RestrictionAxleCount  OPTIONAL,
      restrictionclass      TMDD.Link-RestrictionClass      OPTIONAL,
      restrictionheight     TMDD.Link-RestrictionHeight     OPTIONAL,
      restrictionlength     TMDD.Link-RestrictionLength     OPTIONAL,
      restrictionweight     TMDD.Link-RestrictionWeight     OPTIONAL,
      restrictionwidth      TMDD.Link-RestrictionWidth      OPTIONAL,
      roadnumber            TMDD.Link-RoadNumber            OPTIONAL,
      shoulderwidthleft     TMDD.Link-ShoulderWidthLeft     OPTIONAL,
      shoulderwidthright    TMDD.Link-ShoulderWidthRight    OPTIONAL,
      speed                 TMDD.Link-Speed                 OPTIONAL,
      speedlimit            TMDD.Link-SpeedLimit            OPTIONAL,
      status                TMDD.Link-Status                OPTIONAL,
      surfacecondition      TMDD.Link-SurfaceCondition      OPTIONAL,
      traveltime            TMDD.Link-TravelTime            OPTIONAL,
      truckspeedlimit       TMDD.Link-TruckSpeedLimit       OPTIONAL,
      nd-delay              TMDD.Node-Delay                 OPTIONAL,
      nd-linksnum           TMDD.Node-LinksNum              OPTIONAL,
      nd-name               TMDD.Node-Name                  OPTIONAL,
      nd-status             TMDD.Node-Status                OPTIONAL,
      owner                 TMDD.Link-ownership             OPTIONAL,
      jurisdiction          TMDD.Link-jurisdiction          OPTIONAL,
      tmddOther             TMDD.Link-other                 OPTIONAL,

      -- The following items come from the ITIS properties and definitions
      weatherConditions     ITIS.ITIScodes(4608..4863)      OPTIONAL,
      precipitation         ITIS.ITIScodes(4864..5119)      OPTIONAL,
      winds                 ITIS.ITIScodes(5120..5375)      OPTIONAL,
      windDirection         ITIS.ITIScodes(7998..8005)      OPTIONAL,
      visibility SEQUENCE (SIZE(1..2)) OF ITIS.ITIScodes(5376..5631) OPTIONAL,
         -- and includes air quality
      temperature           ITIS.ITIScodes(5632..5887)      OPTIONAL,
      pavementConditions SEQUENCE (SIZE(1..3)) OF ITIS.ITIScodes(5888..6143) OPTIONAL,
         -- includes data on roadway objects and ice and snow types
      winterDrivingRestrictions  ITIS.ITIScodes(6144..6399)  OPTIONAL,
      winterDrivingIndex   ITIS.ITIScodes(6400..6655)       OPTIONAL,

      -- The following items come from NTCIP ESS work
      temp                NTCIP.EssAirTemperature           OPTIONAL,
      humidity            NTCIP.EssRelativeHumidity         OPTIONAL,
      rainHour            NTCIP.EssPrecipitationOneHour     OPTIONAL,
      rainDay             NTCIP.EssPrecipitation24Hours     OPTIONAL,
      snow                NTCIP.EssRoadwaySnowDepth         OPTIONAL,
      snowPack            NTCIP.EssRoadwaySnowPackDepth     OPTIONAL,
      snowRate            NTCIP.EssSnowfallAccumRate        OPTIONAL,

      ...
      } OPTIONAL,
   ...
   }
```

Remarks: The implementer is cautioned to check with both IEEE as well as the Institute of Transportation Engineers (ITE) and the Society of Automotive Engineers (SAE) and the current state of the data registry to be sure that the underlying definitions of the TMDD portions of this message come from the most current

standards of the ITE. The ITE was engaged in revising these messages during the same time frame that the IEEE was developing this standard. Both work products are intended to be interoperable, and in this case the TMDD message structures (and underlying component data elements) fit within the structures defined above. This is somewhat in contrast to the more typical use of external data elements found in the rest of this standard.

5.13 Message: MSG_RequestPhysicalAsset

Use: This message is used to ask another center what assets it has that meet selected criteria. And finding such assets for the right to use them, or have them assigned to the intended use in the message. These criteria must be either a selection from a set of assets combined with specific gross features, or a sequence of specific assets listed by name (in other words, one could, for example, ask for any large tow that can lift 5,000 pounds, or ask the center to "Send by the big red tow" if this was specifically known to be what was wanted). The asset description field itself allows adding tag and value pairs to suit local practices. It is presumed that local deployments will agree on what characteristics they wish to add and use in these fields so that all centers understand them. This is an important point, as it becomes an agreed upon list of features that centers in the deployment can search and ask each other about.

Once assigned to an incident, an assigned resources submessage would be issued with the current status of each asset (one submessage per asset). Note that the receiving center may not agree to this and may enter into a "conversation" with one or more centers before such a deployment occurs.

The wantsManagement flag is for the use of those centers that actually will allow another center to take over the management of one of their assets (rather than simply loan it, but still direct it from the owning center). Note that once an asset is transferred to another center, the reference established for it related to the incident (assetUnitID) does not change. The agencyID used in the message would change to be that of the new owning agency, and queries directed at the status of the asset would be sent to that agency center. The return of the asset to the owning center (and any refurbishment required before putting it into service) is not a part of the message set but is presumed to occur after the incident is completed.

This structure is used to meet the requirements outlined in 4.9.1 and Table 13.

ASN.1 Representation:

```
RequestPhysicalAsset ::= SEQUENCE {
   header         Header,
   basics         Basics OPTIONAL,
   pollOnly       BOOLEAN,
                  -- a flag, if true then just asking if one exists,
                  -- if false then wanting a response assignment
   wantsManagement BOOLEAN,
                  -- true if the requester desires to have management of the
                  -- asset assigned fully to his center upon use
   request  CHOICE  {
      byType   SEQUENCE
                  {
                  desc  AssetDescription,
                  -- a complex structure describing the asset needed
                  count AssetCnt
                  -- how many of this type are wanted
                  },
      byKind   SEQUENCE
                  {
                  type CHOICE {
                     vehicle  VehicleAssetLists,
```

```
                        -- a basic list of type of vehicle assets
                        -- or assets on trailers used / shared locally
                        -- examples include tows, sand trucks, small VMS
                  device   RoadsideAssetLists,
                        -- a list of roadway devices and traffic
                        -- control items which are not generally
                        -- vehicles or on trailers
                        -- examples include HAR sites, cones, barriers
                  text     FreeText
                        -- used when nothing on either list suits
                  },
               count      AssetCnt
               -- how many of this type are wanted
               },
   byNumber SEQUENCE (SIZE (1..32)) OF CenterAssetPermRef,
            -- one or more specific references to a known asset
            -- presumes a knowledge of the inventory in question
   ...
   },
intendedUse       SEQUENCE (SIZE (1..64)) OF Asset-Use OPTIONAL,
                  -- collection of known phrases regarding the
                  -- proposed use of the asset
vmsUse            VMS-UsePlan          OPTIONAL,
dsrcUse           DSRC-UsePlan         OPTIONAL,
harUse            HAR-UsePlan          OPTIONAL,
intendedUseText   FreeText             OPTIONAL,
                  -- a description of the task/chore to which the
                  -- assets will be applied
whenStart         ATIS.DateTimePair    OPTIONAL,
whenEnd           ATIS.DateTimePair    OPTIONAL,
                  -- an estimated start and stop time for the use
idxOfUse          IncidentRef          OPTIONAL,
                    -- the reference to the IDX event this will be used in
locationOfUse     LRMS.LocationReference OPTIONAL,
                  -- the general location where the assets will be used
miscText          Freetext             OPTIONAL,
                  -- any other logistical information in free text which the
                  -- requester needs to send as well.
...
}
```

Remarks: Note that sending this message with the pollOnly flag set to True and using a known set of asset-Num values (one or more) is tantamount to asking the receiving center to confirm that those numbers exist and are valid with the receiving systems. If any of the passed numbers are invalid, or if the requester does not have permission to gather such data, then no reply will be generated. If the requester does not have the right to ask this question, the response is indeterminate.

It is expected that local deployments will add to the two list types used by this message (response equipment and response groups) to create local extensions. This allows extending the functional types of equipment supported. For example, one could add a rotator tow to the two tow truck types that now exist in the lists (heavy and light tow) if this was felt to be required. One might further divide this into crane capacities if that was determined to be needed. When knowledge of a specific inventory item is present (i.e., rotator tow vehicle #123), the request by number methods above can be used. And in cases where the specific vehicle type requested or recommend is in some doubt, the general purpose description submessage of IDX can be employed between the two center operators to discuss the merits and alternatives available.

5.14 Message: MSG_PhysicalAssetStatus

Use: This message is used as the reply to a RequestPhysicalAsset message asking for assets which meet selected criteria. It allows the sender to list a set of assets which they feel represent a suitable reply to the previous requesting message. Note that these will not match one to one unless the requested assets are able to be offered. More likely the center will make a determination of what the best available assets are at present to suggest and then send back a short list to the other center. Note that, besides the asset structure itself, fields for the location and time of the asset to be made ready are given. Finally, an open text field is provided for any specific aspects of each asset, and an overall text field is similarity provided. If there are any interagency billing and accounting terms that such assets are shared under, these fields can be used to note those exchanges.

This structure is used to meet the requirements outlined in 4.9.2 and Table 14.

ASN.1 Representation:

```
PhysicalAssetStatus ::= SEQUENCE {
   header         Header,
   basics         Basics                       OPTIONAL,
   assetCount     INTEGER (0..255), -- number of assets in reply
   assetChoices   SEQUENCE
      {
      inUse             BOOLEAN               OPTIONAL,
                        -- true if asset is currently assigned to an event or
                        -- otherwise out of service (on break, being restored, etc.)
                        -- the asset in question may have been assigned elsewhere
                        -- since its original report of being available
      assetHandle       IA5String(SIZE(1..32)) OPTIONAL,
                        -- a human usable string for referring to the asset
                        -- which may not be unique in the system (a slang name)
      assetDescription  AssetDescription       OPTIONAL,
                        -- a complex structure describing the asset
      assetNum          CenterAssetPermRef     OPTIONAL,
                        -- specific references to this asset
                        -- note that some center may not wish to share this value
      assetStatus       AssetStatus            OPTIONAL,
                        -- the most current known status of the asset
      assetEvent        IncidentRef            OPTIONAL,
                        -- specific references the event assign to (when assigned)
                        -- this can prove useful is the requesting center wants to
                        -- "wait its turn" to again ask for the asset when free
      timeFrameEnd      ATIS.DateTimePair      OPTIONAL,
                        -- limits of time which it could be used
      currentLocation   LRMS.LocationReference OPTIONAL,
                        -- data regarding its current location
      etaToReady        ATIS.DateTimePair      OPTIONAL,
                        -- time required to prepare asset for use
                        -- make date all zeros if only a time offset is needed
      managementAllowed BOOLEAN                OPTIONAL,
                        -- true if the owner would allow management transfer
      furtherComments   FreeText               OPTIONAL,
                        -- any further comments on this asset
      ...
      },
   miscText             FreeText               OPTIONAL,
                        -- any other logistical information in free text which the
                        -- requester needs to send as well.
   managementConditions FreeText               OPTIONAL,
                        -- any free text requirements demanded by issuer
```

```
                        -- to manage asset
   ...
   }
```

Remarks: The center which makes or advertises any asset available in this way (and subsequently assigns it for use) must be prepared to response when the asset is referenced by one of its reference numbers and return its then current status in an Assigned Resources submessage.

5.15 Message: MSG_RequestPhysicalAssetStatus

Use: This message is used to request the last known current status of an asset. Such assets may be assigned to an incident, and hence known by the incident numbering and the assigned assetUnitID numbering (taken together these are unique over the life of the event). Or it may be known by a long-term (essentially static) assetNum assigned by the owning center. Either referencing method may be used to refer to the asset in question. If both methods are used and a conflict between them occurs the message is considered void. The requestID is a unique field generated by the requester.

Sending this message to another center will typically result in an IDX message being returned with suitable submessages in it that relate the status of the requested asset. This will not occur if the requester does not have the authority to ask about the asset in question (a local use policy issue). The requestID will be returned in the submessage so that when multiple messages are present, the proper one can be determined.

This structure is used to meet the requirements outlined in 4.9.3 and Table 15.

ASN.1 Representation:

```
RequestPhysicalAssetStatus ::= SEQUENCE {
   header        Header,
   basics        Basics                 OPTIONAL,
   assetUnitID   IncidentRef,
                 -- the assignment reference given to this asset during the event
   assetNumber   CenterAssetPermRef     OPTIONAL,
                 -- the long-term numbering of this asset by the owning center
   securityKey   FreeText               OPTIONAL,
                 -- a string to exchange security information
   requestID     UTF8String (SIZE(1..32)) OPTIONAL,
                 -- an internal reference string created by the requestor
                 -- for this message
   ...
   }
```

Remarks: Observe that this message results in only one reply. Other methods available in the deployment may allow the requestor to establish an ongoing subscription to this data when various conditions are met. This is especially likely to be true in deployments using CORBA services.

5.16 Message: MSG_Assigned-Resources

Use: This message is used to report on the current status of an asset. It provides the location, estimated time of arrival, and what action will be taken for the asset. Some of these fields are not applicable to all assets (for example, an asset consisting of 10-dozen traffic control cones on loan to another center probably does not have a current location that is of much interest, nor would a turn-by-turn route be of much use). It may be sent as a reply to a request for status on the specific asset, or as part of the general updating that occurs in the IDX as events are described.

This subclause of the standard provides an improved IDX submessage which should be used to replace the ASN.1 definition of the “assigned-resources” submessage currently found in the base standard (see 5.1.1 of IEEE Std 1512-2000). The content of these messages is entirely repeated here along with some additional fields which make the process of referencing and selecting the asset more uniform. If this improved definition is used, then all of the centers in the deployment should be able to use it and the older “Asgn-Resrc” definition should be retired.

This structure is used to meet the requirements outlined in 4.9.4 and Table 16.

ASN.1 Representation:

```
Assigned-Resources ::= SEQUENCE {
   dispatcherID   IM-DispatcherID OPTIONAL,
         -- ID of the CAD operator
         -- [ITE.TCIP.imddDispatcherID]
   agencyID IM-ResponseAgencyID,
         -- ID of the issuing agency
         -- [ITE.TCIP.imddResponseAgencyID]
   resource SEQUENCE (SIZE (1..16)) OF SEQUENCE {
         dispatcherID   IM-DispatcherID          OPTIONAL,
                        -- ID of the CAD operator for this part
                        -- [ITE.TCIP.imddDispatcherID]
         respUnitID     AssetNum                 OPTIONAL,
                        -- was: IM-ResponseUnitID,
                        -- [ITE.TCIP.imddResponseUnitID]
         idxOfUse       IncidentRef              OPTIONAL,
                        -- the reference to the IDX event
                        -- this resource is assigned to
         assetUnitID    IncidentRef              OPTIONAL,
                        -- the incident assigned reference ID
         assetNum       CenterAssetPermRef       OPTIONAL,
                        -- the owning center perm ID
         desc           AssetDescription         OPTIONAL,
                        -- a complex structure describing the asset
                        -- including the equipment and group types
         currentStat    TMDD.Event-IncidentStatus OPTIONAL,
                        -- was: IM-CurrentStatus  OPTIONAL,
                        -- [ITE.TCIP.imddCurrentStatus]
         currentLoc     LRMS.LocationReference   OPTIONAL,
                        -- Based on [SAE.LRMS.ANY]
                        -- LRMS profile for best estimate of
                        -- point location of resource
         destinationLoc LRMS.LocationReference   OPTIONAL,
                        -- where the resource is being dispatched to
                        -- Based on [SAE.LRMS.ANY]
         eta            ATIS.DateTimePair        OPTIONAL,
                        -- was: GeneralizedTime   OPTIONAL,
                        -- ETA at the destinationLoc
         estimatesLeave ATIS.DateTimePair        OPTIONAL,
                        -- was: GeneralizedTime   OPTIONAL,
                        -- estimate of when will leave destinationLoc
                        -- note that a general time message can also be used
                        -- to clear an event in general, this use is with
                        -- respect to the resource itself
         route          SEQUENCE (SIZE (1..64)) OF SEQUENCE {
                        -- the proposed route: pairs of points and times
                             waypoint LRMS.LocationReference,
                             -- Based on [SAE.LRMS.ANY]
```

```
                        -- a waypoint, any LRMS profile,
                        -- though cross streets is likely
                        when  ATIS.DateTimePair   OPTIONAL,
                        -- was: GeneralizedTime   OPTIONAL
                     ...
                     }                            OPTIONAL,
        comment      Freetext OPTIONAL,
                     -- free form comment text
        commands     SEQUENCE (SIZE (1..64)) OF SEQUENCE {
                        cmd      IM-ResponseCommands
                        -- leave blank if not used
                        -- [ITE.TCIP.imddResponseCommands]
                     } OPTIONAL,
        actions      SEQUENCE (SIZE (1..64)) OF SEQUENCE {
                        action   IM-RestorationAction
                              -- leave blank if not used
                              -- [ITE.TCIP.imddRestorationAction]
                     } OPTIONAL,
        respProcedure IM-IncidentProcedure       OPTIONAL,
                     -- [ITE.TCIP.imddIncidentProcedure]
        time         Issue-Stamp,
                     -- time/version stamp
        qual         Reliability,
                     -- reliability estimate
        ...
        },
   ...
   }

assigned-Resources  IDX-PART-MESSAGE ::= {
   -- the Assigned Resources submessage of IDX
   &name "general purpose assigned resources messages",
   &id      9,
   &Type Assigned-Resources
   }
```

5.17 Data Frame: DF_AssetDescription

Use: The description of the asset requested or returned. The use of the tag and value pairs in the structure allows for a controlled way for local deployment to added whatever attributes about the assets that they feel are required. Local conventions should decide the level of complexity in this regard, and items which are not used to sort or select assets should not be added to the list of local tags.

ASN.1 Representation:

```
AssetDescription ::= SEQUENCE {
   -- add a variety of items such as axle count and weight
   -- and such that are vehicle types but need committee help to add
   -- other items as well.
   status          AssetStatus,
                   -- the current status of the asset
   vehicleType     VehicleAssetLists            OPTIONAL,
                   -- response equipment type for this vehicle asset
   roadsideType    RoadsideAssetLists           OPTIONAL,
                   -- response equipment type for this roadside or fixed asset
   subType         TCIP.Response-Unit-Sub-Type   OPTIONAL,
                   -- response equipment sub-category type for this asset
```

```
                    -- (unlikely to be used in new deployments)
   responseGroup    ITIScodes(9728..9983)         OPTIONAL,
                    -- gross category of response type if applicable
   vehicleSummary   VehicleSummary                OPTIONAL,
                    -- used to convey data about vehicle assets
   dataSets         TailSet                       OPTIONAL,
                    -- locally determined sets tag/value pairs
                    -- shall be inserted here to allow local profiling
   ...
   }
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

MSG_Assigned-Resources [ASN.1: `Assigned-Resources`],
MSG_PhysicalAssetStatus [ASN.1: `PhysicalAssetStatus`], and
MSG_RequestPhysicalAsset [ASN.1: `RequestPhysicalAsset`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: This standard's companion document, IEEE P1512.2 [B4] (currently a draft in developmental stage), dealing with public safety messages, is expected to have more complex asset descriptive abilities. Implementers should check there for additional information. Note that any asset (or object) will have a type from either the vehicle lists or the roadside list, but never from both. Some will have neither.

5.18 Data Frame: DF_CleanUpPlan

Use: The description of a cleanup plan of action, including whom to contact and the estimated time span.

ASN.1 Representation:

```
CleanUpPlan ::= SEQUENCE  {
   description       TMDD.Event-ResponsePlanText  OPTIONAL,
   actions           SEQUENCE (SIZE (1..64)) OF CleanUpItems OPTIONAL,
                     -- a list actions to be performed
   contact           FreeText                     OPTIONAL,
                     -- whom to contact with questions
                     -- use the new "person" DF here?
   whenStart         ATIS.DateTimePair            OPTIONAL,
   whenEnd           ATIS.DateTimePair            OPTIONAL,
                     -- an estimated start and stop time for the work
   ...
   }
```

Used by: This item is used by the following other data structures in this standard:

MSG_ClearOrRepairPlan [ASN.1: `ClearOrRepairPlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: See also RepairPlan.

5.19 Data Frame: DF_DSRC_UsePlan

Use: When a response plan involves the use of dedicated short range communications (DSRC) resources, this structure is used to request various actions to be performed by the DSRC owner or directly by the roadside controller. One or more device may be requested to carry the message, as determined by the coverage area of the devices of the event itself. Typically, this message is sent as part of a complex response plan involving many steps. The receiver of this message may not fully comply with the request (based in part upon other demands placed on the resource).

ASN.1 Representation:

```
DSRC-UsePlan ::= SEQUENCE {
   targetDevice  SEQUENCE {
         who             OwningAgencyID,
         what            DeviceID,
         ...
         },
   requestedAction    RequestedAction     OPTIONAL,
                      -- request if immediate or delayed display of data
   suggestedPhrase    ITIS.ITIScodes      OPTIONAL,
                      -- a sequence of suggested text to be used
                      -- which can be skipped if the same data is
                      -- present in the beaconRequest portion
   messageEndPoint    ATIS.DateTimePair   OPTIONAL,
                      -- when the message should cease being sent
   beaconsRequest     ATIS.RoadSideAlert  OPTIONAL,
                      -- as per the ATIS message for sending DSRC alerts
   -- note that this message allows both "regular" messages
   -- and high priority SAE alert message formats to be used
   ...
   }
```

Used by: This item is used by the following other data structures in this standard:

MSG_RequestPhysicalAsset [ASN.1: `RequestPhysicalAsset`], and MSG_TrafficCntrlPlan [ASN.1: `TrafficControlPlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: The portions of the structures described in this subclause which relate to sending a message to the DSRC beacon are aligned with the current draft message for this purpose from SAE ATIS efforts. Implementers should confirm that they are using the most current version of this standard and that local practices regarding security will allow this message to be sent to the roadside control using (RSU) using the proper standards as well. The adopted message format shall prevail as the preferred definition when it exists.

5.20 Data Frame: DF_HAR_UsePlan

Use: When a response plan involves the use of HAR resources, this structure is used to request various actions to be performed by the HAR owner. One or more devices may be requested to carry the message, as determined by the coverage area of the devices of the event itself. Typically, this message is sent as part of a complex response plan involving many steps. The receiver of this message may not fully comply with the request (based in part upon other demands placed on the resource).

ASN.1 Representation:

```
HAR-UsePlan ::= SEQUENCE {
   targetDevice  SEQUENCE {
      who             OwningAgencyID,
      what            DeviceiD,
      ...
      },
   requestedAction    RequestedAction   OPTIONAL,
                      -- request if immediate or delayed display of data
   suggestedPhrase    ITIS.ITIScodesAndText,
                      -- a sequence of suggested text to be used
   messageEndPoint    ATIS.DateTimePair OPTIONAL,
                      -- when the message should cease being sent
   ...
   }
```

Used by: This item is used by the following other data structures in this standard:

MSG_RequestPhysicalAsset [ASN.1: `RequestPhysicalAsset`], and MSG_TrafficCntrlPlan [ASN.1: `TrafficControlPlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: More information may be added to this data frame once the TMDD revisions complete.

5.21 Data Frame: DF_LaneDescriptions

Use: This data frame is used to describe the conditions found in a lane. In this context, “lane” is used to indicate any portion of roadway including ramps, shoulders, bridges, and other special types of roadway, and network links where the status must also be known. Typically, it is found inside a “SEQUENCE OF” statement so that multiple lane descriptions can be grouped within a link or segment of roadway. The enclosing message will provide the start times of the event and of the report as well as additional information regarding any cause/effect/advise information.

ASN.1 Representation:

```
LaneDescription ::= SEQUENCE  {
   laneSelect   TMDD.Event-lanes-affected    OPTIONAL,
                -- a bit string indicating which lanes this applies top (a mask)
                -- numbered from the inside lane with shoulder as the first bit
                -- all one's taken as all lanes, regardless of the count value below
   laneCnt      TMDD.Link-lane-count         OPTIONAL,
                -- the number of nominal lanes for the link, used as a mask for above
                -- zero indicates the count is unknown
   type         ITIScodes(8192..8447)        OPTIONAL,
                -- the ITIS code for various lane types
                -- such as: HOV, left, right, all, ramp, bridge, etc.
   location     ITIScodes(7936..8191)        OPTIONAL,
                -- the ITIS code for generic locations beside a lane
                -- such as: opposing lanes, on ramps, etc...
   condition    ITIScodes(768..1023)         OPTIONAL,
                -- the ITIS codes for various conditions for the lane
                -- such as: blocked, closed, closed ahead, clearing, etc
   estClearTime ATIS.DateTimePair            OPTIONAL,
```

```
                -- the point in time when the above conditions are estimated to be
                -- removed and the flow over the lane/link returned to normal
   furtherInfo  FreeText                    OPTIONAL,
                -- if information on why the lane(s) was closed, or how the lane(s)
                -- was closed, or what will allow it to reopen is needed, place such
                -- data in free text here. Limit use to only lane information, do not
                -- use it for general event information.
   -- When one of the above items does not apply (i.e. would be represented as zero)
   -- then it should not be sent.
   -- Note that first two elements may require the same map db in order to fully
   -- exchange and understand between centers.
   ...
   }
```

Used by: This item is used by the following other data structures in this standard:

MSG_ReqTrafficCntrlPlan [ASN.1: `ReqTrafficControlPlan`], and MSG_TrafficCntrlPlan [ASN.1: `TrafficControlPlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: The above data frame is used by both IEEE in the IM work and by SAE in the ATIS work. A similar format is expected to be used by ITE in the TMDD work as well. Implementers should check with the data registry process to determine if a final harmonized version has been established and then agree to use that in their deployments once it exists. Note that a LRMS entry may also be found in use to denote lane data for subparts of the event.

5.22 Data Frame: DF_RepairPlan

Use: The description of a infrastructure repair plan of action, including whom to contact and the estimated time span.

ASN.1 Representation:

```
RepairPlan ::= SEQUENCE  {
   description       TMDD.Event-ResponsePlanText  OPTIONAL,
   actions           CleanUpItems                 OPTIONAL,
                     -- a list actions to be performed
   contact           FreeText                     OPTIONAL,
                     -- whom to contact with questions
                     -- use the new "person" DF here?
   whenStart         ATIS.DateTimePair            OPTIONAL,
   whenEnd           ATIS.DateTimePair            OPTIONAL,
                     -- an estimated start and stop time for the work
   ...
   }
```

Used by: This item is used by the following other data structures in this standard:

MSG_ClearOrRepairPlan [ASN.1: `ClearOrRepairPlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: See also CleanUpPlan.

5.23 Data Frame: DF_RestrictionSet

Use: A collection of link attributes taken from a construction or pre-planned event and relating the most restrictive conditions found along the set of links. The concept of “most restrictive” in general means “least” as in the least lane count or the least speed limit.

ASN.1 Representation:

```
RestrictionSet ::= SEQUENCE {
   links  SEQUENCE (SIZE (1..8)) OF LinkID,
            -- links to which the below data pertains
            -- note that these are not in a format to connect them with
            -- the below conditions
   lanesblockedorclosedcount  TMDD.Event-LanesBlockedOrClosedCount OPTIONAL,
   type                  TMDD.Incident-Type              OPTIONAL,
   laneclosedlist        TMDD.LaneClosedList             OPTIONAL,
   laneconfigurationlist TMDD.LaneConfigurationList      OPTIONAL,
   capacity              TMDD.Link-Capacity              OPTIONAL,
   delay                 TMDD.Link-Delay                 OPTIONAL,
   density               TMDD.Link-Density               OPTIONAL,
   lanesminimumnumber    TMDD.Link-LanesMinimumNumber    OPTIONAL,
   lanesnumberopen       TMDD.Link-LanesNumberOpen       OPTIONAL,
   length                TMDD.Link-Length                OPTIONAL,
   levelofservice        TMDD.Link-LevelOfService        OPTIONAL,
   mediantype            TMDD.Link-Median-Type           OPTIONAL,
   name                  TMDD.Link-Name                  OPTIONAL,
   occupancy             TMDD.Link-Occupancy             OPTIONAL,
   pavementtype          TMDD.Link-PavementType          OPTIONAL,
   restrictionaxlecount  TMDD.Link-RestrictionAxleCount  OPTIONAL,
   restrictionclass      TMDD.Link-RestrictionClass      OPTIONAL,
   restrictionheight     TMDD.Link-RestrictionHeight     OPTIONAL,
   restrictionlength     TMDD.Link-RestrictionLength     OPTIONAL,
   restrictionweight     TMDD.Link-RestrictionWeight     OPTIONAL,
   restrictionwidth      TMDD.Link-RestrictionWidth      OPTIONAL,
   roadnumber            TMDD.Link-RoadNumber            OPTIONAL,
   shoulderwidthleft     TMDD.Link-ShoulderWidthLeft     OPTIONAL,
   shoulderwidthright    TMDD.Link-ShoulderWidthRight    OPTIONAL,
   speed                 TMDD.Link-Speed                 OPTIONAL,
   speedlimit            TMDD.Link-SpeedLimit            OPTIONAL,
   status                TMDD.Link-Status                OPTIONAL,
   surfacecondition      TMDD.Link-SurfaceCondition      OPTIONAL,
   traveltime            TMDD.Link-TravelTime            OPTIONAL,
   truckspeedlimit       TMDD.Link-TruckSpeedLimit       OPTIONAL,
   nd-delay              TMDD.Node-Delay                 OPTIONAL,
   nd-linksnum           TMDD.Node-LinksNum              OPTIONAL,
   nd-name               TMDD.Node-Name                  OPTIONAL,
   nd-status             TMDD.Node-Status                OPTIONAL,
   owner                 TMDD.Link-ownership             OPTIONAL,
   jurisdiction          TMDD.Link-jurisdiction          OPTIONAL,
   tmddOther             TMDD.Link-other                 OPTIONAL,
   ...
   }
```

Used by: This item is used by the following other data structures in this standard:

MSG_WorkZoneData [ASN.1: `WorkZoneData`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

5.24 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 values 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 metadata 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..1000))
          -- 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
}
```

Used by: This item is used by the following other data structures in this standard:

DF_AssetDescription [ASN.1: `AssetDescription`], and DF_VehicleSummary [ASN.1: `VehicleSummary`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Local deployments must agree on what sets of data are to be carried using this structure in various messages.

5.25 Data Frame: DF_VehicleSummary

Use: This data frame presents a summary of one or more vehicles and their associated restrictions and types. It is typically used to describe a set of vehicles that must move over a link (and where restrictions must be checked or routing must be provided).

ASN.1 Representation:

```
VehicleSummary ::= SEQUENCE {
   -- note that here the reused TMDD data concepts are used
   -- for the vehicle, not the link on which it travels
   axlecount        TMDD.Link-RestrictionAxleCount    OPTIONAL,
   class            TMDD.Link-RestrictionClass        OPTIONAL,
   height           TMDD.Link-RestrictionHeight       OPTIONAL,
   length           TMDD.Link-RestrictionLength       OPTIONAL,
   weight           TMDD.Link-RestrictionWeight       OPTIONAL,
   width            TMDD.Link-RestrictionWidth        OPTIONAL,
```



```
   maxSpeed          TMDD.Link-SpeedLimit              OPTIONAL,
   minTurnRadius     INTEGER(1..255)                   OPTIONAL,
                     -- the min radius circle the vehicle can make moving
                     -- forward and allowing a margin of clearance.  Measured
                     -- from the farthest edge of the vehicle including all
                     -- protrusions (such as side view mirrors -which may be
                     -- in a retracted state)
                     -- Units are in tenths of a meter.
   owner             TMDD.AgencyID                     OPTIONAL,
   responseType      ITIS.ITIScodes(9728..9983)        OPTIONAL,
                     -- the gross type of response vehicle this is classed as
   canReverseLane    BOOLEAN                           OPTIONAL,
                     -- set to true if the vehicle can run on reversed lanes
   vehicleID         CenterAssetPermRef                OPTIONAL,
                     -- the perm refer number, if needed to provide
   vehicleEvent      IncidentRef                       OPTIONAL,
                     -- the assigned ref number in the event (if available)
   preemptTech       PreemptTech                       OPTIONAL,
                     -- a list of the type of equipment this vehicle carries
   dataSets          TailSet                           OPTIONAL,
                     -- locally determined sets tag/value pairs
                     -- shall be inserted here to allow local profiling
   ...
   }
```

Used by: This item is used by the following other data structures in this standard:

DF_AssetDescription [ASN.1: `AssetDescription`], and MSG_RequestRouteAdvice [ASN.1: `RequestRouteAdvice`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

5.26 Data Frame: DF_VMS_UsePlan

Use: When a response plan involves the use of VMS resources, this structure is used to request various actions to be performed by the VMS owner. One or more devices may be requested to carry the message, as determined by the coverage area of the devices of the event itself. Typically, this message is sent as part of a complex response plan involving many steps. The receiver of this message may not fully comply with the request (based in part upon other demands placed on the resource).

ASN.1 Representation:

```
VMS-UsePlan ::= SEQUENCE {
   targetDevice  SEQUENCE {
      who            OwningAgencyID,
      what           DeviceiD,
      ...
      },
   requestedAction   RequestedAction   OPTIONAL,
                     -- request if immediate or delayed display of data
   suggestedPhrase   ITIS.ITIScodesAndText,
                     -- a sequence of suggested text to be used
   messageEndPoint   ATIS.DateTimePair  OPTIONAL,
                     -- when the message should cease being sent
   ...
   }
```

Used by: This item is used by the following other data structures in this standard:

MSG_RequestPhysicalAsset [ASN.1: `RequestPhysicalAsset`], and MSG_TrafficCntrlPlan [ASN.1: `TrafficControlPlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: More information may be added to this data frame once the TMDD revisions complete.

6. Data elements

Messages and data frames specified in Clause 5 shall be composed of message elements. In some cases, these message elements shall be data frames (DFs) (found in the base standard), such as a message 'Header' DF, where each frame is in turn made up of primitive components. In other cases, these message elements shall be DEs. Any message or data frame specified in Clause 5 shall have all of its DEs and DFs 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 the base standard, or in the IEEE 1512 family of standards. In the later cases, the referenced standards shall be consulted. The specifications shall be expressed in ASN.1 syntax as per ISO/IEC 8824-1:1998 and ISO/IEC 8824-2:1998.

6.1 Data Element: DE_Asset_Use

Use: This list will be used to describe one or more roles in an incident to which an asset may be applied. For example, a given asset might be assigned to be a part of the paving operations or it may be engaged in traffic redirections, etc. This element is used in a sequence of statement as often a single asset can be performing multiple roles. Also, by building a sequence of codes more specific use information can be created (i.e. rather than a generic phrase like "flagging operations," one can send "flagging operations around the curve and along the exit ramp").

ASN.1 Representation:

```
Asset-Use ::= ITIS.ITIScodes (0..65535)
```

Used by: This item is used by the following other data structures in this standard:

MSG_RequestPhysicalAsset [ASN.1: `RequestPhysicalAsset`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: The ITIS codes include a range of values, only some of which make sense when used as a sequence to relate the use of an asset. Local deployments will want to determine what set of the ITIS codes they wish to use, and add values for terms used locally that do not appear in the list (such as "jughandle" to describe a portion of roadway). These can be added in the prescribed areas (code ranges 127 to 254 in most cases).

6.2 Data Element: DE_AssetStatus

Use: The Asset Status data element is used to convey the overall status of people and things (more formally to all objects in the realm of IEEE 1512). It is used with roadside devices, with people and response crews,

and with various inanimate objects used as a part of the incident. Obviously some status values can only apply to some type of objects. This data concept is different than the status of the overall incident itself, or of its various subpieces, which is given from the perspective of the issuing center and often found in the message basics.

ASN.1 Representation:

```
AssetStatus ::= ENUMERATED {
   unknown              (10240),
   readyForUse          (10241),
   workingNormally      (10242),
   workingAutonomously  (10243),
   workingIncorrectly   (10244),
   notWorking           (10245),
   normalMaintenance    (10246),
   inRouteToUse         (10247),
   returningFromUse     (10248),
   outOfService         (10249),
   offDuty              (10250),
   onPatrol             (10251),
   onCall               (10252),
   onBreak              (10253),
   mandatoryTimeOff     (10254),
   lowOnFuel            (10255),
   lowOnWater           (10256),
   lowCharge            (10257),
   ...
   }
   -- values in this sub range to 127 reserved for std use
   -- values in this sub range from 128 to 255 reserved for local use
```

XML Representation:

```
<xsd:simpleType name="AssetStatus" >
      <xsd:annotation>
         <xsd:appinfo>
            unknown (10240)
            readyForUse (10241)
            workingNormally (10242)
            workingAutonomously (10243)
            workingIncorrectly (10244)
            notWorking (10245)
            normalMaintenance (10246)
            inRouteToUse (10247)
            returningFromUse (10248)
            outOfService (10249)
            offDuty (10250)
            onPatrol (10251)
            onCall (10252)
            onBreak (10253)
            mandatoryTimeOff (10254)
            lowOnFuel (10255)
            lowOnWater (10256)
            lowCharge (10257)
         </xsd:appinfo>
         <xsd:documentation>
            values in this sub range to 127 reserved for std use
            values in this sub range from 128 to 255 reserved for local use
```

```
         </xsd:documentation>
      </xsd:annotation>
      <xsd:union>
         <xsd:simpleType>
            <xsd:restriction base="xsd:unsignedInt">
               <xsd:minInclusive value="10240"/>
               <xsd:maxInclusive value="10257"/>
            </xsd:restriction>
         </xsd:simpleType>
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:enumeration value="unknown"/>
               <xsd:enumeration value="readyForUse"/>
               <xsd:enumeration value="workingNormally"/>
               <xsd:enumeration value="workingAutonomously"/>
               <xsd:enumeration value="workingIncorrectly"/>
               <xsd:enumeration value="notWorking"/>
               <xsd:enumeration value="normalMaintenance"/>
               <xsd:enumeration value="inRouteToUse"/>
               <xsd:enumeration value="returningFromUse"/>
               <xsd:enumeration value="outOfService"/>
               <xsd:enumeration value="offDuty"/>
               <xsd:enumeration value="onPatrol"/>
               <xsd:enumeration value="onCall"/>
               <xsd:enumeration value="onBreak"/>
               <xsd:enumeration value="mandatoryTimeOff"/>
               <xsd:enumeration value="lowOnFuel"/>
               <xsd:enumeration value="lowOnWater"/>
               <xsd:enumeration value="lowCharge"/>
            </xsd:restriction>
         </xsd:simpleType >
      </xsd:union>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_AssetDescription [ASN.1: `AssetDescription`], and MSG_PhysicalAssetStatus [ASN.1: `PhysicalAssetStatus`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Note that the enumerations of this data element are chosen to fit within a currently unused range of the ITIS codes. It is expected that these entries will be merged with those codes at a latter date.

6.3 Data Element: DE_CenterAssetPermRef

Use: This is the permanent reference number used by a center to refer to the asset. It may be shared with other centers when needed, or hidden (local deployment choice). If shared, this allows other centers to request information about its status at any time (even when not connected with an incident).

ASN.1 Representation:

```
CenterAssetPermRef ::= IA5String (SIZE(1..32))
```

XML Representation:

```
<xsd:simpleType name="CenterAssetPermRef" >
      <xsd:restriction base="xsd:string">
         <xsd:minLength value="1"/>
         <xsd:maxLength value="32"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_VehicleSummary [ASN.1: `VehicleSummary`],
MSG_Assigned-Resources [ASN.1: `Assigned-Resources`],
MSG_PhysicalAssetStatus [ASN.1: `PhysicalAssetStatus`],
MSG_RequestPhysicalAsset [ASN.1: `RequestPhysicalAsset`], and
MSG_RequestPhysicalAssetStatus [ASN.1: `RequestPhysicalAssetStatus`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: The data element DE_IncidentRef is used to reference the asset when it is committed to a specific incident. This value then becomes the primary way other centers refer to it during the incident (typically to request a status update).

6.4 Data Element: DE_CleanUpItems

Use: A list of items which require clean-up actions from the event. When free text is selected, the next data element in the using message contains a natural language expression of the item. Local agreements may add to this list in the normal way (items above 128).

ASN.1 Representation:

```
CleanUpItems ::= ITIScodes -- all codes
   -- plus the following codes defined locally
   -- freeText           (0),
   -- fluidsCleanUp      (1),  use for oil / gas / antifreeze etc..
   -- guardrailInRoadway (2),  when rail must be removed to clear path
   -- broken Curbs       (3),  curb or barrier damage has left clutter in road
   -- wreckDebrisSmall   (4),  misc small debris which can be manually picked up
   -- wreckDebrisLarge   (5),  larger debris which cannot be manually picked up
   -- retreadInLane      (6),  tire debris of all kinds
   -- miscObjects        (7),  misc object requiring removal from a location
   -- miscObjectsAlongRoadway (8), multiple objects requiring removal from along a
                                   link
      -- values to 127 reserved for std use
      -- values 128 to 255 reserved for local use
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_CleanUpPlan [ASN.1: `CleanUpPlan`],
DF_RepairPlan [ASN.1: `RepairPlan`], and
MSG_InfrastructureReport [ASN.1: `InfrastructureReport`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: See also the repair items list. Many times there are also ITIS codes to reflect an event which matched this cleanup repair. For example, if is there is an object in the lane, the ITIS code “Object on roadway” (code value 5-2) might also be used in the header summary of the event. The ITIS codes include a range of values, only some of which make sense when used as a sequence to relate the use of an asset. Local deployments will want to determine what set of the ITIS codes they wish to use, and add values for terms used locally that do not appear in the list (such as “jughandle” to describe a portion of roadway). These can be added in the proscribed areas (code ranges 127 to 254 in most cases).

6.5 Data Element: DE_ConditionTypes

Use: This element is used to convey various types of network conditions (typically used when requesting information of these types). Unlike the ITIS event type codes, this list reflects specific detailed network related event such as link speed restrictions or axle counts, or asking for data on all lanes of a link to be merged.

ASN.1 Representation:

```
ConditionTypes ::= ENUMERATED {
   -- the following items are TMDD data elements about the link
   laneByLane             (1), -- provide information on EACH lane
   mergeLanes             (2), -- merge all lanes into summary
   blockedClosesList      (3),
   incidentType           (4), -- returns type of incident in the lane
   laneConfigLists        (5), -- returns lane configuration lists
   linkCapacity           (6),
   linkDelay              (7),
   linkDensity            (8),
   linkLaneMinNum         (9),
   linkLanesOpen          (10),
   linkLength             (11),
   linkLevelOfService     (12),
   linkMedianType         (13),
   linkName               (14),
   linkOccupancy          (15),
   linkPavementType       (16),
   linkRestrictionAxleCnt (17),
   linkRestrictionClass   (18),
   linkRestrictionHeight  (19),
   linkRestrictionLength  (20),
   linkRestrictionWeight  (21),
   linkRoadNumber         (22),
   linkShoulderWidthLeft  (23),
   linkShoulderWidthRight (24),
   linkSpeed              (25),
   linkSpeedLimit         (26),
   linkStatus             (27),
   linkSurfaceConditions  (28),
   linkTravelTime         (29),
   linkTruckSpeedLimit    (30),
   nodeDelay              (31),
   nodeLinksNum           (32),
   nodeName               (33),
   nd-status              (34),
   owner                  (35),
```



```
   jurisdiction           (36),
   tmddOther              (37),
   weatherConditions      (38),
   precipitation          (39),
   winds                  (40),
   windDirection          (41),
   visibility             (42),
   temperature            (43),
   pavementConditions     (44),
   winterDrivingRestrictions (45),
   winterDrivingIndex     (46),
   temp                   (47),
   humidity               (48),
   rainHour               (49),
   rainDay                (50),
   snow                   (50),
   snowPack               (51),
   snowRate               (52),

   -- the following items are complete messages covering the link
   -- these come from the SAE ATIS work
   weatherInformation           (64),
   pollutionInformation         (65),
   trafficInformation           (66),
   incidentInformation          (67),
   eventInformation             (68),
   roadAdditionalInformation    (69),
   airlineTravelInformation     (70),
   wideAreaTravelInformation    (71),
   transitRoute                 (72),
   ...
   }
-- values to 127 reserved for std use
-- values 128 to 255 reserved for local use
```

XML Representation:

```
<xsd:simpleType name="ConditionTypes" >
      <xsd:annotation>
         <xsd:appinfo>
             -- the following items are TMDD data elements about the link
            laneByLane (1) -- provide information on EACH lane
            mergeLanes (2) -- merge all lanes into summary
            blockedClosesList (3)
            incidentType (4) -- returns type of incident in the lane
            laneConfigLists (5) -- returns lane configuration lists
            linkCapacity (6)
            linkDelay (7)
            linkDensity (8)
            linkLaneMinNum (9)
            linkLanesOpen (10)
            linkLength (11)
            linkLevelOfService (12)
            linkMedianType (13)
            linkName (14)
            linkOccupancy (15)
            linkPavementType (16)
            linkRestrictionAxleCnt (17)
            linkRestrictionClass (18)
```

```
            linkRestrictionHeight (19)
            linkRestrictionLength (20)
            linkRestrictionWeight (21)
            linkRoadNumber (22)
            linkShoulderWidthLeft (23)
            linkShoulderWidthRight (24)
            linkSpeed (25)
            linkSpeedLimit (26)
            linkStatus (27)
            linkSurfaceConditions (28)
            linkTravelTime (29)
            linkTruckSpeedLimit (30)
            nodeDelay (31)
            nodeLinksNum (32)
            nodeName (33)
            nd-status (34)
            owner (35)
            jurisdiction (36)
            tmddOther (37)
            weatherConditions (38)
            precipitation (39)
            winds (40)
            windDirection (41)
            visibility (42)
            temperature (43)
            pavementConditions (44)
            winterDrivingRestrictions (45)
            winterDrivingIndex (46)
            temp (47)
            humidity (48)
            rainHour (49)
            rainDay (50)
            snow (50)
            snowPack (51)
            snowRate (52) -- the following items are complete messages covering the
                             link
             -- these come from the SAE ATIS work
            weatherInformation (64)
            pollutionInformation (65)
            trafficInformation (66)
            incidentInformation (67)
            eventInformation (68)
            roadAdditionalInformation (69)
            airlineTravelInformation (70)
            wideAreaTravelInformation (71)
            transitRoute (72)
         </xsd:appinfo>
         <xsd:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xsd:documentation>
      </xsd:annotation>
      <xsd:union>
         <xsd:simpleType>
            <xsd:restriction base="xsd:unsignedInt">
               <xsd:minInclusive value="0"/>
               <xsd:maxInclusive value="72"/>
            </xsd:restriction>
         </xsd:simpleType>
         <xsd:simpleType>
```

```
            <xsd:restriction base="xsd:string">
               <xsd:enumeration value="laneByLane"/>
               <xsd:enumeration value="mergeLanes"/>
               <xsd:enumeration value="blockedClosesList"/>
               <xsd:enumeration value="incidentType"/>
               <xsd:enumeration value="laneConfigLists"/>
               <xsd:enumeration value="linkCapacity"/>
               <xsd:enumeration value="linkDelay"/>
               <xsd:enumeration value="linkDensity"/>
               <xsd:enumeration value="linkLaneMinNum"/>
               <xsd:enumeration value="linkLanesOpen"/>
               <xsd:enumeration value="linkLength"/>
               <xsd:enumeration value="linkLevelOfService"/>
               <xsd:enumeration value="linkMedianType"/>
               <xsd:enumeration value="linkName"/>
               <xsd:enumeration value="linkOccupancy"/>
               <xsd:enumeration value="linkPavementType"/>
               <xsd:enumeration value="linkRestrictionAxleCnt"/>
               <xsd:enumeration value="linkRestrictionClass"/>
               <xsd:enumeration value="linkRestrictionHeight"/>
               <xsd:enumeration value="linkRestrictionLength"/>
               <xsd:enumeration value="linkRestrictionWeight"/>
               <xsd:enumeration value="linkRoadNumber"/>
               <xsd:enumeration value="linkShoulderWidthLeft"/>
               <xsd:enumeration value="linkShoulderWidthRight"/>
               <xsd:enumeration value="linkSpeed"/>
               <xsd:enumeration value="linkSpeedLimit"/>
               <xsd:enumeration value="linkStatus"/>
               <xsd:enumeration value="linkSurfaceConditions"/>
               <xsd:enumeration value="linkTravelTime"/>
               <xsd:enumeration value="linkTruckSpeedLimit"/>
               <xsd:enumeration value="nodeDelay"/>
               <xsd:enumeration value="nodeLinksNum"/>
               <xsd:enumeration value="nodeName"/>
               <xsd:enumeration value="nd-status"/>
               <xsd:enumeration value="owner"/>
               <xsd:enumeration value="jurisdiction"/>
               <xsd:enumeration value="tmddOther"/>
               <xsd:enumeration value="weatherConditions"/>
               <xsd:enumeration value="precipitation"/>
               <xsd:enumeration value="winds"/>
               <xsd:enumeration value="windDirection"/>
               <xsd:enumeration value="visibility"/>
               <xsd:enumeration value="temperature"/>
               <xsd:enumeration value="pavementConditions"/>
               <xsd:enumeration value="winterDrivingRestrictions"/>
               <xsd:enumeration value="winterDrivingIndex"/>
               <xsd:enumeration value="temp"/>
               <xsd:enumeration value="humidity"/>
               <xsd:enumeration value="rainHour"/>
               <xsd:enumeration value="rainDay"/>
               <xsd:enumeration value="snow"/>
               <xsd:enumeration value="snowPack"/>
               <xsd:enumeration value="snowRate"/>
               <xsd:enumeration value="weatherInformation"/>
               <xsd:enumeration value="pollutionInformation"/>
               <xsd:enumeration value="trafficInformation"/>
               <xsd:enumeration value="incidentInformation"/>
               <xsd:enumeration value="eventInformation"/>
               <xsd:enumeration value="roadAdditionalInformation"/>
```

```
               <xsd:enumeration value="airlineTravelInformation"/>
               <xsd:enumeration value="wideAreaTravelInformation"/>
               <xsd:enumeration value="transitRoute"/>
            </xsd:restriction>
         </xsd:simpleType >
      </xsd:union>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_RequestNetworkConditions [ASN.1: `RequestNetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: See also the ITIS codes for a wide variety of encoding related to events.

6.6 Data Element: DE_FlowType

Use: The type of vehicle flow which will be allowed on a set of links used in a routing. Some route events are simply travel requesting a route where they will be interspersed with other vehicles in normal traffic flow and conditions. At other times a route may be setup for reasons such as a detour or an evacuations, or special events, or for response personnel to be able to reach an event. Under such conditions the type of traffic flow to occur over the set of links may be unusual and best described by the terms in this list.

ASN.1 Representation:

```
FlowType ::= ENUMERATED {
   grant                       (1),
   deny                        (2),
   na                          (3),
   grantButNotSwept            (4),
   reversedFlowAlreadyActive   (5),
   useWithCaution              (6),
   dividerBarriersPresent      (7),
   followDetourSigns           (8),
   followFlaggerDirections     (9),
   reservedForResponseUseOnly (10),
   reservedForConstructionUseOnly (11),
   forPublicUse                (12),
   forEventParkingUseOnly      (13),
   doNotLeaveRoadSurface       (14),
   ...
   }
-- values to 127 reserved for std use
-- values 128 to 255 reserved for local use
```

XML Representation:

```
<xsd:simpleType name="FlowType" >
      <xsd:annotation>
         <xsd:appinfo>
            grant (1)
            deny (2)
            na (3)
            grantButNotSwept (4)
```



```
            reversedFlowAlreadyActive (5)
            useWithCaution (6)
            dividerBarriersPresent (7)
            followDetourSigns (8)
            followFlaggerDirections (9)
            reservedForResponseUseOnly (10)
            reservedForConstructionUseOnly (11)
            forPublicUse (12)
            forEventParkingUseOnly (13)
            doNotLeaveRoadSurface (14)
         </xsd:appinfo>
         <xsd:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xsd:documentation>
      </xsd:annotation>
      <xsd:union>
         <xsd:simpleType>
            <xsd:restriction base="xsd:unsignedInt">
               <xsd:minInclusive value="1"/>
               <xsd:maxInclusive value="14"/>
            </xsd:restriction>
         </xsd:simpleType>
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:enumeration value="grant"/>
               <xsd:enumeration value="deny"/>
               <xsd:enumeration value="na"/>
               <xsd:enumeration value="grantButNotSwept"/>
               <xsd:enumeration value="reversedFlowAlreadyActive"/>
               <xsd:enumeration value="useWithCaution"/>
               <xsd:enumeration value="dividerBarriersPresent"/>
               <xsd:enumeration value="followDetourSigns"/>
               <xsd:enumeration value="followFlaggerDirections"/>
               <xsd:enumeration value="reservedForResponseUseOnly"/>
               <xsd:enumeration value="reservedForConstructionUseOnly"/>
               <xsd:enumeration value="forPublicUse"/>
               <xsd:enumeration value="forEventParkingUseOnly"/>
               <xsd:enumeration value="doNotLeaveRoadSurface"/>
            </xsd:restriction>
         </xsd:simpleType >
      </xsd:union>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_RouteAdvice [ASN.1: `RouteAdvice`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

6.7 Data Element: DE_FreeText

Use: A simple free text field used in the message when structured information will not serve.

ASN.1 Representation:

```
FreeText ::= UTF8String (SIZE(1..500))
```

XML Representation:

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

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_CleanUpPlan [ASN.1: `CleanUpPlan`],
DF_LaneDescriptions [ASN.1: `LaneDescription`],
DF_RepairPlan [ASN.1: `RepairPlan`],
MSG_InfrastructureReport [ASN.1: `InfrastructureReport`],
MSG_PhysicalAssetStatus [ASN.1: `PhysicalAssetStatus`],
MSG_PreemptionUserData [ASN.1: `PreemptionUserData`],
MSG_ReqTrafficCntrlPlan [ASN.1: `ReqTrafficControlPlan`],
MSG_RequestPhysicalAsset [ASN.1: `RequestPhysicalAsset`],
MSG_RequestPhysicalAssetStatus [ASN.1: `RequestPhysicalAssetStatus`],
MSG_RequestPreemptionUserData [ASN.1: `RequestPreemptionUserData`],
MSG_RequestRouteAdvice [ASN.1: `RequestRouteAdvice`],
MSG_TrafficCntrlPlan [ASN.1: `TrafficControlPlan`], and
MSG_WorkZoneData [ASN.1: `WorkZoneData`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

6.8 Data Element: DE_IncidentRef

Use: This is a reference used for various assets when they are committed to an incident event. Taken together with the incident number of the IDX header, this forms a unique sequence. Often this value will be used to "stringify" an object reference to a data model for the asset. The values are created when the asset is committed to the incident and lasts for the life of its involvement (after which is it is no longer guaranteed to be valid). This value is the primary way to share references to the assets between centers.

ASN.1 Representation:

```
IncidentRef ::= IA5String (SIZE(1..32))
```

XML Representation:

```
<xsd:simpleType name="IncidentRef" >
      <xsd:restriction base="xsd:string">
         <xsd:minLength value="1"/>
         <xsd:maxLength value="32"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_VehicleSummary [ASN.1: `VehicleSummary`],
MSG_Assigned-Resources [ASN.1: `Assigned-Resources`],
MSG_ClearOrRepairPlan [ASN.1: `ClearOrRepairPlan`],
MSG_PhysicalAssetStatus [ASN.1: `PhysicalAssetStatus`],
MSG_PreemptionUserData [ASN.1: `PreemptionUserData`],
MSG_RequestPhysicalAsset [ASN.1: `RequestPhysicalAsset`],
MSG_RequestPhysicalAssetStatus [ASN.1: `RequestPhysicalAssetStatus`], and
MSG_WorkZoneData [ASN.1: WorkZoneData].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: See also the asset's permanent reference number (centerAssetPermRef), a number used by the owning center to refer to the asset during all times (not just when engaged in an incident). Some centers may not wish to share this value with the centers for security reasons.

6.9 Data Element: DE_InfrastructureRestorationList

Use: This data element (DE) comprises a list of ITIS codes to express common repairs/cleanup/replacement operations that occur as part of the restoration of full services after an incident. It is used in the messages to describe the activity that needs to take place (or is currently taking place) to recover from the event.

ASN.1 Representation:

```
InfrastructureRestorationList ::= ITIS.ITIScodes (0..65535)
-- plus the following locally defined values
-- freeText             (0),
-- barrierRestoration   (1)
-- strippingOperations  (2)
-- BulbRenewal          (3),
-- BulbRenewalinLane    (4),
   -- use when changing signal light and needing to block a lane
-- signalControlRepairs (5)
-- vmsControlrepairs    (6).
   -- values to 127 reserved for std use
   -- values 128 to 255 reserved for local use
```

Used by: This item is used by the following other data structures in this standard:

MSG_InfrastructureReport [ASN.1: `InfrastructureReport`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: The ITIS codes include a range of values, only some of which make sense when used as a sequence to relate the restoration of an asset to service. Local deployments will want to determine what set of the ITIS codes they wish to use, and add values for terms used locally that do not appear in the list (such as "freeway ramp meter" to describe a roadside device). These can be added in the prescribed areas (code ranges 127 to 254 in most cases).

6.10 Data Element: DE_PreemptAuthorization

Use: The authorization or status of a specific preemption access point along a route. Typically used to track the progress of vehicles using preemption in an authorized way.

ASN.1 Representation:

```
PreemptAuthorization ::= ENUMERATED {
   yes                (1), -- grant
   no                 (2), -- deny
   possibleViolation  (3), -- confusing data which MAY indicate an
                           -- unauthorized attempt to take over the access point
   confirmedViolation (4), -- data clearly indicates that an
                           -- unauthorized attempt to take over the access point
                           -- is in progress
   usedOnce           (5), -- an access point which was set up for use has been
                           -- used, typically indicating that the vehicle has passed
   notYetUsed         (6), -- an access point which was set up for use has
                           -- not yet been used, Typically indicating that the
                           -- vehicle has not yet passed this point
   currentlyInUse     (7), -- to be used when the vehicle is
                           -- present in the range of the technology and has
                           -- taken control of the access point
   currentlyInView    (8), -- to be used when the vehicle is
                           -- present in the range of the technology
   ...
   }
```

XML Representation:

```
<xsd:simpleType name="PreemptAuthorization" >
      <xsd:annotation>
         <xsd:appinfo>
            yes (1) -- grant
            no (2) -- deny
            possibleViolation (3) -- confusing data which MAY indicate an
             -- unauthorized attempt to take over the access point
            confirmedViolation (4) -- data clearly indicates that an
             -- unauthorized attempt to take over the access point
             -- is in progress
            usedOnce (5) -- an access point which was set up for use has been
             -- used ,  typically indicating that the vehicle has passed
            notYetUsed (6) -- an access point which was set up for use has
             -- not yet been used ,  Typically indicating that the
             -- vehicle has not yet passed this point
            currentlyInUse (7) -- to be used when the vehicle is
             -- present in the range of the technology and has
             -- taken control of the access point
            currentlyInView (8) -- to be used when the vehicle is
             -- present in the range of the technology
         </xsd:appinfo>
      </xsd:annotation>
      <xsd:union>
         <xsd:simpleType>
            <xsd:restriction base="xsd:unsignedInt">
               <xsd:minInclusive value="0"/>
               <xsd:maxInclusive value="8"/>
            </xsd:restriction>
```



```
         </xsd:simpleType>
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:enumeration value="yes"/>
               <xsd:enumeration value="no"/>
               <xsd:enumeration value="possibleViolation"/>
               <xsd:enumeration value="confirmedViolation"/>
               <xsd:enumeration value="usedOnce"/>
               <xsd:enumeration value="notYetUsed"/>
               <xsd:enumeration value="currentlyInUse"/>
               <xsd:enumeration value="currentlyInView"/>
            </xsd:restriction>
         </xsd:simpleType >
      </xsd:union>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_PreemptionUserData [ASN.1: `PreemptionUserData`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

6.11 Data Element: DE_PreemptGrant

Use: The reply status of a preemption request. This may grant or deny the requested preemption with various reasons in a list format.

ASN.1 Representation:

```
PreemptGrant ::= ENUMERATED {
   freeText             (0),
   grant                (1),
   deny                 (2),
   grantWithFreeText    (3),
   denyWithfreeText     (4),
   ...
   }
   -- values to 127 reserved for std use
   -- values 128 to 255 reserved for local use
   -- use odd values for grants and event values for deny
```

XML Representation:

```
<xsd:simpleType name="PreemptGrant" >
      <xsd:annotation>
         <xsd:appinfo>
            freeText (0)
            grant (1)
            deny (2)
            grantWithFreeText (3)
            denyWithfreeText (4)
         </xsd:appinfo>
         <xsd:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
            use odd values for grants and event values for deny
```

```
         </xsd:documentation>
      </xsd:annotation>
      <xsd:union>
         <xsd:simpleType>
            <xsd:restriction base="xsd:unsignedInt">
               <xsd:minInclusive value="0"/>
               <xsd:maxInclusive value="4"/>
            </xsd:restriction>
         </xsd:simpleType>
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:enumeration value="freeText"/>
               <xsd:enumeration value="grant"/>
               <xsd:enumeration value="deny"/>
               <xsd:enumeration value="grantWithFreeText"/>
               <xsd:enumeration value="denyWithfreeText"/>
            </xsd:restriction>
         </xsd:simpleType >
      </xsd:union>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_RouteAdvice [ASN.1: `RouteAdvice`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

6.12 Data Element: DE_PreemptTech

Use: A list of preemption technologies support at a given access point location.

ASN.1 Representation:

```
PreemptTech ::= ENUMERATED {
   freeText             (0),
   none                 (1),  -- none are in use
   ...
   }
   -- values to 127 reserved for std use
   -- values 128 to 255 reserved for local use
```

XML Representation:

```
<xsd:simpleType name="PreemptTech" >
      <xsd:annotation>
         <xsd:appinfo>
            freeText (0)
            none (1) -- none are in use
         </xsd:appinfo>
         <xsd:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xsd:documentation>
      </xsd:annotation>
      <xsd:union>
```



```
         <xsd:simpleType>
            <xsd:restriction base="xsd:unsignedInt">
               <xsd:minInclusive value="0"/>
               <xsd:maxInclusive value="1"/>
            </xsd:restriction>
         </xsd:simpleType>
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:enumeration value="freeText"/>
               <xsd:enumeration value="none"/>
            </xsd:restriction>
         </xsd:simpleType >
      </xsd:union>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_VehicleSummary [ASN.1: `VehicleSummary`], and
MSG_PreemptionUserData [ASN.1: `PreemptionUserData`], and
MSG_RouteAdvice [ASN.1: `RouteAdvice`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: It is not IEEE policy to mention specific manufacturers, or their makes and models, in its published standards. However that is likely to be needed in order to deploy a useful list or preemption technologies as a local level. Deployment should establish an inventory of devices, grouped by those that are interoperable and use this as the basis of a local list which should be added to the above in the normal way.

6.13 Data Element: DE_RepairNeeds

Use: A list of items comprising ITIS codes and local codes which can express the need for repair actions on some device to return it to service. When free text is selected the next data element in the using message contains a natural language expression of the item. Local agreements may add to this list in the normal way (items above 128).

ASN.1 Representation:

```
RepairNeeds ::= ITIScodes (0..65535)
-- In addition the following local items
-- freeText             (0),
   -- values to 127 reserved for std use
   -- values 128 to 255 reserved for local use
```

Remarks: See also the cleanup items list. The ITIS codes include a range of values, only some of which make sense when used as a sequence to relate the needs to repair an asset. Local deployments will want to determine what set of the ITIS codes they wish to use, and add values for terms used locally that do not appear in the list (such as “freeway ramp meter” to describe a roadside device). These can be added in the proscribed areas (code ranges 127 to 254 in most cases).

6.14 Data Element: DE_RoadsideAssetLists

Use: This is a list of traffic control devices (both electric and “smart” like a VMS, and “dumb” like a traffic cone) and other incident management assets. It can be used to specify items from the list when requesting from another center. It primarily contains items that are not mobile (are not type of vehicles, nor mounted on trailers). There is another list, derived form the ITIS lists for that purpose.

ASN.1 Representation:

```
RoadsideAssetLists ::= ENUMERATED {
   none                     (10496), -- implies free text follows

   -- inanimate objects
   lightPole                (10497),
   utilityPole              (10498),
   gantryWay                (10499),
   signSupport              (10500), -- all forms of signage
   signalPole               (10501),
   signagePublic            (10502),
   signagePrivate           (10503),
   cones                    (10504), -- typical std height cones as per MUTC
   conesPostType            (10505), -- also called channelizer cones
                                     -- or delineator posts
   conesGluePost            (10506), -- for all glue down types
   conesOther               (10507), -- specialty types or misc smaller cones
   barriers                 (10508),
   barrierAframe            (10509), -- sizes larger than 1.5 meters in length
   barriersHeavyDuty        (10510), -- all types requireing equipment to place
   barricadeTypeIII         (10511), -- all collapsible Type III Barricades
   barricadeSmall           (10512), -- type I and all small A frame types,
                                     -- also so-called "mini" or "narrows"
   barricadeLights          (10513), -- std 7" light as per ITE stds
   beacon                   (10514), -- all types of strobe and rotating lights
   tStand                   (10515),
   aStand                   (10516),
   drums                    (10517), -- common drums and barrel types
   impactAttenuator         (10518), -- water filled and other crushable types
   barricadeTape            (10519), -- lettering type to be conveyed elsewhere
   safetyFence              (10520),
   tempPavtMarkings         (10521), -- all forms of temp markings
   speedBumps               (10522),
   tempCurbs                (10523),
   parkingBlocks            (10524),
   signboardsFixed          (10525),
   signboardPortable        (10526),

   -- controllable or active objects
   har                      (10527),
   har-AM                   (10528),
   har-FM                   (10529),
   har-DSRC                 (10530),
   trafficLight             (10531),
   laneControlSignal        (10532),
   trafficDetector          (10533),
   vehicleDetector          (10534),
   systemAlarm              (10535),
   arrowBoard               (10536),
   fixedVMS                 (10537),
```

```
   mobileVMS                (10538),
   rampControl              (10539),
   gateControl              (10540),
   temporaryTrafficLight    (10541),
   overHeightWarningSystem  (10542),
   overWeightWarningSystem  (10543),
   emergencyTelephones      (10544),
   railroadCrossingEquipment (10545),
   tunnelVentilation        (10546),
   ccTV                     (10547),
   environmentalSensor      (10548),
   ...
   }
   -- values in this sub range to 127 reserved for std use
   -- values in this sub range from 128 to 255 reserved for local use
```

XML Representation:

```
<xsd:simpleType name="RoadsideAssetLists" >
      <xsd:annotation>
         <xsd:appinfo>
            none (10496) -- implies free text follows
             -- inanimate objects
            lightPole (10497)
            utilityPole (10498)
            gantryWay (10499)
            signSupport (10500) -- all forms of signage
            signalPole (10501)
            signagePublic (10502)
            signagePrivate (10503)
            cones (10504) -- typical std height cones as per MUTC
            conesPostType (10505) -- also called channelizer cones
             -- or delineator posts
            conesGluePost (10506) -- for all glue down types
            conesOther (10507) -- specialty types or misc smaller cones
            barriers (10508)
            barrierAframe (10509) -- sizes larger than 1.5 meters in length
            barriersHeavyDuty (10510) -- all types requireing equipment to place
            barricadeTypeIII (10511) -- all collapsible Type III Barricades
            barricadeSmall (10512) -- type I and all small A frame types ,
             -- also so-called &quot;mini&quot; or &quot;narrows&quot;
            barricadeLights (10513) -- std 7&quot; light as per ITE stds
            beacon (10514) -- all types of strobe and rotating lights
            tStand (10515)
            aStand (10516)
            drums (10517) -- common drums and barrel types
            impactAttenuator (10518) -- water filled and other crushable types
            barricadeTape (10519) -- lettering type to be conveyed elsewhere
            safetyFence (10520)
            tempPavtMarkings (10521) -- all forms of temp markings
            speedBumps (10522)
            tempCurbs (10523)
            parkingBlocks (10524)
            signboardsFixed (10525)
            signboardPortable (10526) -- controllable or active objects
            har (10527)
            har-AM (10528)
            har-FM (10529)
```

```
            har-DSRC (10530)
            trafficLight (10531)
            laneControlSignal (10532)
            trafficDetector (10533)
            vehicleDetector (10534)
            systemAlarm (10535)
            arrowBoard (10536)
            fixedVMS (10537)
            mobileVMS (10538)
            rampControl (10539)
            gateControl (10540)
            temporaryTrafficLight (10541)
            overHeightWarningSystem (10542)
            overWeightWarningSystem (10543)
            emergencyTelephones (10544)
            railroadCrossingEquipment (10545)
            tunnelVentilation (10546)
            ccTV (10547)
            environmentalSensor (10548)
         </xsd:appinfo>
         <xsd:documentation>
            values in this sub range to 127 reserved for std use
            values in this sub range from 128 to 255 reserved for local use
         </xsd:documentation>
      </xsd:annotation>
      <xsd:union>
         <xsd:simpleType>
            <xsd:restriction base="xsd:unsignedInt">
               <xsd:minInclusive value="0"/>
               <xsd:maxInclusive value="10548"/>
            </xsd:restriction>
         </xsd:simpleType>
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:enumeration value="none"/>
               <xsd:enumeration value="lightPole"/>
               <xsd:enumeration value="utilityPole"/>
               <xsd:enumeration value="gantryWay"/>
               <xsd:enumeration value="signSupport"/>
               <xsd:enumeration value="signalPole"/>
               <xsd:enumeration value="signagePublic"/>
               <xsd:enumeration value="signagePrivate"/>
               <xsd:enumeration value="cones"/>
               <xsd:enumeration value="conesPostType"/>
               <xsd:enumeration value="conesGluePost"/>
               <xsd:enumeration value="conesOther"/>
               <xsd:enumeration value="barriers"/>
               <xsd:enumeration value="barrierAframe"/>
               <xsd:enumeration value="barriersHeavyDuty"/>
               <xsd:enumeration value="barricadeTypeIII"/>
               <xsd:enumeration value="barricadeSmall"/>
               <xsd:enumeration value="barricadeLights"/>
               <xsd:enumeration value="beacon"/>
               <xsd:enumeration value="tStand"/>
               <xsd:enumeration value="aStand"/>
               <xsd:enumeration value="drums"/>
               <xsd:enumeration value="impactAttenuator"/>
               <xsd:enumeration value="barricadeTape"/>
               <xsd:enumeration value="safetyFence"/>
```

```
                <xsd:enumeration value="tempPavtMarkings"/>
                <xsd:enumeration value="speedBumps"/>
                <xsd:enumeration value="tempCurbs"/>
                <xsd:enumeration value="parkingBlocks"/>
                <xsd:enumeration value="signboardsFixed"/>
                <xsd:enumeration value="signboardPortable"/>
                <xsd:enumeration value="har"/>
                <xsd:enumeration value="har-AM"/>
                <xsd:enumeration value="har-FM"/>
                <xsd:enumeration value="har-DSRC"/>
                <xsd:enumeration value="trafficLight"/>
                <xsd:enumeration value="laneControlSignal"/>
                <xsd:enumeration value="trafficDetector"/>
                <xsd:enumeration value="vehicleDetector"/>
                <xsd:enumeration value="systemAlarm"/>
                <xsd:enumeration value="arrowBoard"/>
                <xsd:enumeration value="fixedVMS"/>
                <xsd:enumeration value="mobileVMS"/>
                <xsd:enumeration value="rampControl"/>
                <xsd:enumeration value="gateControl"/>
                <xsd:enumeration value="temporaryTrafficLight"/>
                <xsd:enumeration value="overHeightWarningSystem"/>
                <xsd:enumeration value="overWeightWarningSystem"/>
                <xsd:enumeration value="emergencyTelephones"/>
                <xsd:enumeration value="railroadCrossingEquipment"/>
                <xsd:enumeration value="tunnelVentilation"/>
                <xsd:enumeration value="ccTV"/>
                <xsd:enumeration value="environmentalSensor"/>
            </xsd:restriction>
        </xsd:simpleType >
    </xsd:union>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_AssetDescription [ASN.1: `AssetDescription`], and MSG_RequestPhysicalAsset [ASN.1: `RequestPhysicalAsset`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Local agreements will likely add to this list in the normal way. Note that the enumerations of this data element are chosen to fit within a currently unused range of the ITIS codes. It is expected that these entries will be merged with those codes at a later date.

6.15 Data Element: DE_RouteStatus

Use: The overall status of a route. A route may be a passive collection of recommended links, in which case its status is not typically important enough to be aware of. However, some routes represent explicitly setup segments and can have lane reverses or escort resources waiting to assist in the route. In such cases this DE is used to reflect the current status.

ASN.1 Representation:

```
RouteStatus ::= ENUMERATED {
   unKnown         (0),
   proposed        (1),
   planned         (2),  -- currently inactive
   settingUp       (3),
   notYetSwept     (5),  -- use for reversed lanes when not yet checked
   active          (6),
   activePassive   (7),
   tearDown        (8),
   noLongerActive  (9),
   closed          (10),  -- use for blocked as well
   ...
   }
   -- values to 127 reserved for std use
   -- values 128 to 255 reserved for local use
```

XML Representation:

```
<xsd:simpleType name="RouteStatus" >
      <xsd:annotation>
         <xsd:appinfo>
            unKnown (0)
            proposed (1)
            planned (2) -- currently inactive
            settingUp (3)
            notYetSwept (5) -- use for reversed lanes when not yet checked
            active (6)
            activePassive (7)
            tearDown (8)
            noLongerActive (9)
            closed (10) -- use for blocked as well
         </xsd:appinfo>
         <xsd:documentation>
            values to 127 reserved for std use
            values 128 to 255 reserved for local use
         </xsd:documentation>
      </xsd:annotation>
      <xsd:union>
         <xsd:simpleType>
            <xsd:restriction base="xsd:unsignedInt">
               <xsd:minInclusive value="0"/>
               <xsd:maxInclusive value="10"/>
            </xsd:restriction>
         </xsd:simpleType>
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:enumeration value="unKnown"/>
               <xsd:enumeration value="proposed"/>
               <xsd:enumeration value="planned"/>
               <xsd:enumeration value="settingUp"/>
               <xsd:enumeration value="notYetSwept"/>
               <xsd:enumeration value="active"/>
               <xsd:enumeration value="activePassive"/>
               <xsd:enumeration value="tearDown"/>
               <xsd:enumeration value="noLongerActive"/>
               <xsd:enumeration value="closed"/>
```

```
            </xsd:restriction>
         </xsd:simpleType >
      </xsd:union>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_RouteAdvice [ASN.1: `RouteAdvice`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

6.16 Data Element: DE_SubMessageRefNum

Use: This string is used to uniquely refer to a submessage over the life of the event. The reference is used in requesting and linking between the IDX submessages issued during the event.

ASN.1 Representation:

```
SubMessageRefNum ::= IA5String (SIZE(1..100))
-- a valid object reference string for a submessage
```

XML Representation:

```
<xsd:simpleType name="SubMessageRefNum" >
      <xsd:annotation>
         <xsd:documentation>
            a valid object reference string for a submessage
         </xsd:documentation>
      </xsd:annotation>
      <xsd:restriction base="xsd:string">
         <xsd:minLength value="1"/>
         <xsd:maxLength value="100"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

MSG_RouteAdvice [ASN.1: `RouteAdvice`],
MSG_TrafficCntrlPlan [ASN.1: `TrafficControlPlan`],
MSG_WorkZoneData [ASN.1: `WorkZoneData`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Note that the underlying choice for center-to-center communications may affect this string. For example, CORBA has a number of features in this regard, while a non-CORBA older CAD systems might just use a simple “case number” string composed of the date and time. The validity of these objects once the event which they are associated with closes is not set by the standard but should be determined by local conventions.

6.17 Data Element: DE_Urgency

Use: The reporting person's or center's assessment of urgency, 0 being the least urgent.

ASN.1 Representation:

```
Urgency ::= INTEGER (0..5)
```

XML Representation:

```
<xsd:simpleType name="Urgency" >
      <xsd:restriction base="xsd:unsignedByte">
         <xsd:maxInclusive value="5"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_InfrastructureReport [ASN.1: `InfrastructureReport`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

6.18 Data Element: DE_Vehicle_Asset_Lists

Use: A list of mobile asset types used in the response plan, the assignment of resources, or the request for a type of asset. Local deployments will often want to add to this list for types of equipment common found in their area.

ASN.1 Representation:

```
VehicleAssetLists ::= ITIS.ITIScodes (9984..10239)
```

XML Representation:

```
<xsd:simpleType name="VehicleAssetLists" >
      <xsd:restriction base ="itis:ITIScodes">
         <xsd:minInclusive value="9984"/>
         <xsd:maxInclusive value="10239"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_AssetDescription [ASN.1: `AssetDescription`], and MSG_RequestPhysicalAsset [ASN.1: `RequestPhysicalAsset`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: See also the roadside assets for other types of useful assets (typically non-vehicle types composed of more traditional traffic control roadside equipment and devices).

6.19 Data Element: DF_URL_Link

Use: A valid internet style URI/ URL in the form of a text string which will link to the designated resource.

ASN.1 Representation:

```
URL-Link ::= IA5String (SIZE(1..100))
```

XML Representation:

```
<xsd:simpleType name="URL-Link" >
      <xsd:restriction base="xsd:string">
         <xsd:minLength value="1"/>
         <xsd:maxLength value="100"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

MSG_ReqTrafficCntrlPlan [ASN.1: `ReqTrafficControlPlan`],
MSG_RequestRouteAdvice [ASN.1: `RequestRouteAdvice`],
MSG_RouteAdvice [ASN.1: `RouteAdvice`],
MSG_TrafficCntrlPlan [ASN.1: `TrafficControlPlan`], and
MSG_WorkZoneData [ASN.1: `WorkZoneData`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: It is the responsibility of the user to ensure that all parties can reach the URL given over their own networks and that the protocols used are acceptable to all.

7. Externally defined data elements

Data frames specified in Clause 5 are also composed of message elements defined by other standards bodies. These “foreign” elements are defined in 7.1 through 7.58. 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 following 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 clause 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 specifications shall be expressed in ASN.1 syntax as per ISO/IEC 8824-1:1998 and ISO/IEC 8824-2:1998.

7.1 Data Element: EXT_ATIS_TimeInterval_quantity

Use: Used as part of sending a various time and price schedules and durations. For example, the Time Interval for the Rate (such as 30 minutes) with all other qualifiers specified. Fixed rates are specified with the First Payment field.

ASN.1 Representation:

```
TimeInterval ::= INTEGER (0..65535)
-- Units of minutes
-- use 0 for "unknown"
-- use 65535 for "forever"
```

XML Representation:

```
<xsd:simpleType name="TimeInterval" >
      <xsd:annotation>
         <xsd:documentation>
            Units of minutes
            use 0 for &quot;unknown&quot;
            use 65535 for &quot;forever&quot;
         </xsd:documentation>
      </xsd:annotation>
      <xsd:restriction base="xsd:unsignedShort"/>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_RequestNetworkConditions [ASN.1: `RequestNetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Synonymous Descriptive Names: PRICE_TimeInterval_quantity

Remarks: See also the TCIP element “PI_OffSchedule) which can be used for positive and negative time offsets. This item (which was redefined in the ATIS use of it) allows a range of 2 million minutes (3.9 years).

Source: SAE Draft J2354 [B9].

7.2 Data Frame: EXT_DateTimePair

Use: External data element taken from ATIS, used to represent date and time.

ASN.1 Representation:

```
DateTimePair ::=  SEQUENCE {
     date    Date,
     time    Time,
     offset  TimeOffset OPTIONAL
}
-- defined in the ATIS work, where:

Date ::= IA5String (SIZE(8))
-- format as: YYYYMMDD where
-- YYYY  the year, in common era units
-- MM  the month, range 01 to 12
-- DD the day, range 01 to 31
-- use zero for MM and DD when not applicable

Time ::= IA5String (SIZE(6..10))
-- Format:  HHMMSSssss
```

```
-- Valid times using 24 hour notation.
-- HH=00 through 23; MM=00 through 59;
-- SS=00 through 59; 00 if NA
-- ssss=0000 through 9999.
-- Use SS= 60 for leap seconds
-- HH represents hours, MM minutes, SS seconds,
-- and ssss decimal seconds to whatever number
-- of significant digits is required (up to four)

TimeOffset ::= IA5String (SIZE(4))
-- Valid time offset using 24 hour notation.
-- HH=00 through 23; MM=00 through 59;
```

XML Representation:

```
<xsd:complexType name="DateTimePair" >
      <xsd:annotation>
         <xsd:documentation>
            defined in the ATIS work,  where:
         </xsd:documentation>
      </xsd:annotation>
      <xsd:sequence>
         <xsd:element name="date" type="Date" />
         <xsd:element name="time" type="Time" />
         <xsd:element name="offset" type="TimeOffset"  minOccurs="0"/>
      </xsd:sequence>
</xsd:complexType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_CleanUpPlan [ASN.1: `CleanUpPlan`],
DF_DSRC_UsePlan [ASN.1: `DSRC-UsePlan`],
DF_HAR_UsePlan [ASN.1: `HAR-UsePlan`],
DF_LaneDescriptions [ASN.1: `LaneDescription`],
DF_RepairPlan [ASN.1: `RepairPlan`],
DF_VMS_UsePlan [ASN.1: `VMS-UsePlan`],
MSG_Assigned-Resources [ASN.1: `Assigned-Resources`],
MSG_InfrastructureReport [ASN.1: `InfrastructureReport`],
MSG_PhysicalAssetStatus [ASN.1: `PhysicalAssetStatus`],
MSG_RequestNetworkConditions [ASN.1: `RequestNetworkConditions`],
MSG_RequestPhysicalAsset [ASN.1: `RequestPhysicalAsset`],
MSG_RequestRouteAdvice [ASN.1: `RequestRouteAdvice`],
MSG_RequestWorkZoneData [ASN.1: `RequestWorkZoneData`], and
MSG_RouteAdvice [ASN.1: `RouteAdvice`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: SAE Draft J2354 [B9].

7.3 Data Element: EXT_ESS_EssAirTemperature_quantity

Use: The dry-bulb temperature in tenths of degrees Celsius. The temperature is an instantaneous reading at the height specified by essTemperatureSensorHeight. The value 1001 shall indicate an error condition or missing value.

ASN.1 Representation:

```
EssAirTemperature ::= INTEGER (-1000..1001)
```

XML Representation:

```
<xsd:simpleType name="EssAirTemperature" >
      <xsd:restriction base="xsd:short">
         <xsd:minInclusive value="-1000"/>
         <xsd:maxInclusive value="1001"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of degree Celsius.

Source: NTCIP 1204-98 [B8].

7.4 Data Element: EXT_ESS_EssPrecipitation24Hours_quantity

Use: The total water equivalent precipitation over the 24 hours preceding the observation in tenths of kilograms per square meter (for rain, this is equivalent to tenths of millimeters). A value of 65535 shall indicate an error condition or missing value.

ASN.1 Representation:

```
EssPrecipitation24Hours ::= INTEGER (0..65535)
```

XML Representation:

```
<xsd:simpleType name="EssPrecipitation24Hours" >
      <xsd:restriction base="xsd:unsignedShort"/>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of millimeters.

Source: NTCIP 1204-98 [B8].

7.5 Data Element: EXT_ESS_EssPrecipitationOneHour_quantity

Use: The total water equivalent precipitation over the 24 hours preceding the observation in tenths of kilograms per square meter (for rain, this is equivalent to tenths of millimeters). A value of 65535 shall indicate an error condition or missing value.

ASN.1 Representation:

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

XML Representation:

```
<xsd:simpleType name="EssPrecipitationOneHour" >
      <xsd:restriction base="xsd:unsignedShort"/>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of millimeters.

Source: NTCIP 1204-98 [B8].

7.6 Data Element: EXT_ESS_EssRelativeHumidity_quantity

Use: The relative humidity in percent. The value of 101 shall indicate an error condition or missing value.

ASN.1 Representation:

```
EssRelativeHumidity ::= INTEGER (0..101)
```

XML Representation:

```
<xsd:simpleType name="EssRelativeHumidity" >
      <xsd:restriction base="xsd:unsignedByte">
         <xsd:maxInclusive value="101"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of percent.

Source: NTCIP 1204-98 [B8].

7.7 Data Element: EXT_ESS_EssRoadwaySnowDepth_quantity

Use: The current depth of unpacked snow (in centimeters) on the driving surface. The value 3001 shall indicate an error condition or missing value.

ASN.1 Representation:

```
EssRoadwaySnowDepth ::= INTEGER (0..3001)
```

XML Representation:

```
<xsd:simpleType name="EssRoadwaySnowDepth" >
      <xsd:restriction base="xsd:unsignedShort">
         <xsd:maxInclusive value="3001"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: NTCIP 1204-98 [B8].

7.8 Data Element: EXT_ESS_EssRoadwaySnowPackDepth_quantity

Use: The current depth of packed snow (in centimeters) on the roadway surface. The value 3001 shall indicate an error condition or missing value.

ASN.1 Representation:

```
EssRoadwaySnowPackDepth ::= INTEGER (0..3001)
```

XML Representation:

```
<xsd:simpleType name="EssRoadwaySnowPackDepth" >
      <xsd:restriction base="xsd:unsignedShort">
         <xsd:maxInclusive value="3001"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: NTCIP 1204-98 [B8].

7.9 Data Element: EXT_ESS_EssSnowfallAccumRate_quantity

Use: The snowfall accumulation rate in 10^{-7} meters per second (this is equivalent to 0.36 mm/hr). The value 65535 shall indicate an error condition or missing value.

ASN.1 Representation:

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

XML Representation:

```
<xsd:simpleType name="EssSnowfallAccumRate" >
      <xsd:restriction base="xsd:unsignedShort"/>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: NTCIP 1204-98 [B8].

7.10 Data Element: EXT_Event-IncidentSeverity

Use: External data element taken from TMDD. A code which describes the severity of an incident. Each region must define the meaning of the values defined.

ASN.1 Representation:

```
Event-incident-severity ::= ENUMERATED {
   noAdditionalInformation     (0),
   otherAdditionalInformation  (1),
   none                        (2),
   minor                       (3),
   major                       (4),
   naturalDisaster             (5),
   ...
   }
-- Select only one value from list
```

XML Representation:

```
<xsd:simpleType name="Event-incident-severity" >
      <xsd:annotation>
         <xsd:appinfo>
            noAdditionalInformation (0)
            otherAdditionalInformation (1)
            none (2)
            minor (3)
            major (4)
            naturalDisaster (5)
         </xsd:appinfo>
         <xsd:documentation>
            Select only one value from list
```

```
         </xsd:documentation>
      </xsd:annotation>
      <xsd:union>
         <xsd:simpleType>
            <xsd:restriction base="xsd:unsignedInt">
               <xsd:minInclusive value="0"/>
               <xsd:maxInclusive value="5"/>
            </xsd:restriction>
         </xsd:simpleType>
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:enumeration value="noAdditionalInformation"/>
               <xsd:enumeration value="otherAdditionalInformation"/>
               <xsd:enumeration value="none"/>
               <xsd:enumeration value="minor"/>
               <xsd:enumeration value="major"/>
               <xsd:enumeration value="naturalDisaster"/>
            </xsd:restriction>
         </xsd:simpleType >
      </xsd:union>
</xsd:simpleType>
```

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.11 Data Element: EXT_Event-IncidentStatus

Use: External data element originally taken from TMDD work and then merged into the ITS-wide ITIS codes. A code which indicates a status of the incident. This is taken from a sub range of ITIS codes called "Incident Response Status."

ASN.1 Representation:

```
Event-IncidentStatus ::= ITIS.ITIScodes (2816..3071)
```

XML Representation:

```
<xsd:simpleType name="Event-IncidentStatus">
   <xsd:union>
      <xsd:simpleType>
         <xsd:restriction base="xsd:unsignedInt">
            <xsd:minInclusive value="2816"/>
            <xsd:maxInclusive value="3071"/>
         </xsd:restriction>
      </xsd:simpleType>
      <xsd:simpleType>
         <xsd:restriction base="xsd:string">
            <!-- the following subset of the ITIS codes shall be used -->
            <xsd:enumeration value="unconfirmed report"/>
            <xsd:enumeration value="initial response en-route"/>
            <xsd:enumeration value="follow-up response en-route"/>
            <xsd:enumeration value="initial response on scene"/>
            <xsd:enumeration value="follow-up response on scene"/>
            <xsd:enumeration value="confirmed report"/>
            <xsd:enumeration value="scene is unsecured at this time"/>
            <xsd:enumeration value="response scene secured"/>
            <xsd:enumeration value="rescue and recovery work in progress"/>
            <xsd:enumeration value="extraction in progress"/>
            <xsd:enumeration value="clearance work in progress"/>
```

```
            <xsd:enumeration value="body removal operations"/>
            <xsd:enumeration value="fire / containment contained"/>
            <xsd:enumeration value="fire / containment not contained"/>
            <xsd:enumeration value="event cleared"/>
            <xsd:enumeration value="traffic clearing"/>
            <xsd:enumeration value="incident closed"/>
         </xsd:restriction>
      </xsd:simpleType >
   </xsd:union>
   <xsd:annotation>
      <xsd:appinfo>
         unconfirmed report (2817)
         initial response en-route (2818)
         follow-up response en-route (2819)
         initial response on scene (2820)
         follow-up response on scene (2821)
         confirmed report (2822)
         scene is unsecured at this time (2823)
         -- Caution this has different meanings in PS use
         response scene secured (2824)
         -- Caution this has different meanings in PS use
         rescue and recovery work in progress (2825)
         extraction in progress (2826)
         clearance work in progress (2827)
         body removal operations (2828)
         fire / containment contained (2829)
         fire / containment not contained (2830)
         event cleared (2831)
         -- Meaning that responder has left scene, not that surrounding traffic has
cleared to a normal level
         traffic clearing (2832)
         incident closed (2833)
         -- A &quot;case closed&quot; meaning which can differ considerably by local
agency policies
      </xsd:appinfo>
   </xsd:annotation>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_Assigned-Resources [ASN.1: `Assigned-Resources`], and MSG_TrafficCntrlPlan [ASN.1: `TrafficControlPlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.12 Data Element: EXT_Event-IncidentVehiclesInvolved

Use: External data element taken from TMDD. A code which indicates the types of vehicles involved in a verified incident.

ASN.1 Representation:

```
Event-IncidentVehiclesInvolved ::= ENUMERATED {
   otherNoInfo       (0), -- Other No Additional Information;
```

```
   otherInfo         (1), -- Other Additional Information (follows in message)
   transitBus        (2), -- Public Transit Bus;
   lightRail         (3), -- Light Rail;
   commuterRail      (4), -- Commuter/Passenger Rail;
   freightRail       (5), -- Freight Rail;
   publicSafety      (6), -- Public Safety Vehicle;
   convertible       (7), -- Convertible (excludes sun-roof, t-bar);
   twoDoorHardtop    (8), -- 2-door sedan, hardtop, coupe;
   twoDoorHatchback  (9), -- 3-door/2-door hatchback;
   ...
   -- consult TMDD for other known values
   }
```

XML Representation:

```
<xsd:simpleType name="Event-IncidentVehiclesInvolved" >
      <xsd:annotation>
         <xsd:appinfo>
            otherNoInfo (0) -- Other No Additional Information;
            otherInfo (1) -- Other Additional Information  (follows in message)
            transitBus (2) -- Public Transit Bus;
            lightRail (3) -- Light Rail;
            commuterRail (4) -- Commuter/Passenger Rail;
            freightRail (5) -- Freight Rail;
            publicSafety (6) -- Public Safety Vehicle;
            convertible (7) -- Convertible  (excludes sun-roof ,
            twoDoorHardtop (8) -- 2-door sedan ,
            twoDoorHatchback (9) -- 3-door/2-door hatchback;
             -- consult TMDD for other known values
         </xsd:appinfo>
      </xsd:annotation>
      <xsd:union>
         <xsd:simpleType>
            <xsd:restriction base="xsd:unsignedInt">
               <xsd:minInclusive value="0"/>
               <xsd:maxInclusive value="9"/>
            </xsd:restriction>
         </xsd:simpleType>
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:enumeration value="otherNoInfo"/>
               <xsd:enumeration value="otherInfo"/>
               <xsd:enumeration value="transitBus"/>
               <xsd:enumeration value="lightRail"/>
               <xsd:enumeration value="commuterRail"/>
               <xsd:enumeration value="freightRail"/>
               <xsd:enumeration value="publicSafety"/>
               <xsd:enumeration value="convertible"/>
               <xsd:enumeration value="twoDoorHardtop"/>
               <xsd:enumeration value="twoDoorHatchback"/>
            </xsd:restriction>
         </xsd:simpleType >
      </xsd:union>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_ReqTrafficCntrlPlan [ASN.1: `ReqTrafficControlPlan`], and MSG_TrafficCntrlPlan [ASN.1: `TrafficControlPlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Originally this was defined as a Bit String now changed to be an Enumerated type for use in this standard. Consult TMDD for a complete and current list of items.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.13 Data Element: EXT_Event-IncidentVehiclesInvolvedCount

Use: External data element taken from TMDD. The total number of vehicles involved in an incident.

ASN.1 Representation:

```
Event-IncidentVehiclesInvolvedCount ::= INTEGER (0..255)
```

XML Representation:

```
<xsd:simpleType name="Event-IncidentVehiclesInvolvedCount" >
      <xsd:restriction base="xsd:unsignedByte"/>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_ReqTrafficCntrlPlan [ASN.1: `ReqTrafficControlPlan`], and MSG_TrafficCntrlPlan [ASN.1: `TrafficControlPlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.14 Data Frame: EXT_EventInformation

Use: This is a complex data frame used by the message set to describe all forms of pre-planned events including work zone information. Complex repeating time schedules are supported, as well as ITIS codes to sort the events.

ASN.1 Representation:

```
EventInformation ::=  SEQUENCE {
     head           Head OPTIONAL,
     location       LRMS.LocationReference,
     areaExtent     LRMS.LocationReference OPTIONAL,
     typeEvent      TMDD.Event-DescriptionTypeEvent,
                    -- the major category (and sub category)
                    -- of the event (from ITIS)
     severity       TMDD.Event-IncidentSeverity OPTIONAL,
     status         TMDD.Event-IncidentStatus OPTIONAL,
                    -- status of the event(from ITIS)
     cause          SEQUENCE OF ITIScodesAndText,
```

```
description   SEQUENCE OF ITIScodesAndText OPTIONAL,
advice         SEQUENCE OF ITIScodesAndText OPTIONAL,
               -- current relevant information in text and codes
lanesEffected  SEQUENCE (SIZE(1..16)) OF IM.LaneDescription  OPTIONAL,
vehiclesInvolvedCount  TMDD.Event-IncidentVehiclesInvolvedCount OPTIONAL,
               -- the number of vehicles
vehiclesInvolved SEQUENCE OF TMDD.Event-IncidentVehiclesInvolved OPTIONAL,
               -- the types of vehicles
startTime      DateTimePair OPTIONAL,
               -- point in time this event started
clearTime      DateTimePair OPTIONAL,
               -- an estimated clear time
repeatTimes    ComplexTime OPTIONAL,
               -- a set of repeating times for events
               -- which re-occur over a periods of days
furtherData    URL-Link OPTIONAL,
tail           Tail OPTIONAL,
...
}
```

Used by: This item is used by the following other data structures in this standard:

MSG_NetworkConditions [ASN.1: `NetworkConditions`], and MSG_WorkZoneData [ASN.1: `WorkZoneData`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: The ITIS codes used in the incident type are other instances where local agreement is required to tailor the list of codes to a subset suitable for use by local deployments. For example, one regional deployment may chose to use the weather-related events as event information types, while another deployment does not. Codes which could not be considered top-level event classifications (such as “on bridge”) would not be used. Because any possible ITIS code could be received from a TMDD deployment, receiving centers should be constructed to handle this event. Because all parties are based on the same underlying code list, the syntactic meaning would be the same regardless of the subset of codes chosen for local use. Note that the cause, description, and advise sections allow mixture of both open free text and code phrases.

Source: SAE Draft J2354 [B9].

7.15 Data Element: EXT_Event-LanesBlockedOrClosedCount

Use: External data element taken from TMDD. A bit string which indicates the lanes and shoulders affected by an event (e.g., an incident, roadway closure, special event).

ASN.1 Representation:

```
Event-LanesBlockedOrClosedCount ::= BIT STRING (SIZE(1..15))
-- Select one bit per lane.
-- Lanes are numbered from the median out beginning with 1.
-- 0 and 15 represent left shoulder and right shoulder, respectively.
```

XML Representation:

```
<xsd:simpleType name="Event-LanesBlockedOrClosedCount" >
      <xsd:annotation>
         <xsd:documentation>
            Select one bit per lane.
            Lanes are numbered from the median out beginning with 1.
            0 and 15 represent left shoulder and right shoulder,  respectively.
         </xsd:documentation>
      </xsd:annotation>
      <xsd:restriction base="binary">
         <xsd:minLength value="1"/>
         <xsd:maxLength value="15"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Note that this element not expected to be used in many parts of ITS, as the lane description data frame of this standard (which relates the same information) makes it unneeded.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.16 Data Element: EXT_Event-ResponsePlanText

Use: External data element taken from TMDD. A free text description of the response plan to follow.

ASN.1 Representation:

```
Event-ResponsePlanText ::= IA5String (SIZE(1..10000))
-- bound at 10,000 char for use.  TMDD has no bound
```

XML Representation:

```
<xsd:simpleType name="Event-ResponsePlanText">
   <xsd:restriction base="xsd:string">
      <xsd:minLength value="1"/>
      <xsd:maxLength value="10000"/>
   </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_CleanUpPlan [ASN.1: `CleanUpPlan`],
DF_RepairPlan [ASN.1: `RepairPlan`],
MSG_ClearOrRepairPlan [ASN.1: `ClearOrRepairPlan`], and
MSG_ReqTrafficCntrlPlan [ASN.1: `ReqTrafficControlPlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.17 Data Element: EXT_IM_ResponseAgencyID_text

Use: An identifying code or name for a specific agency that may respond to an incident. The first two characters are a code for the type of agency, and consequently for the identifier. The last 17 characters are the identifiers for the Incident Management responding unit.

ASN.1 Representation:

```
IM-ResponseAgencyID ::= UTF8String (SIZE(1..19))
-- The std also states:
-- Valid Value Range:  Characters 18-19 (OCTETS 35-38): [0,9]
-- Characters 1-17 (OCTETS 1-34): [UCS];  Valid Value List:  00 = Not used, escape.
-- 01 = Transit Agency ID
-- 02 = NCIC
-- 03 = NFIRS
-- 04 = FARS
-- 05 - 49 = reserved
-- 50 - 89 = Local Use.
-- 90 =  Null (data is null)
-- 91 = Intentionally left blank (not used)
-- 92 = Deleted by device (reset to null)
-- 93 = Data unavailable
-- 94 = Illegal calculation (e.g. divide by zero)
-- 95 = value out of range
-- 96 = device malfunction (no value returned)
-- 97 = data expired (data deleted, no longer available)
-- 98 = data suppressed for security or privacy
-- 99 = unspecified
```

XML Representation:

```
<xsd:simpleType name="IM-ResponseAgencyID" >
      <xsd:annotation>
         <xsd:documentation>
            The std also states:
            Valid Value Range:  Characters 18-19  (OCTETS 35-38) : [0, 9]
              Characters 1-17  (OCTETS 1-34) : [UCS];  Valid Value List:  00 = Not used,
escape.
            01 = Transit Agency ID
            02 = NCIC
            03 = NFIRS
            04 = FARS
            05 - 49 = reserved
            50 - 89 = Local Use.
```

```
            90 =  Null  (data is null)
            91 = Intentionally left blank  (not used)
            92 = Deleted by device  (reset to null)
            93 = Data unavailable
            94 = Illegal calculation  (e.g. divide by zero)
            95 = value out of range
            96 = device malfunction  (no value returned)
            97 = data expired  (data deleted,  no longer available)
            98 = data suppressed for security or privacy
            99 = unspecified
         </xsd:documentation>
      </xsd:annotation>
      <xsd:restriction base="xsd:string">
         <xsd:minLength value="1"/>
         <xsd:maxLength value="19"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

MSG_Assigned-Resources [ASN.1: `Assigned-Resources`], and MSG_ClearOrRepairPlan [ASN.1: `ClearOrRepairPlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Updated to recorded status.

Source: ITE TCIP-IM, NTCIP 1402v01.02.

7.18 Data Element: EXT_Incident-Type

Use: External data element taken from TMDD which is in turn taken from the ITIS codes. A description of which general top-level category the event is.

ASN.1 Representation:

```
Incident-Type ::= ITIS.ITIScodes (512..767)
```

XML Representation:

```
<xsd:simpleType name="Incident-Type">
   <xsd:union>
      <xsd:simpleType>
         <xsd:restriction base="xsd:unsignedInt">
            <xsd:minInclusive value="512"/>
            <xsd:maxInclusive value="767"/>
         </xsd:restriction>
      </xsd:simpleType>
      <xsd:simpleType>
         <xsd:restriction base="xsd:string">
            <!-- the following subset of the ITIS codes shall be used -->
            <xsd:enumeration value="accident"/>
            <xsd:enumeration value="serious accident"/>
            <xsd:enumeration value="injury accident"/>
            <xsd:enumeration value="minor accident"/>
            <xsd:enumeration value="multi vehicle accident"/>
```

```
            <xsd:enumeration value="numerous accidents"/>
            <xsd:enumeration value="accident involving a bicycle"/>
            <xsd:enumeration value="accident involving a bus"/>
            <xsd:enumeration value="accident involving a motorcycle"/>
            <xsd:enumeration value="accident involving a pedestrian"/>
            <xsd:enumeration value="accident involving a train"/>
            <xsd:enumeration value="accident involving a truck"/>
            <xsd:enumeration value="accident involving hazardous materials"/>
            <xsd:enumeration value="earlier accident"/>
            <xsd:enumeration value="medical emergency"/>
            <xsd:enumeration value="secondary accident"/>
            <xsd:enumeration value="rescue and recovery work in progress"/>
            <xsd:enumeration value="accident investigation work"/>
            <xsd:enumeration value="incident"/>
            <xsd:enumeration value="stalled vehicle"/>
            <xsd:enumeration value="abandoned vehicle"/>
            <xsd:enumeration value="disabled vehicle"/>
            <xsd:enumeration value="disabled truck"/>
            <xsd:enumeration value="disabled semi-trailer"/>
            <xsd:enumeration value="disabled bus"/>
            <xsd:enumeration value="disabled train"/>
            <xsd:enumeration value="vehicle spun out"/>
            <xsd:enumeration value="vehicle on fire"/>
            <xsd:enumeration value="vehicle in water"/>
            <xsd:enumeration value="vehicles slowing to look at accident"/>
            <xsd:enumeration value="jackknifed semi trailer"/>
            <xsd:enumeration value="jackknifed trailer home"/>
            <xsd:enumeration value="jackknifed trailer"/>
            <xsd:enumeration value="spillage occurring from moving vehicle"/>
            <xsd:enumeration value="acid spill"/>
            <xsd:enumeration value="chemical spill"/>
            <xsd:enumeration value="fuel spill"/>
            <xsd:enumeration value="hazardous materials spill"/>
            <xsd:enumeration value="oil spill"/>
            <xsd:enumeration value="spilled load"/>
            <xsd:enumeration value="toxic spill"/>
            <xsd:enumeration value="overturned vehicle"/>
            <xsd:enumeration value="overturned truck"/>
            <xsd:enumeration value="overturned semi-trailer"/>
            <xsd:enumeration value="overturned bus"/>
            <xsd:enumeration value="derailed train"/>
            <xsd:enumeration value="stuck vehicle"/>
            <xsd:enumeration value="truck stuck under bridge"/>
            <xsd:enumeration value="bus stuck under bridge"/>
            <xsd:enumeration value="accident cleared"/>
            <xsd:enumeration value="incident cleared"/>
         </xsd:restriction>
      </xsd:simpleType >
   </xsd:union>
   <xsd:annotation>
      <xsd:appinfo>
         accident (513)
         -- Use when no further data is available regarding involved vehicle type
         serious accident (514)
         injury accident (515)
         minor accident (516)
         multi vehicle accident (517)
         -- To be used when events are NOT distributed along a road
         -- segment (i.e. one location)
         numerous accidents (518)
```

```
        -- To be used when events are distributed along a road segment
        accident involving a bicycle (519)
        accident involving a bus (520)
        accident involving a motorcycle (521)
        accident involving a pedestrian (522)
        accident involving a train (523)
        accident involving a truck (524)
        accident involving hazardous materials (525)
         earlier accident (526) -- Hint: Typically used as a cause, &quot;Due to&quot;
        medical emergency (527)
        secondary accident (528)
        rescue and recovery work in progress (529)
        accident investigation work (530)
        incident (531)
        -- Hint: For non-accident incidents (disabled, jackknife, etc.)
        -- where no further information is available
        stalled vehicle (532)
        abandoned vehicle (533)
        disabled vehicle (534)
        disabled truck (535)
         disabled semi-trailer (536)-- Alternative Rendering: disabled tractor-trailer
        disabled bus (537)
        disabled train (538)
        vehicle spun out (539)
        vehicle on fire (540)
        vehicle in water (541)
        vehicles slowing to look at accident (542)
        -- Alternative Rendering:  On-looker slowdown, Rubbernecking
        jackknifed semi trailer (543)
        -- Alternatives can use: jackknifed tractor-trailer, jackknifed truck,
        -- jackknifed big-rig
        jackknifed trailer home (544)
        jackknifed trailer (545)
        -- Hint: Used for smaller trailers (i.e. not type &quot;jackknifed
        -- semi trailer&quot; above)
        spillage occurring from moving vehicle (546)
        acid spill (547)
        chemical spill (548)
        fuel spill (549)
        hazardous materials spill (550)
        -- Also use the Disaster lists for large HAZMAT events
        oil spill (551)
        spilled load (552)
        toxic spill (553)
        overturned vehicle (554)
        -- Use when no further data is available regarding involved vehicle types
        overturned truck (555)
        overturned semi-trailer (556)
        overturned bus (557)
        derailed train (558)
        stuck vehicle (559)
        -- It is preferred to provide data which denotes WHY the vehicle is
        -- stuck (I.e. mud/snow, under bridge, too wide, etc.)
        truck stuck under bridge (560)
        -- Alternative Rendering:  high load hit involving truck
        bus stuck under bridge (561)
        -- Alternative Rendering:  high load hit involving bus
        accident cleared (638)
        incident cleared (639)
    </xsd:appinfo>
```

```
   </xsd:annotation>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.19 Data Element: EXT_ITIS-Codes

Use: The complete set of ITIS codes can be found in SAE J2540-2. This is a set of over 1000 items which are used to encode common events and list items in ITS.

ASN.1 Representation:

```
ITIScodes ::= INTEGER (0..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.
```

XML Representation:

```
<xsd:simpleType name="ITIScodes" >
      <xsd:annotation>
         <xsd:documentation>
            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.
         </xsd:documentation>
      </xsd:annotation>
      <xsd:restriction base="xsd:unsignedInt">
         <xsd:maxInclusive value="65565"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_AssetDescription [ASN.1: `AssetDescription`],
DF_DSRC_UsePlan [ASN.1: `DSRC-UsePlan`],
DF_LaneDescriptions [ASN.1: `LaneDescription`],
DF_VehicleSummary [ASN.1: `VehicleSummary`],

MSG_NetworkConditions [ASN.1: `NetworkConditions`],
MSG_RequestNetworkConditions [ASN.1: `RequestNetworkConditions`], and
MSG_RequestWorkZoneData [ASN.1: `RequestWorkZoneData`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Refer to the SAE documents listed in Clause 2 of this standard for the complete listing of these codes and for an XML rendering.

Source: SAE J2540-2.

7.20 Data Frame: EXT_ITIS-Codes-And-Text

Use: The use of ITIS codes interspersed with free text. The complete set of ITIS codes can be found in SAE J2540-2. This is a set of over 1000 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 FreeText
       }
  }
```

Used by: This item is used by the following other data structures in this standard:

DF_HAR_UsePlan [ASN.1: `HAR-UsePlan`], and DF_VMS_UsePlan [ASN.1: `VMS-UsePlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Refer to the SAE ITIS documents for the complete (and lengthy) listing of these codes and for an XML rendering. Note that the XML rendering of this item is defined there and consists of only two inner tags used to hold the data.

Source: SAE J2540-2.

7.21 Data Element: EXT_LaneClosedList

Use: External data element taken from TMDD.

ASN.1 Representation:

```
LaneClosedList ::= SEQUENCE {id INTEGER, dv OCTET STRING}
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Note that this structure will likely be replaced with an improved three-part structure describing lanes and shoulders together with any blocked or closure information. Another item where an event reporting message (ERM) causes improvement to TMDD which others such as ATIS and IM should follow.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.22 Data Element: EXT_LaneConfigurationList

Use: External data element taken from TMDD.

ASN.1 Representation:

```
LaneConfigurationList ::= SEQUENCE {id INTEGER, dv OCTET STRING}
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Note that this structure will likely be replaced with an improved three-part structure describing lanes and shoulders together with any blocked or closure information. Another item where ERM causes improvement to TMDD which others such as ATIS and IM should follow.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.23 Data Element: EXT_LINK_Capacity_rate

Use: External data element taken from TMDD. The link maximum capacity in vehicles per hour.

ASN.1 Representation:

```
Link-Capacity ::= INTEGER (0..300000)
```

XML Representation:

```
<xsd:simpleType name="Link-Capacity" >
      <xsd:restriction base="xsd:unsignedInt">
         <xsd:maxInclusive value="300000"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.24 Data Element: EXT_LINK_Delay_quantity

Use: External data element taken from TMDD. Delay time for travel along a particular link. This is the additional time it will take above the free flow travel time for that time period to travel from one end of the link to the other.

ASN.1 Representation:

```
Link-Delay ::= INTEGER (0..605000)
```

XML Representation:

```
<xsd:simpleType name="Link-Delay" >
      <xsd:restriction base="xsd:unsignedInt">
         <xsd:maxInclusive value="605000"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of seconds.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.25 Data Element: EXT_LINK_Density_rate

Use: External data element taken from TMDD. Vehicle concentration per kilometer of the link.

ASN.1 Representation:

```
Link-Density ::= INTEGER (0..2000)
```

XML Representation:

```
<xsd:simpleType name="Link-Density" >
      <xsd:restriction base="xsd:unsignedShort">
         <xsd:maxInclusive value="2000"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Proposed new ASN.1 name: Link-density.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.26 Data Element: EXT_LINK_Jurisdiction_text

Use: The name of the law enforcement agency with authority over this link.

ASN.1 Representation:

```
Link-jurisdiction ::= IA5String (SIZE(1..128))-- Any set of ASCII characters up to 128
```

XML Representation:

```
<xsd:simpleType name="Link-jurisdiction" >
      <xsd:annotation>
         <xsd:documentation>
            Any set of ASCII characters up to 128
         </xsd:documentation>
      </xsd:annotation>
      <xsd:restriction base="xsd:string">
         <xsd:minLength value="1"/>
         <xsd:maxLength value="128"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: V1.3—revised definition. Removed ANSI X3.4 from REFERENCE VALUE DOMAIN.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.27 Data Element: EXT_LINK_LaneCount_quantity

Use: External data element taken from TMDD. The prevailing number of through lanes at any point on the link.

ASN.1 Representation:

```
Link-lane-count ::= INTEGER (1..50)
```

XML Representation:

```
<xsd:simpleType name="Link-lane-count" >
      <xsd:restriction base="xsd:unsignedByte">
         <xsd:minInclusive value="1"/>
         <xsd:maxInclusive value="50"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_LaneDescriptions [ASN.1: `LaneDescription`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.28 Data Element: EXT_LINK_LanesNumberOpen

Use: External data element taken from TMDD. The lowest number of lanes currently open in the link at any point.

ASN.1 Representation:

```
Link-LanesNumberOpen ::= INTEGER (0..50)
```

XML Representation:

```
<xsd:simpleType name="Link-LanesNumberOpen" >
      <xsd:restriction base="xsd:unsignedByte">
         <xsd:maxInclusive value="50"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.29 Data Element: EXT_LINK_LanesNumberOpen_quantity

Use: External data element taken from TMDD. The lowest number of lanes currently open in the link at any point.

ASN.1 Representation:

```
Link-LanesMinimumNumber ::= INTEGER (0..50)
```

XML Representation:

```
<xsd:simpleType name="Link-LanesMinimumNumber" >
      <xsd:restriction base="xsd:unsignedByte">
         <xsd:maxInclusive value="50"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.30 Data Element: EXT_LINK_Length_quantity

Use: External data element taken from TMDD. The length of the link from beginning node to ending node, in meters.

ASN.1 Representation:

```
Link-Length ::= INTEGER (0..160000)
```

XML Representation:

```
<xsd:simpleType name="Link-Length" >
      <xsd:restriction base="xsd:unsignedInt">
         <xsd:maxInclusive value="160000"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of meters.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.31 Data Element: EXT_LINK_LevelOfService_code

Use: External data element taken from TMDD. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers as defined in HCM 2000 [B2].

ASN.1 Representation:

```
Link-LevelOfService ::= ENUMERATED {
   unknown  (0),
   a        (1), -- A = Free flow conditions,
   b        (2), -- B = Stable flow with noticeable decline in free flow conditions,
   c        (3), -- C = Stable flow with significant increase in driver discomfort,
   d        (4), -- D = High Density but stable flow,
   e        (5), -- E = Conditions near capacity level,
   f        (6), -- F = Forced or breakdown flow
   ...
   }
```

XML Representation:

```
<xsd:simpleType name="Link-LevelOfService" >
      <xsd:annotation>
         <xsd:appinfo>
            unknown (0)
            a (1) -- A = Free flow conditions ,
            b (2) -- B = Stable flow with noticeable decline in free flow conditions ,
            c (3) -- C = Stable flow with significant increase in driver discomfort ,
            d (4) -- D = High Density but stable flow ,
            e (5) -- E = Conditions near capacity level ,
            f (6) -- F = Forced or breakdown flow
         </xsd:appinfo>
      </xsd:annotation>
      <xsd:union>
         <xsd:simpleType>
            <xsd:restriction base="xsd:unsignedInt">
               <xsd:minInclusive value="0"/>
               <xsd:maxInclusive value="6"/>
            </xsd:restriction>
         </xsd:simpleType>
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:enumeration value="unknown"/>
               <xsd:enumeration value="a"/>
               <xsd:enumeration value="b"/>
               <xsd:enumeration value="c"/>
               <xsd:enumeration value="d"/>
               <xsd:enumeration value="e"/>
               <xsd:enumeration value="f"/>
            </xsd:restriction>
         </xsd:simpleType >
      </xsd:union>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.32 Data Element: EXT_LINK_MedianType

Use: External data element taken from TMDD. Type of the median for the separation of opposing or parallel traffic links.

ASN.1 Representation:

```
Link-Median-Type ::= ENUMERATED {
   other-no-additional-information-required  (0),
   other-additional-information-required     (1),
   curbed                                    (2),
   concrete-barrier                          (3),
   concrete-barrier-with-visibility-screen   (4),
   guard-rail                                (5),
   open-grass                                (6),
   open-sand                                 (7),
   painted-median-no-access                  (8),
   separate-roadways                         (9),
   unprotected                               (10),
   ...
   }
```

XML Representation:

```
<xsd:simpleType name="Link-Median-Type" >
      <xsd:annotation>
         <xsd:appinfo>
            other-no-additional-information-required (0)
            other-additional-information-required (1)
            curbed (2)
            concrete-barrier (3)
            concrete-barrier-with-visibility-screen (4)
            guard-rail (5)
            open-grass (6)
            open-sand (7)
            painted-median-no-access (8)
            separate-roadways (9)
            unprotected (10)
         </xsd:appinfo>
      </xsd:annotation>
      <xsd:union>
         <xsd:simpleType>
            <xsd:restriction base="xsd:unsignedInt">
               <xsd:minInclusive value="0"/>
               <xsd:maxInclusive value="10"/>
            </xsd:restriction>
         </xsd:simpleType>
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:enumeration value="other-no-additional-information-required"/>
               <xsd:enumeration value="other-additional-information-required"/>
               <xsd:enumeration value="curbed"/>
               <xsd:enumeration value="concrete-barrier"/>
               <xsd:enumeration value="concrete-barrier-with-visibility-screen"/>
               <xsd:enumeration value="guard-rail"/>
               <xsd:enumeration value="open-grass"/>
               <xsd:enumeration value="open-sand"/>
               <xsd:enumeration value="painted-median-no-access"/>
               <xsd:enumeration value="separate-roadways"/>
               <xsd:enumeration value="unprotected"/>
            </xsd:restriction>
         </xsd:simpleType >
      </xsd:union>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.33 Data Element: EXT_LINK_Name

Use: External data element taken from TMDD. The name of the link for user identification.

ASN.1 Representation:

```
Link-Name ::= IA5String (SIZE(1..128))
```

XML Representation:

```
<xsd:simpleType name="Link-Name" >
      <xsd:restriction base="xsd:string">
         <xsd:minLength value="1"/>
         <xsd:maxLength value="128"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.34 Data Element: EXT_LINK_Occupancy_percent

Use: External data element taken from TMDD. The current average percent occupancy of the vehicles determined by detectors on the link. This is percent of time, within a given time period in seconds, that a point on the roadway is occupied by the vehicles.

ASN.1 Representation:

```
Link-Occupancy ::= INTEGER (0..100)
```

XML Representation:

```
<xsd:simpleType name="Link-Occupancy" >
      <xsd:restriction base="xsd:unsignedByte">
         <xsd:maxInclusive value="100"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.35 Data Element: EXT_LINK_Other_text

Use: Data element used to indicate the presence of additional information. This data element is to be used only when a precedent LINK data element of type code has a value of '1 = Other, additional information required'.

ASN.1 Representation:

```
Link-other ::= IA5String (SIZE(1..256)) -- Any set of ASCII characters up to 256.
```

XML Representation:

```
<xsd:simpleType name="Link-other" >
      <xsd:annotation>
         <xsd:documentation>
            Any set of ASCII characters up to 256.
         </xsd:documentation>
      </xsd:annotation>
      <xsd:restriction base="xsd:string">
         <xsd:minLength value="1"/>
         <xsd:maxLength value="256"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: V1.5—New data element.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.36 Data Element: EXT_LINK_Ownership_text

Use: The name of the designated owner of the link.

ASN.1 Representation:

```
Link-ownership ::= IA5String (SIZE(1..256)) -- Any set of ASCII characters up to 256
```

XML Representation:

```
<xsd:simpleType name="Link-ownership" >
      <xsd:annotation>
         <xsd:documentation>
            Any set of ASCII characters up to 256
         </xsd:documentation>
      </xsd:annotation>
      <xsd:restriction base="xsd:string">
         <xsd:minLength value="1"/>
         <xsd:maxLength value="256"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: V1.3—removed ANSI X3.4 from REFERENCE VALUE DOMAIN.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.37 Data Element: EXT_LINK_PavementType

Use: External data element taken from TMDD. The type of material from which the roadway pavement is constructed (e.g. concrete, asphalt). This lists the surfaces used by traffic on the link.

ASN.1 Representation:

```
Link-PavementType ::= ENUMERATED {
   other-no-additional-information-required  (0),
   other-additional-information-required     (1),
   asphalt                                   (2),
   open-graded-asphalt                       (3),
   concrete                                  (4),
   grooved-concrete                          (5),
   steel-bridge                              (6),
   concrete-bridge                           (7),
   asphalt-overlay-bridge                    (8),
   timber-bridge                             (9),
   gravel                                    (10),
   dirt                                      (11),
   ...
   }
```

XML Representation:

```
<xsd:simpleType name="Link-PavementType" >
      <xsd:annotation>
         <xsd:appinfo>
            other-no-additional-information-required (0)
            other-additional-information-required (1)
```

```
            asphalt (2)
            open-graded-asphalt (3)
            concrete (4)
            grooved-concrete (5)
            steel-bridge (6)
            concrete-bridge (7)
            asphalt-overlay-bridge (8)
            timber-bridge (9)
            gravel (10)
            dirt (11)
         </xsd:appinfo>
      </xsd:annotation>
      <xsd:union>
         <xsd:simpleType>
            <xsd:restriction base="xsd:unsignedInt">
               <xsd:minInclusive value="0"/>
               <xsd:maxInclusive value="11"/>
            </xsd:restriction>
         </xsd:simpleType>
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:enumeration value="other-no-additional-information-required"/>
               <xsd:enumeration value="other-additional-information-required"/>
               <xsd:enumeration value="asphalt"/>
               <xsd:enumeration value="open-graded-asphalt"/>
               <xsd:enumeration value="concrete"/>
               <xsd:enumeration value="grooved-concrete"/>
               <xsd:enumeration value="steel-bridge"/>
               <xsd:enumeration value="concrete-bridge"/>
               <xsd:enumeration value="asphalt-overlay-bridge"/>
               <xsd:enumeration value="timber-bridge"/>
               <xsd:enumeration value="gravel"/>
               <xsd:enumeration value="dirt"/>
            </xsd:restriction>
         </xsd:simpleType >
      </xsd:union>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.38 Data Element: EXT_LINK_RestrictionAxleCount_quantity

Use: External data element taken from TMDD. Maximum axle count for a vehicle allowed on the link.

ASN.1 Representation:

```
Link-RestrictionAxleCount ::= INTEGER (0..20)
```

XML Representation:

```
<xsd:simpleType name="Link-RestrictionAxleCount" >
      <xsd:restriction base="xsd:unsignedByte">
         <xsd:maxInclusive value="20"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_RestrictionSet [ASN.1: `RestrictionSet`],
DF_VehicleSummary [ASN.1: `VehicleSummary`], and
MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Proposed new ASN.1 name: Link-restriction-axle-count.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.39 Data Element: EXT_LINK_RestrictionClass_code

Use: External data element taken from TMDD, which is in turn taken from the ITIS codes. Class of traffic restrictions applied to a link. This is used to characterize traffic restrictive conditions currently in effect.

ASN.1 Representation:

```
Link-RestrictionClass ::= ITIS.ITIScodes (2560..2815)
```

XML Representation:

```
<xsd:simpleType name="Link-RestrictionClass" >
      <xsd:restriction base ="itis:ITIScodes">
         <xsd:minInclusive value="2560"/>
         <xsd:maxInclusive value="2815"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_RestrictionSet [ASN.1: `RestrictionSet`],
DF_VehicleSummary [ASN.1: `VehicleSummary`], and
MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.40 Data Element: EXT_LINK_RestrictionHeight_quantity

Use: External data element taken from TMDD. Minimum vertical clearance on a link in centimeters.

ASN.1 Representation:

```
Link-RestrictionHeight ::= INTEGER (0..2000)
```

XML Representation:

```
<xsd:simpleType name="Link-RestrictionHeight" >
      <xsd:restriction base="xsd:unsignedShort">
         <xsd:maxInclusive value="2000"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_RestrictionSet [ASN.1: `RestrictionSet`],
DF_VehicleSummary [ASN.1: `VehicleSummary`], and
MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of centimeters.

Remarks: Proposed new ASN.1 name: Link-restriction-height.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.41 Data Element: EXT_LINK_RestrictionLength_quantity

Use: External data element taken from TMDD. Maximum vehicle length allowable on a link in centimeters.

ASN.1 Representation:

```
Link-RestrictionLength ::= INTEGER (0..6000)
```

XML Representation:

```
<xsd:simpleType name="Link-RestrictionLength" >
      <xsd:restriction base="xsd:unsignedShort">
         <xsd:maxInclusive value="6000"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_RestrictionSet [ASN.1: `RestrictionSet`],
DF_VehicleSummary [ASN.1: `VehicleSummary`], and
MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of centimeters.

Remarks: Proposed new ASN.1 name: Link-restriction-length.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.42 Data Element: EXT_LINK_RestrictionWeightVehicle_quantity

Use: External data element taken from TMDD. Maximum vehicle weight allowable on a link in kilograms.

ASN.1 Representation:

```
Link-RestrictionWeight ::= INTEGER (0..80000)
```

XML Representation:

```
<xsd:simpleType name="Link-RestrictionWeight" >
      <xsd:restriction base="xsd:unsignedInt">
         <xsd:maxInclusive value="80000"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_RestrictionSet [ASN.1: `RestrictionSet`],
DF_VehicleSummary [ASN.1: `VehicleSummary`], and
MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of kilograms.

Remarks: Proposed new ASN.1 name: Link-restriction-weight.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.43 Data Element: EXT_LINK_RestrictionWidth_quantity

Use: External data element taken from TMDD. Maximum allowable vehicle width on a link in centimeters.

ASN.1 Representation:

```
Link-RestrictionWidth ::= INTEGER (0..2000)
```

XML Representation:

```
<xsd:simpleType name="Link-RestrictionWidth" >
      <xsd:restriction base="xsd:unsignedShort">
         <xsd:maxInclusive value="2000"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_RestrictionSet [ASN.1: `RestrictionSet`],
DF_VehicleSummary [ASN.1: `VehicleSummary`], and
MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of centimeters.

Remarks: Proposed new ASN.1 name: Link-restriction-width.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.44 Data Element: EXT_LINK_RoadNumber

Use: External data element taken from TMDD. County, State, or Federal route numbers with any associated alphabetic designators.

ASN.1 Representation:

```
Link-RoadNumber ::= IA5String (SIZE(1..64))
   -- Any set of alphanumeric characters up to 64
```

XML Representation:

```
<xsd:simpleType name="Link-RoadNumber">
   <xsd:restriction base="xsd:string">
      <xsd:minLength value="1"/>
      <xsd:maxLength value="64"/>
   </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Proposed new ASN.1 name: Link-road-designator.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.45 Data Element: EXT_LINK_ShoulderWidthLeft_quantity

Use: External data element taken from TMDD. The width of the left shoulder of the link.

ASN.1 Representation:

```
Link-ShoulderWidthLeft ::= INTEGER (0..999)
```

XML Representation:

```
<xsd:simpleType name="Link-ShoulderWidthLeft" >
      <xsd:restriction base="xsd:unsignedShort">
         <xsd:maxInclusive value="999"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of centimeters.

Remarks: Proposed new ASN.1 name: Link-shoulder-width-left.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.46 Data Element: EXT_LINK_ShoulderWidthRight

Use: External data element taken from TMDD. The width of the right shoulder of the link.

ASN.1 Representation:

```
Link-ShoulderWidthRight ::= INTEGER (0..999)
```

XML Representation:

```
<xsd:simpleType name="Link-ShoulderWidthRight" >
      <xsd:restriction base="xsd:unsignedShort">
         <xsd:maxInclusive value="999"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of centimeters.

Remarks: Proposed new ASN.1 name: Link-shoulder-width-right.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.47 Data Element: EXT_LINK_SpeedAverage_rate

Use: External data element taken from TMDD. The current average speed of the vehicles using the link.

ASN.1 Representation:

```
Link-Speed ::= INTEGER (0..255)
```

XML Representation:

```
<xsd:simpleType name="Link-Speed" >
      <xsd:restriction base="xsd:unsignedByte"/>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_RestrictionSet [ASN.1: `RestrictionSet`], and
MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of kilometers per hour (kph).

Remarks: Alternative ASN name also used: Link-speed-average.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.48 Data Element: EXT_LINK_SpeedLimit_rate

Use: External data element taken from TMDD. The posted or legal speed limit on the link for automobiles in kph.

ASN.1 Representation:

```
Link-SpeedLimit ::= INTEGER (0..255)
```

XML Representation:

```
<xsd:simpleType name="Link-SpeedLimit" >
      <xsd:restriction base="xsd:unsignedByte"/>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

DF_RestrictionSet [ASN.1: `RestrictionSet`],
DF_VehicleSummary [ASN.1: `VehicleSummary`], and
MSG_NetworkConditions [ASN.1: `NetworkConditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Proposed new ASN.1 name: Link-speed-limit.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.49 Data Element: EXT_LINK_Status

Use: External data element taken from TMDD, taken from the ITIS codes. The current link status that provides an indication of standard or non-standard link operations.

ASN.1 Representation:

```
Link-Status ::= ITIS.ITIScodes (768..1023)
```

XML Representation:

```
<xsd:simpleType name="Link-Status">
   <xsd:union>
      <xsd:simpleType>
         <xsd:restriction base="xsd:unsignedInt">
            <xsd:minInclusive value="768"/>
            <xsd:maxInclusive value="1023"/>
         </xsd:restriction>
      </xsd:simpleType>
      <xsd:simpleType>
         <xsd:restriction base="xsd:string">
            <!-- the following subset of the ITIS codes shall be used -->
            <xsd:enumeration value="closed to traffic"/>
            <xsd:enumeration value="closed"/>
            <xsd:enumeration value="closed ahead"/>
            <xsd:enumeration value="closed intermittently"/>
            <xsd:enumeration value="closed for repairs"/>
            <xsd:enumeration value="closed for the season"/>
            <xsd:enumeration value="blocked"/>
            <xsd:enumeration value="blocked ahead"/>
            <xsd:enumeration value="reduced to one lane"/>
            <xsd:enumeration value="reduced to two lanes"/>
            <xsd:enumeration value="reduced to three lanes"/>
            <xsd:enumeration value="collapse"/>
            <xsd:enumeration value="out"/>
            <xsd:enumeration value="open to traffic"/>
            <xsd:enumeration value="open"/>
            <xsd:enumeration value="reopened to traffic"/>
            <xsd:enumeration value="clearing"/>
            <xsd:enumeration value="cleared"/>
         </xsd:restriction>
      </xsd:simpleType >
   </xsd:union>
   <xsd:annotation>
      <xsd:appinfo>
```

```
         closed to traffic (769)
         closed (770)
         -- Hint: use this only for NON road-lane items (such as a rest stop)
         closed ahead (771)
         closed intermittently (772)
         closed for repairs (773)
         closed for the season (774)
         blocked (775)
         blocked ahead (776)
         reduced to one lane (777)
         reduced to two lanes (778)
         reduced to three lanes (779)
         collapse (780) -- Used with bridges and tunnels
         out (781)
         -- Used with bridges and roads
         open to traffic (891)
         open (892)
         -- Hint: use this only for NON road-lane items (such as a rest stop)
         reopened to traffic (893)
         clearing (894)
         cleared (895)
      </xsd:appinfo>
   </xsd:annotation>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Observe that the original TMDD definition of this code set only included the following: open, restricted, and closed—as well as the normal additional information settings. This was greatly expanded during the ITIS harmonization process and is now reflected in the “closures” sub range of ITIS. Note also that a wide range of other restrictions can be denoted by other ITIS ranges as well.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.50 Data Element: EXT_LINK_SurfaceCondition

Use: External data element taken from TMDD. The abnormal surface conditions currently found on the link (e.g., dry, wet, ice, snow, etc.). This is taken from a sub range of ITIS codes called “Pavement Conditions.”

ASN.1 Representation:

```
Link-SurfaceCondition ::= ITIS.ITIScodes (5888..6143)
```

XML Representation:

```
<xsd:simpleType name="Link-SurfaceCondition" >
      <xsd:restriction base ="itis:ITIScodes">
         <xsd:minInclusive value="5888"/>
         <xsd:maxInclusive value="6143"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Observe that the original TMDD definition of this code set was somewhat different and that the ITIS harmonization process both added new codes and placed some other codes into other categories (such as moving “power lines down” into obstructions).

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.51 Data Element: EXT_LINK_TravelTime_quantity

Use: External data element taken from TMDD. The current average travel time of the vehicles using the link.

ASN.1 Representation:

```
Link-TravelTime ::= INTEGER (0..65535)
```

XML Representation:

```
<xsd:simpleType name="Link-TravelTime" >
      <xsd:restriction base="xsd:unsignedShort"/>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of seconds.

Remarks: Proposed revised ASN.1 name: Link-travel-time.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.52 Data Element: EXT_LINK_TruckSpeedLimit

Use: External data element taken from TMDD. The posted or legal speed limit on the Link for trucks in kph.

ASN.1 Representation:

```
Link-TruckSpeedLimit ::= INTEGER (0..255)
```

XML Representation:

```
<xsd:simpleType name="Link-TruckSpeedLimit" >
      <xsd:restriction base="xsd:unsignedByte"/>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of kph.

Remarks: Alternative ASN.1 name: Link-speed-limit-truck.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.53 Data Frame: EXT_LRMS

Use: The all-purpose LRMS message used in all of ITS.

ASN.1 Representation:

```
LocationReference ::=  CHOICE
   {
   -- Which is in turn defined in the LRMS module as    geometry
GeometryProfile,
   geocoordinate       GeographicCoordinate,
   grid                GridProfile,
   linearReferencing   LinearReferenceProfile,
   crossStreets        CrossStreetsProfile,
   address             AddressProfile,
   mdi                 ModelProfile
   }

GeographicCoordinate ::= SEQUENCE {id INTEGER, dv OCTET STRING}
GridProfile ::= SEQUENCE {id INTEGER, dv OCTET STRING}
LinearReferenceProfile ::= SEQUENCE {id INTEGER, dv OCTET STRING}
CrossStreetsProfile ::= SEQUENCE {id INTEGER, dv OCTET STRING}
AddressProfile ::= SEQUENCE {id INTEGER, dv OCTET STRING}
ModelProfile ::= SEQUENCE {id INTEGER, dv OCTET STRING}
```

XML Representation:

```
<xsd:complexType name="LocationReference" >
      <xsd:choice>
         <!-- Which is in turn defined in the LRMS module as    geometry
GeometryProfile, -->
         <xsd:element name="geocoordinate" type="GeographicCoordinate" />
         <xsd:element name="grid" type="GridProfile" />
         <xsd:element name="linearReferencing" type="LinearReferenceProfile" />
         <xsd:element name="crossStreets" type="CrossStreetsProfile" />
         <xsd:element name="address" type="AddressProfile" />
```



```
         <xsd:element name="mdi" type="ModelProfile" />
      </xsd:choice>
</xsd:complexType>
```

Used by: This item is used by the following other data structures in this standard (descriptive name and ASN.1 name of each):

MSG_Assigned-Resources [ASN.1: `Assigned-Resources`],
MSG_InfrastructureReport [ASN.1: `InfrastructureReport`],
MSG_PhysicalAssetStatus [ASN.1: `PhysicalAssetStatus`],
MSG_ReqTrafficCntrlPlan [ASN.1: `ReqTrafficControlPlan`],
MSG_RequestNetworkConditions [ASN.1: `RequestNetworkConditions`],
MSG_RequestPhysicalAsset [ASN.1: `RequestPhysicalAsset`],
MSG_RequestRouteAdvice [ASN.1: `RequestRouteAdvice`],
MSG_RequestWorkZoneData [ASN.1: `RequestWorkZoneData`], and
MSG_TrafficCntrlPlan [ASN.1: `TrafficControlPlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: At this time the entire LRMS system is being adopted as an SAE standard. Consult that effort for the most current definitions of the elements which make up this structure.

Source: DRAFT XLRMS

7.54 Data Element: EXT_NODE_LinksNumber_quantity

Use: External data element taken from TMDD. This is the number of links beginning or ending at the node.

ASN.1 Representation:

```
Node-LinksNum ::= INTEGER (0..999)
```

XML Representation:

```
<xsd:simpleType name="Node-LinksNum" >
      <xsd:restriction base="xsd:unsignedShort">
         <xsd:maxInclusive value="999"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: Alternative ASN.1 name: Node-links-number.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.55 Data Element: EXT_NODE_Name_text

Use: External data element taken from TMDD. The name of the node for user identification.

ASN.1 Representation:

```
Node-Name ::= IA5String (SIZE(1..128))
```

XML Representation:

```
<xsd:simpleType name="Node-Name" >
      <xsd:restriction base="xsd:string">
         <xsd:minLength value="1"/>
         <xsd:maxLength value="128"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.56 Data Element: EXT_Node-Delay

Use: External data element taken from TMDD. Delay time for travel along at a particular node.

ASN.1 Representation:

```
Node-Delay ::= INTEGER (0..605000)
```

XML Representation:

```
<xsd:simpleType name="Node-Delay" >
      <xsd:restriction base="xsd:unsignedInt">
         <xsd:maxInclusive value="605000"/>
      </xsd:restriction>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Units: This element is in units of seconds.

Source: ITE TMDD Standard TM1.03, Amendment 1.

7.57 Data Element: EXT_Node-Status

Use: External data element taken from TMDD, which in turn comes from ITIS codes. Node current traffic status or condition that provides an indication of standard or non-standard node operations.

ASN.1 Representation:

```
Node-Status ::= ITIS.ITIScodes (768..1023)
```

XML Representation:

```
<xsd:simpleType name="Node-Status">
   <xsd:union>
      <xsd:simpleType>
         <xsd:restriction base="xsd:unsignedInt">
            <xsd:minInclusive value="768"/>
            <xsd:maxInclusive value="1023"/>
         </xsd:restriction>
      </xsd:simpleType>
      <xsd:simpleType>
         <xsd:restriction base="xsd:string">
            <!-- the following subset of the ITIS codes shall be used -->
            <xsd:enumeration value="closed to traffic"/>
            <xsd:enumeration value="closed"/>
            <xsd:enumeration value="closed ahead"/>
            <xsd:enumeration value="closed intermittently"/>
            <xsd:enumeration value="closed for repairs"/>
            <xsd:enumeration value="closed for the season"/>
            <xsd:enumeration value="blocked"/>
            <xsd:enumeration value="blocked ahead"/>
            <xsd:enumeration value="reduced to one lane"/>
            <xsd:enumeration value="reduced to two lanes"/>
            <xsd:enumeration value="reduced to three lanes"/>
            <xsd:enumeration value="collapse"/>
            <xsd:enumeration value="out"/>
            <xsd:enumeration value="open to traffic"/>
            <xsd:enumeration value="open"/>
            <xsd:enumeration value="reopened to traffic"/>
            <xsd:enumeration value="clearing"/>
            <xsd:enumeration value="cleared"/>
         </xsd:restriction>
      </xsd:simpleType >
   </xsd:union>
   <xsd:annotation>
      <xsd:appinfo>
         closed to traffic (769)
         closed (770)
         -- Hint: use this only for NON road-lane items (such as a rest stop)
         closed ahead (771)
         closed intermittently (772)
         closed for repairs (773)
         closed for the season (774)
         blocked (775)
         blocked ahead (776)
         reduced to one lane (777)
         reduced to two lanes (778)
         reduced to three lanes (779)
         collapse (780) -- Used with bridges and tunnels
```

```
         out (781) -- Used with bridges and roads
         open to traffic (891)
         open (892)
         -- Hint: use this only for NON road-lane items (such as a rest stop)
         reopened to traffic (893)
         clearing (894)
         cleared (895)
      </xsd:appinfo>
   </xsd:annotation>
</xsd:simpleType>
```

Used by: This item is used by the following other data structures in this standard:

DF_RestrictionSet [ASN.1: `RestrictionSet`], and MSG_NetworkConditions [ASN.1: `Network-Conditions`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: See link status code (7.23 through 7.52) for commentary on changes.

Source: Draft ITE TMDD MS/ETMCC revision effort.

7.58 Message: EXT_RoadSideAlert

Use: This message is defined as part of the ATIS effort and is used to send alerts for nearby hazards to travelers. It is only a committee draft at this stage so a more complete definition of use should be sought from the sponsoring SDO at the time of deployment. 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 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 “trail coming” or “ambulances operating in the area.” This message is for the alerting of roadway hazards; not for vehicle cooperative communications, mayday, or other safety applications. It is generally presumed that each receiving device is aware of its own position and heading, but this is not a requirement to receive and understand these messages, nor is having a local base map. The 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 message themselves is represented in a fixed list, similar to the ITIS codes but reflecting the needs of short term alerts. This list is national in scope, never outdated (items can only be added), and does not allow local additions. 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. A delay and duration field provides a gross level for the range 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 hard coded in transmission, that the byte ordering is known and fixed, and therefore no tagging is required to denote internal elements when transmitted.

ASN.1 Representation:

```
RoadSideAlert ::=  SEQUENCE {
    eventMsg     AlertMsgList,
                           -- a list of well known phrase lists
                           -- which explains the type of  the
                           -- alert / danger / hazard involved
                           -- two 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
                           -- messages being sent by the RSU, nor a
                           -- priority of display urgency
                           -- one byte in length
    duration     Duration,
                           -- 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.
                           -- 12 bytes in length
    furtherMsg   ITIS.ITIScode (SIZE(8)),
                           -- 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
    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 known bytes when sent over DSRC media
```

Used by: This item is used by the following other data structures in this standard:

DF_DSRC_UsePlan [ASN.1: `DSRC-UsePlan`].

In addition, this item may be used by data structures in other ITS standards. Implementers are advised to consult the IEEE ITS data registry for the most current information.

Remarks: This message is only a draft as the standard was going to ballot. Confirm the most current adopted definition of this structure before use.

Source: SAE Draft J2354 [B9].

Annex A

(informative)

Using the messages of this standard

This annex will describe which of the messages specified in Clause 5 may be used to transmit each of several commonly transmitted types of information. The 22 example uses are organized in a scenario, though in some cases a particular example use is not an integral part of that scenario. For brevity and focus, that scenario is not a complete description of an incident, but only includes those parts of an incident that would involve the use of the messages specified in this standard. The 22-step scenario is summarized as follows:

— *Step 1:* Law enforcement (LE), upon seeing the announcement of a new incident, asks TMC if there are any work zones in the vicinity.
— *Step 2:* TMC responds that yes, in fact, there is a work zone in the vicinity, and describes it.
— *Step 3:* First to arrive on scene is the fire department (FD), which then assesses the situation and requests local traffic control from TMC and LE, describing the traffic control needs.
— *Step 4:* TMC, receiving that message, immediately requests that LE execute a particular diversion.
— *Step 5:* TMC confers with LE to develop a local traffic control plan, then broadcasts that to all agencies on the IEEE 1512 network.
— *Step 6:* TMC requests a HAR.
— *Step 7:* TMC broadcasts the traffic control plan it will implement for the incident, accounting for the LE plan and over a broader area.
— *Step 8:* Emergency medical services (EMS) requests an ingress route, and signal-light priority on that route.
— *Step 9:* TMC grants EMS a route and signal-light priority on that route.
— *Step 10:* Incident commander (IC) requests the status/location of the dispatched ambulance.
— *Step 11:* EMS responds to that request by informing IC of the status/location of the ambulance, based on its AVL and other internal data.
— *Step 12:* LE identifies a need for traction management in the area around the incident, and polls agencies for that service/asset.
— *Step 13:* TMC responds to that poll with an offer to dispatch an asset to perform that service.
— *Step 14:* LE accepts that offer, asking for that dispatch.
— *Step 15:* TMC broadcasts that it has dispatched the asset to perform that service.
— *Step 16:* When that asset doesn't appear by its ETA, LE asks for the status of that asset.
— *Step 17:* TMC responds with the status of that asset.
— *Step 18:* LE reports to TMC the need to replace a damaged guard rail at the incident.
— *Step 19:* TMC broadcasts its plan for replacing that damaged guard rail.
— *Step 20:* TMC informs LE that it has detected an unauthorized use of signal-light priority by an LE vehicle.
— *Step 21:* LE asks TMC for network traffic conditions on particular parameters for a particular area.
— *Step 22:* TMC responds with those parameters for that area.

The following steps are described first in natural language, then in an illustrative, informal XML rendition. That rendition is not meant to be valid-syntax XML, but simply uses the conventions of XML to illustrate one possible structure of the message. In the XML rendition, the actual data content is indicated by bold text. All the rest of the renditions are labels ("tags") and explanations.

A.1 Step 1: Ask about any nearby work zones

Suppose that LE, upon hearing about a new incident XYZ, as a matter of procedure asks TMC if there are any work zones in the vicinity. It would send the following message to TMC:

RZD Request Zone Data

Interested in work zones active any time from now until 1300.

Area within which LE wants to know about work zones: within one-half mile of incident XYZ.

(The location of that incident is specified in the Basics data frame that is part of the IDX and New Incident Event (NIE) messages that have already been sent.)

XML Rendition:

```
<RequestWorkZoneData>
    <onlyActive> False </onlyActive><!-- False = don't return only currently active -->
       <!-- incidents.  Instead return those active in a time period bounded as: -->
    <whenStart></whenStart><!-- Since whenStart is blank, that time period -->
                                <!-- starts at the time of this message. -->
    <whenStop>                  <!-- EXT_DateTimePair -->
       <time> 130000 </time>    <!-- time period to search ends at 1300 today. -->
                  <!-- implementation sets unspecified time offset = local time>
    </whenStop>
    <where>                               <!-- DF_LRMS -->
       <profile> GeometryProfile </profile><!-- within that profile, specify: -->
                                <!-- circle, half-mile radius from the incident -->
    </where>
</RequestWorkZoneData>
```

A.2 Step 2: Describe a nearby work zone

TMC responds to the RZD message just described with:

WZD Work Zone Data:

There is one work zone in the requested area.

That work zone has been previously described as road closure 123.

Because of differences between that previous description and the current situation, the work zone is described here in terms only of the data that needs updating: parking lane and second lane of EB Jackson St. between A and B are closed, for the entire block, with coned taper, arrowboard, unstaffed, closed from now until 6 AM April 2; digital graphic overhead depiction of work zone.

XML Rendition:

```
<WorkZoneData>
    <eventID> 123 </eventID><!-- Previously described as 123.  Updated here below. -->
    <currentlyActive> True </currentlyActive>
    <description>   <!-- ATIS.EventInformation.  Previous description as 123 covers -->
                    <!--    all event info except updates as follows: -->
              <!-- startTime not necessary since the work zone is currently active. -->
       <clearTime>
              <date> 20020402 </date><!-- April 2, 2002 -->
              <time> 060000 </time><!-- 6:00 am -->
       </clearTime>
       <laneData>
              <laneSelect> 11 </laneSelect>
                                <!— both lanes affected in the following way: -->
              <condition> blocked </condition><-- ITIS Code -->
              <furtherInfo> unstaffed, coned taper, arrowboard </furtherInfo>
       </laneData>
    </description>
    <graphicOverview> 63.210.62.123 </graphicOverview> <!-- URL for graphic of zone.-->
</WorkZoneData>
```

A.3 Step 3: Request traffic control

First to arrive on scene is the FD, which then assesses the situation and requests local traffic control from TMC and LE, describing the traffic control needs, using the message:

RTC Request Traffic Control Plan

Incident is blocking both EB lanes of Jackson.
EB cars attempting to get around incident are causing WB cars to stop, backing up WB Jackson.
Traffic turning on to Jackson from NB A has backed up and is now blocking NB A.
Contact information for on-scene POC: role, human-readable rank/name, network and radio addresses.

Note that this is a description of the problem, not a recommendation of what traffic control to engage.

XML Rendition:

```
<ReqTrafficControlPlan>
    <conditions> A St. lane blocked because of right turners onto Adams </conditions>
    <sceneSketch> 63.210.62.123 </sceneSketch><!-- URL for graphic of zone. -->
    <laneConditions>
       <laneLocation><!-- EXT_LRMS. Here = GPS location of lane: EB Adams bet A,B. -->
              <profile> geocoordinate </profile>
                     <longitude> -122,094,340 </longitude>
                     <latitude> +37,402,778 </latitude>
       </laneLocation >
       <laneDescription>
              <laneSelect> 11 </laneSelect><!—Both lanes affected in following way:-->
              <condition> blocked </condition><!-- ITIS code -->
       </laneDescription>
       <laneLocation><!-- EXT_LRMS. Here = GPS location of lane: WB Adams betw A,B -->
              <profile> geocoordinate </profile>
                     <longitude> -122,094,340 </longitude>
                     <latitude> +37,402,779 </latitude>
       </laneLocation >
       <laneDescription>
              <laneSelect> 10 </laneSelect><!—Cntng from median, 1st lane affected:-->
              <condition> blocked </condition><!-- ITIS code -->
       </laneDescription>
       <laneLocation><!-- EXT_LRMS. Here = GPS loc’n of lane: NB A St S of Jackson -->
              <profile> geocoordinate </profile>
                     <longitude> -122,094,345 </longitude>
                     <latitude> +37,402,779 </latitude>
       </laneLocation >
       <laneDescription>
              <laneSelect> 01 </laneSelect><!—Cntng from median, 2nd lane affected:-->
              <condition> blocked </condition><!-- ITIS code -->
       </laneDescription>
    </laneConditions>
    <onSceneContact> IC FD Cmdr Jim Smith FD107 </onSceneContact>
       <!-- Note that can be role (IC), agency, rank/name, and network address -->
    <radioContact> FD207 </radioContact>
       <!—Radio address of onSceneContact, loaded and understood by comm. system. -->
</ReqTrafficControlPlan >
```

A.4 Step 4: Additional request traffic control

TMC receives that message and, based on its knowledge of traffic patterns and the current network conditions, immediately requests that LE divert traffic to a particular route, using another RTC message:

RTC Request Traffic Control Plan

Divert EB Adams traffic at A to one block south via A then back via B.
Block any attempts to turn onto EB Adams from NB or SB A.

XML Rendition:

```
<ReqTrafficControlPlan>
    <conditions> Divert EB Adams traffic at A to one block south via A.
              Block any attempts to turn onto EB Adams from NB or SB A.</conditions>
</ReqTrafficControlPlan >
```

A.5 Step 5: TMC broadcasts a local traffic control plan

TMC then formulates a local traffic control plan, in concert with LE, exchanging messages similar to the TCP message presented in this step. After the plan is completed, TMC broadcasts that plan to the IEEE 1512 network using the message:

TCP Description of Traffic Control Plan

Both EB lanes of Adams to be closed at A, immediately, by LE officers.
Detoured one block south via A then back via B.
Those and other officers directing SB and NB A-St. traffic trying to turn onto EB Adams to continue on A.
Ingress WB Adams from B, and by permission from A, but not advised.
TMC requests HAR advising all traffic avoid the area (that request handled in a separate message—see Step 6).

XML Rendition:

```
<TrafficControlPlan>
    <specialInstructions> LE close EB Adams at A, immediate.  Those and other LE
       directing SB and NB A-St. traffic trying to turn onto EB Adams to continue on A.
    </specialInstructions>
    <laneConditions>
       <laneLocation><!-- EXT_LRMS. Here = GPS loc'n of lane: EB Adams St. Btw A,B. -->
              <profile> geocoordinate </profile>
                     <longitude> -122,094,340 </longitude>
                     <latitude> +37,402,778 </latitude>
       </laneLocation >
       <laneDescription>
              <laneSelect> 11 </laneSelect><!-- Both lanes affected following way: -->
              <condition> blocked </condition><!-- ITIS code -->
       </laneDescription>
    </laneConditions>
    <onSceneContact> IC PD LEO Jack Jones PD112 </onSceneContact>
              <!-- Note that this signals a change in IC. -->
              <!-- System can detect first two characters and check for role change.-->
    <radioContact> PD212 </radioContact>
       <!—Radio address of onSceneContact, loaded and understood by comm. system. -->
    <impactSummary>   <!-- IDX submessage, used here to describe detour. -->
```

```
        <routeSets> 176, 233, 173 </routeSets><!-- Describes detour. -->
                <!— Sequence of link numbers specifies: -->
                <!—SB A one block to Jefferson, EB Jefferson to B, NB B back to Adams -->
                <!—System GUI etc. can make loading and reading links user friendly. -->
    </impactSummary>
    <harUse>          <!—Describes HAR request, which is sent by following message. -->
        <targetDevice>
                <who> TMC </who>
        </targetDevice>
        <requestedAction> immediate </requestedAction>
        <suggestedPhrase> Avoid area within two blocks of Adams and A. Severe congestion
                            until 4 pm. </suggestedPhrase>
        <messageEndPoint>
                <time> 160000 </time>     <!-- HAR broadcast to end at 1600 today. -->
        </messageEndPoint>
    </harUse>
    <relatedMsgs> 175, 176 </relatedMsgs><!-- ID# of RouteAdvice mssg re ingress rt.-->
</TrafficControlPlan>
<RouteAdvice><!-- Message called out by relatedMsgs re "175." -->
    <routeName> Ingress to 123 </routeName>  <!-- Name serves to ID route type. -->
                                    <!-- 123 = incident number, lifted from Header. -->
    <route> 236 </route>            <!-- WB Adams from B. -->
</RouteAdvice>
<RouteAdvice><!-- Message called out by relatedMsgs re "176." -->
    <routeName> Notadvised Bypermission Ingress to 123 </routeName>
                                    <!-- Name explains route type. -->
    <route> 235 </route>            <!-- EB Adams from A. -->
</RouteAdvice>
```

A.6 Step 6: Request a HAR

TMC requests HAR using an asset management message:

AFA Ask For Assets

Not a poll for assets. This is a direct request for the asset.
Asking for an HAR message for broadcast over the city.
Stating: “Avoid area within two blocks of Adams and A. Severe congestion until 4 PM.”
Run it immediately and until 4 PM.

XML Rendition:

```
<RequestPhysicalAsset>
    (pollOnly> False </pollOnly>     <!-- This message asks for a "dispatch." -->
    <wantsManagement> False </wantsManagement>      <!-- Management to stay with TMC. -->
    <request> byType </request>      <!-- Sets list used to lists in AssetDescription -->
        <desc>                       <!-- No "count" field => asking for one "asset." -->
                <roadsideType> har </roadsideType>
        </desc>
    </request>
    <harUse>                         <!—Describes HAR request. -->
        <targetDevice>
                <who> TMC </who>
        </targetDevice>
        <requestedAction> immediate </requestedAction>
        <suggestedPhrase> Avoid area within two blocks of Adams and A.  Severe congestion
                            until 4 pm. </suggestedPhrase>
        <messageEndPoint>
                <time> 160000 </time>        <!-- HAR broadcast to end at 1600 today. -->
```



```
        </messageEndPoint>
    </harUse>
</RequestPhysicalAsset>
```

A.7 Step 7: Broadcast TMC's traffic control plan

TMC also formulates its "less-local" traffic control plan to manage the incident, and broadcasts that plan using the same kind of TCP message:

TCP Description of Traffic Control Plan

Implementing system-wide signal timing plan AA for network subarea C, favoring EW > NS traffic.
Designate a VMS message: at Adams at A to divert traffic away from EB Adams.

XML Rendition:

```
<TrafficControlPlan>
    <trafficPlanType> system-plan </trafficPlanType>
                                          <!-- TMDD.Event-response-plan-type. -->
    <trafficPlanNumber> AA </trafficPlanNumber>
                                          <!-- TMDD.Event-response-plan-identifier. -->
    <conditions> for Subarea C.  Favors EW over NS. </conditions>
    <vmsUse>
        <targetDevice>
               <who> TMC </who>
               <what> TMCVMS101 </what>
        </targetDevice>
        <requestedAction> immediate </requestedAction>
        <suggestedPhrase> (As necessary to divert traffic away from EB Adams.)
        </suggestedPhrase>
        <messageEndPoint>
               <time> 160000 </time>         <!-- VMS display to end at 1600 today. -->
        </messageEndPoint>
    </vmsUse>
</TrafficControlPlan>
```

Note that the location of the VMS if it is fixed, or the dispatch of the VMS if it is portable, is handled in other messages. If the VMS is fixed, its location is either known to the TMC as a TMC asset, or if it is managed by another agency, its location and availability can be known to the TMC by use of previous TMDD messages. If the VMS is portable, its location, availability and management can be ascertained and secured using the asset management messages specified in this volume.

A.8 Step 8: Request an ingress route and signal priority on that route

Suppose now that EMS is to dispatch an ambulance to the site. It may request route advice from TMC. It may also request signal priority for that route. It requests both things from TMC with the message:

RRA Request Route Advice

Vehicle:	Vehicle ID: EMS102 Vehicle Type/Subtype: Ambulance/ALS (can be automatically set from ID). Limitations: None. Reason: To remove injured to hospital.
Origin:	Station EMS-A.
Destination:	Incident site.

Time:	Immediately, for duration of travel.
Request Priority:	Yes.
Reason f Priority:	Urgency due to medical condition of injured.

XML Rendition:

```
<RequestRouteAdvice>
    (vehicleID> EMS202 </vehicleID>  <!-- Vehicle ID tells the system: ALS Ambulance. -->
    <rationale> Remove injured to hospital. </rationale>
    <origin>          <!-- EXT_LRMS. Here = GPS location of cruising ambulance. -->
       <profile> geocoordinate </profile>
       <longitude> -122,094,340 </longitude>       <!-- 122 deg  5’ 40" West. -->
       <latitude> +37,402,778 </latitude>          <!--  37 deg 24’ 10" North. -->
    </origin>
    <destination> incident </destination>          <!-- EXT_LRMS overridden by known -->
       <!-- location. Here incident loc known by Basics message already broadcast. -->
    <whenStart></whenStart>   <!-- blank = run to start immediately. -->
    <whenEnd></whenEnd>       <!-- blank = run to end in (default value) = 30 minutes. -->
    <reqPriority> 1 </reqPriority>   <!-- request priority, arguing for top priority. -->
    (priRationale> Life/death severity of injuries. </priRationale>
                      <!-- Implementation can agree on a standard set of phrases. -->
</RequestRouteAdvice >
```

A.9 Step 9: Offer route advice and grant signal priority on that route

TMC responds to an RRA using:

ORA Offer Route Advice

This is a response to RRA message xyzw (so all data there applies here, e.g., vehicle ID).
Route advised: Cotton – Coltrain – Skaggs – Carter – Lennon – B – Adams.
Priority granted for advised route.
Priority Technology: Toxycon; passcode = xyzwstuv

As before, any data that is the same as the request, e.g., time, does not need to be filled in.

XML Rendition:

```
<RouteAdvice>
    <requestorIdent> 121 </requestorIdent>
    <route> 123,243,587,389,073,173,236 </route>    <!-- Specified by link numbers. -->
    <requestGrant> grant </requestGrant>
    <signalTechnology> Toxycon </signalTechnology>
    <secString> xyzwstuv </secString>
</RouteAdvice >
```

A.10 Step 10: Request status/location of an asset

Now suppose the ambulance has not arrived by its ETA (which was specified in the IDX Assigned-Resource submessage describing its dispatch). The IC is concerned and requests the status/location of the ambulance from EMS headquarters (HQ) using a request message designed in particular for vehicles using priority/pre-emption technology:

RLP Request Preemption User Data

Passcode certifying that requester is authorized for the information: xyqwust
Vehicle ID: EMS202

Assigned-Resource submessage would also describe the vehicle, and is a data frame for this message, but is not necessary if the vehicle ID is known.

XML Rendition:

```
<RequestPreemptionUserData>
    <password> MalteseFalcon </password>
    <vehicleID> EMS202 </vehicleID>
</RequestPreemptionUserData>
```

A.11 Step 11: Provide status/location information for an asset

The EMS HQ, we might suppose, keeps track of its ambulances with AVL, or simply by voice query/answer. It can respond to the RLP with:

LPI Location/Priority/Preemption Information

RLP message to which this is in response: RLP-12546.
Vehicle location: lat = 37.512345, long = 122.152345; 80% confidence = 300m.
Priority technology: Toxycon.
This vehicle currently associated with incident #: XYZ.
This vehicle is authorized to use the priority technology: Yes.

Vehicle ID and the Assigned-Resource submessage are DE/DFs in this message as alternative ways to describe the vehicle, but aren't necessary if the RLP message to which this is in response is specified.

XML Rendition:

```
<PreemptionUserData>
    <respondingTo> RLP-12546 </respondingTo> <!-- Responding to mssg of Step 10. -->
                                    <!-- Specifying which mssg this responds to. -->
                                    <!-- Removes need to include repeated information.-->
                                    <!-- Handled by communication system, not a DE -->
    <password> MalteseFalcon </password>
    <assignedResourcesSubmessage>
        <currentLoc><!-- EXT_LRMS. Here = GPS location of en route ambulance. -->
                <profile> geocoordinate </profile>
                <longitude> -122,094,860 </longitude><!-- 122 deg  5′ 41" West. -->
                <latitude> +37,402,930 </latitude>   <!--  37 deg 24′ 11" North. -->
        </currentLoc>
        <eta>
                <time> 130000 </time>
        </eta>
        <route> 123,243,587,389,073,173,236 </route> <!-- Specified by link numbers. -->
    </assignedResourcesSubmessage>
    <technology> Toxycon </technology>
    <relatedEvent> 123 </relatedEvent>
                                <!-- The incident with which the ambulance is involved. -->
    <authorizationValue> Yes </authorizationValue>
                <!-- This ambulance is authorized to use the preemption technology. -->
</PreemptionUserData>
```

A.12 Step 12: Poll for an asset or service

Suppose that there are icing conditions, which make the incident site hazardous. LE identifies a need for traction management, and polls agencies for that service with:

AFA Ask for Assets

Poll vs Request: Poll, i.e., this message is asking only for availability—don't dispatch in response.
Request: Traction management.
What is required: Icing conditions, some patches of ice.
Intended time of use: Immediate.
Location: Incident XYZ and surrounding 300 meters.
Management of asset: Providing agency manages.
Details of how service provided: Just come, survey the situation, and start in.

Note that this message allows the requesting agency to simply state the need, and leaves it to the polled agency to figure out the best way to respond to that need.

XML Rendition:

```
<RequestPhysicalAsset>
    (pollOnly> True </pollOnly>              <!-- This message is a poll; -->
                                             <!-- it does not ask for a "dispatch." -->
    <wantsManagement> False </wantsManagement>
                                             <!-- Management to stay with provider. -->
    <request> byKind </request>              <!-- Sets list to use. -->
        <text> traction management </text>
    </request>
    <intendedUse> ice build up, icy patches, traffic congestion </intendedUse>
                            <!-- Allows requester to describe the problem, -->
                            <!-- so that provider can suggest a solution. -->
    <whenStart></whenStart>   <!-- Blank indicates asset/service desired immediately. -->
    <whenEnd>
        <time> 130000 </time>
    </whenEnd>
    <miscText> Incident and surrounding 300 meters. </miscText>
        <!-- Location of incident known from Basics. -->
</RequestPhysicalAsset>
```

A.13 Step 13: Respond to a poll for an asset or service

TMC Yard Z receives the above poll, identifies the required asset, and responds with:

RPA Respond to Poll for Assets

Asset: Sand truck, ID = ST101, located at Yard ZZ.
Availability: Yes, immediately, for duration of need.

This message can specify management and how service provided, but those are both in agreement with the poll, and so not filled in.

XML Rendition:

```
<PhysicalAssetStatus>
    <respondingTo> 125 </respondingTo>       <!-- Responding to message of Step 12. -->
                                    <!-- Handled by communication system, not a DE -->
    <assetChoices>
        <assetHandle> Jim's usual sand truck. </assetHandle>
        <assetDescription>
               <status> readyForUse </status>
               <vehicleType> sand truck </vehicleType>      <!-- ITIS phrase. -->
        </assetDescription>
        <assetNum> ST101 </assetNum>
        <timeFrameEnd>
               <time> 180000 </time>
        </timeFrameEnd>
        <!-- Yard must have this asset available for other uses as of 6 pm tonight. -->
        <currentLocation> Yard ZZ </currentLocation>
        <!-- Implementation can agree to names of locations, rather than lat/long. -->
        <etaToReady> immediate </etaToReady>
    </assetChoices>
</PhysicalAssetStatus>
```

A.14 Step 14: Ask for a dispatch of an asset or service

Perhaps LE received more than one response to its poll, from two different TMC equipment yards. It decides on Yard ZZ, based on its earlier ETA, and so now accepts that offer to dispatch, i.e., it asks TMC Yard ZZ to dispatch with:

AFA Ask for Assets

Poll vs Request: Request, i.e., please dispatch.

The information in all other fields in this message remain unchanged, and so are left blank.

XML Rendition:

```
<RequestPhysicalAsset>
    <respondingTo> 126 </respondingTo>       <!-- Responding to message of Step 13. -->
                                    <!-- Handled by communication system, not a DE -->
    (pollOnly> False </pollOnly>     <!-- This message is a request for a dispatch. -->
</RequestPhysicalAsset>
```

A.15 Step 15: Announce a dispatch of an asset or service

TMC Yard ZZ responds to the above request by dispatching sand truck ST101. It simply issues an Assigned-Resources submessage of an IDX.

XML Rendition:

```
<Assigned-Resources>  <!-- Assigned-Resources submessage of Base Standard's IDX. -->
    <dispatcherID> TMZZ101 </dispatcherID>
    <resource>
        <respUnitID> ST101 </respUnitID>
        <desc>
               <status> inRouteToUse </status>
               <vehicleType> sand truck </vehicleType>      <!-- ITIS phrase. -->
        </desc>
```

```
<currentLoc>   <!-- EXT_LRMS. Here = GPS location of en route sand truck. -->
               <profile> geocoordinate </profile>
               <longitude> -122,094,112 </longitude><!-- 122 deg  5′ 39" West. -->
               <latitude> +37,402,215 </latitude>    <!--  37 deg 24′ 8" North. -->
       </currentLoc>
       <destinationLoc> Incident </destinationLoc>  <!-- Inc location in Basics -->
       <eta> 160000 </eta>
    </resource>
</Assigned-Resources>
```

A.16 Step 16: Ask for asset status

Now suppose the sand truck doesn't appear by its ETA. The IC, concerned and irritated, asks for the status of that asset with:

RAS Request Asset Status

Password (certifying that the sender is authorized to receive this information): xyzw
Asset ID: ST101

Note that this message fulfills a role similar to the RLP Request Location/Priority/Preemption Information message in A.10. This message is different in that it is oriented simply to asset management, and calls for a response targeted to asset management, not to the tracking of priority/preemption use.

XML Rendition:

```
<RequestPhysicalAssetStatus>
    <assetNumber> ST101 </assetNumber>
    <securityKey> xyzw </securityKey>
</RequestPhysicalAssetStatus>
```

A.17 Step 17: Respond to a request for asset status

The TMC receives the above request and responds with:

AST Asset Status

RAS message to which this is in response: 128
Encryption string if that is necessary for this secure exchange: xyzwsuv
Asset ID: ST101
Location status: en route, ETA = 4:00 (Note that this ETA is later than the one specified in the asset management exchange, in the RPA message in Step 13.)
Location: lat = 37.402215, long = -122.094112.
Team Manager: communication location address HASTERT.
The other information of this message format, operational plan and current operation, doesn't apply and so is left blank.

XML Rendition:

```
<Assigned-Resources>  <!-- Assigned-Resources submessage of Base Standard's IDX. -->
    <respondingTo> 128 </respondingTo>       <!-- Responding to message of Step 16. -->
                                    <!-- Handled by communication system, not a DE -->
    <resource>
        <assetNum> ST101 </assetNum>
        <desc>
               <status> inRouteToUse </status>
               <vehicleType> sand truck </vehicleType>      <!-- ITIS phrase. -->
        </desc>
        <currentStat> en route </currentStat><!-- proposed ITIS phrase. -->
        <currentLoc>   <!-- EXT_LRMS. Here = GPS location of en route sand truck. -->
               <profile> geocoordinate </profile>
               <longitude> -122,094,112 </longitude><!-- 122 deg  5' 39" West. -->
               <latitude> +37,402,215 </latitude>   <!--  37 deg 24' 8" North. -->
        </currentLoc>
        <destinationLoc> Incident </destinationLoc>  <!-- Inc location in Basics -->
        <eta> 160000 </eta>
        <comment> Asset POC = Driver TMC Dr John Jones TM304.  radioAddr = TM404
        </comment>
    </resource>
</Assigned-Resources>
```

A.18 Step 18: Report a need for cleanup or infrastructure repair

Suppose LE notes that a guard rail has been damaged and clearly needs replacement. It sends this message to TMC:

NCI Need for Cleanup, Infrastructure Repair

Location: At incident 123 (i.e., once you're on site, it will be obvious where the item is).
Infrastructure Unit: Guard rail.
Unit ID: Unavailable.
Needing what: Replacement.
By when: ASAP.
Time problem observed: During incident 123.
Person reporting: Communication location address LOTT.
Effects/urgency: Urgent: blocks sidewalk.
Have marked off with yellow CAUTION tape, but must leave it unstaffed.

XML Rendition:

```
<InfrastructureReport>
               <!-- That is, report on need for cleanup, infrastructure repair. -->
    <repairText> Guard rail section Type C3 replacement </repairText>
    <where> Incident </where>               <!-- Inc location in Basics -->
    <timeObserved>
               <date> 20020402 </date>      <!-- April 2, 2002 -->
               <time> 120000 </time>        <!-- noon -->
    </timeObserved>
    <reportedBy>
        <role> employee of public safety agency </role>
                           <!-- This list to be improved in revised Base Standard. -->
        <last> Smith </last>                <!-- details in POC data structure. -->
        <first> John </first>
    <pointOfContact> Wt PD LEO John Smith PD289 </pointOfContact>
    <urgency> 4 </urgency>    <!-- On a scale 1-5 developed by implementation. -->
</InfrastructureReport>
```

A.19 Step 19: Broadcast a cleanup or infrastructure repair plan

The TMC should respond to the above request with its plan for repair. The same message could be broadcast at any time the TMC has developed such a plan and needs to inform the rest of the IEEE 1512 network of that plan. The message:

CRP TMC Cleanup, Infrastructure Repair Plan

Location: Specified by incident number.
What: A standard truck to replace guard rail.
Time: April 3, 2002, noon to 5:00 PM.
Point Of Contact: Jim Jones.

XML Rendition:

```
<ClearOrRepairPlan>
    <responsePlanID> 123rail </responsePlanID>
    <responsePlanType> manual input </responsePlanType>
    <issuingCenter> TMC </issuingCenter>
    <eventID> 123 </eventID>          <!-- ID of incident associated with repair. -->
    <repairPlan>
        <actions> (0) freeText: remove damaged guard rail section, install new Type C3
                        guard rail, file insurance claim per procedure ADF. </actions>
        <whenStart>
                <date> 20020403 </date>       <!-- April 3, 2002 -->
                <time> 120000 </time>         <!-- noon -->
        </whenStart>
        <whenEnd>
                <date> 20020403 </date>       <!-- April 3, 2002 -->
                <time> 170000 </time>         <!-- 5:00 pm -->
        </whenEnd>
    </repairPlan>
    <pointOfContact> Fm TM TE Jim Jones TM127 </pointOfContact>
</ClearOrRepairPlan>
```

A.20 Step 20: Inform of an unauthorized use of priority/preemption

Different local implementations can have different arrangements and abilities to detect unauthorized use of priority/preemption. In this case, we suppose that the TMC can detect use of the priority/preemption technology and, being the agency that grants that use, has the records to compare to detect whether that use is authorized or not. The TMC will log that violation in its own records for its own action in the future, but as that is within-agency, that does not involve IEEE 1512 communication. We also suppose that violations are to be reported in real time to the agency of the violating vehicle. At least two modes of use are anticipated: 1) if the preemption technology can detect the vehicle ID, then violations can be reported directly to that vehicle's agency; and 2) if the preemption technology cannot detect the vehicle ID, then violations can be broadcast to all agencies with vehicles capable of using that technology. In either case, that reporting would use the message:

LPI Location/Priority/Preemption Information

Vehicle ID: PD105

Vehicle location: Adams at C [supposing TMC knows location by which light is triggered. It could send such a message (automatically) each time a new light is triggered].

Priority Technology: Toxycon.

Incident with which this vehicle is associated: No known association.

Flag: Unauthorized use, i.e., TMC never granted this vehicle use of the priority technology.

XML Rendition:

```
<PreemptionUserData>
    <vehicleID> PD105 </vehicleID>   <!-- This scenario assumes TMC can detect -->
        <!-- vehicle ID from the preemption system.  If not, TMC can broadcast this -->
        <!-- message for any detected unauthorized preemption use to all agencies with -->
        <!-- vehicles that could use it. -->
    <assignedResourcesSubmessage>
        <resource>
                <currentLoc>   <!-- EXT_LRMS. location of preemption system receiver. -->
                        <profile> geocoordinate </profile>
                        <longitude> -122,094,860 </longitude>
                        <latitude> +37,402,930 </latitude>
                </currentLoc>
        </resource>
    </assignedResourcesSubmessage>
    <technology> Toxycon </technology>
    <authorizationValue> No </authorizationValue>
        <!-- PD105 is not authorized to use this preemption technology here, now. -->
</PreemptionUserData>
```

A.21 Step 21: Ask for network traffic conditions

Suppose that LE wants to know traffic conditions in the area around the incident. It can ask TMC for those with:

RNC Request Network Conditions

Area of interest: One-mile radius around incident.

Parameters requested: LE standard (assume LE has a pre-arranged set of parameters it is always interested in, such as lane-by-lane speed, lane occupancy, pavement conditions, and weather).

Time period: Now, and any projections for next hour.

XML Rendition:

```
<RequestNetworkConditions>
    <focus> CHOICE:  lrms                    <!-- Use LRMS as opposed to routes. -->
        <profile> GeometryProfile </profile> <!—- within that profile, specify: -->
                                    <!-- circle, one-mile radius from the incident -->
    </focus>
    <summary> True </summary>                <!-- Request summary statistics, also. -->
    <whenEnd>
        <time> 130000 </time> <!-- Keep sending those conditions from now until 1 pm. -->
    </whenEnd>
</RequestNetworkConditions>
```

A.22 Step 22: Respond to request for network traffic conditions

The TMC would then respond to that request with:

NWC Network Conditions

A pre-arranged file in a pre-arranged format, meeting the specifications of the RNC message. This would make use of TMDD, TCIP and ATIS messages.

Annex B

(informative)

Recommended local ITIS codes

Informative advice is given for those deploying systems meeting this standard and wishing to extend the ITIS codes which are used throughout the standard to relate data concepts. The ITIS codes are often “strung together” to form a natural language-like data concept. Provisions are made in the encoding of these lists to allow local deployment to add additional items as needed. This allows local refinement of the codes, and also provides an orderly way for the national standards making groups to consider the elements added by a local deployments for inclusion in the national ITIS list when reballoting occurs. System developers should consult the Incident Management Guide to IEEE 1512 Standards [B5] and SAE J2540 for details of use of these codes within messages.

The following local use items are recommended to be added to the ITIS lists when deploying an IEEE 1512.1 system. Other codes are also likely to be added in the local deployment range (128 to ~255 in most of the sublists) and systems deployments must locally decide what codes are to be used in addition to the national standardized ones. Over time some of these codes will be added to the national list and at that time, should be removed from the local listings. Bear in mind that locally determined extensions will likely not be understood by others outside the deployment. If mutual aid systems with other regions will be using these codes, this can become a concern.

It is recommended that the following items be added to the denoted sublisting of the ITIS codes, with the values listed and that any additional local code entries be placed after these codes. The value of the lower byte is provided for readability, but of course the actual encoding value would combine this value with the value of the sublisting group itself [for example the enumeration value transmitted for “crack” would be 128 + (4 * 256) or 1152].

Table B.1—Recommend additional ITIS codes to be used

Subgroup	Item	Value	Comment
To the subgroup referred to as: Roadwork add:			
	Crack(s)	128	Used for disjoint roadway surface.
	Bump(s)	129	
	Storm drain	130	
	Overgrown grass	131	
	Overgrown brush/shrubs	132	
	Overgrown trees	133	
	Crack(s)	134	Used for disjoint roadway surface.
	Dropoff	135	
To the subgroup referred to as: Device and Equipment status:			
	Manhole cover	128	
	Sign down	129	

Table B.1—Recommend additional ITIS codes to be used *(continued)*

Subgroup	Item	Value	Comment
	Lines in road faded	130	
	Damaged light standard	131	Used for all forms of pole/support damage.
	Traffic signal stuck on flash	132	
	Guide rail	133	Used for barriers as well.
	Fencing	134	
	Light standard hanging by wires	135	
	Call box	136	
	Signal cabinet	137	Use for all type of equipment cabinets.
	Detector	138	All forms of vehicle detectors.
	Improper use of state vehicle/equipment	139	
	Bulb out	140	
	Not yet operational	141	When installed but not yet brought online for use by the system.
	Not yet installed	142	When planned.
	Missing	143	Use “sign down” if an object is damaged (or use “damaged”) and could be returned to service, use “missing” only if an object is in fact missing.
To the subgroup referred to as: Qualifiers add:			
	Damaged	128	
	Out of order	129	
	Vandalism	130	
	On state right of way	131	
	Graffiti	132	
	Found property	133	
To the subgroup referred to as: Visibility add:			
	Visibility blocked	128	Used when signs, trees, etc., block view.
To the subgroup referred to as: Obstructions add:			
	Overgrown tree(s)	128	
	Tree limb(s)	129	
	Utility pole down	130	
	Advertising signs	131	Used for illegal signage as well.
To the subgroup referred to as: Responder Group Effected add:			

Table B.1—Recommend additional ITIS codes to be used *(continued)*

Subgroup	Item	Value	Comment
	Freeway service patrols	128	
To the subgroup referred to as: Incident Response Equipment add:			
	Dump truck	128	
	Supervisor vehicle	129	

This standard defines and proposes two new list categories, that of asset statues and of roadside assets. These are defined in the prior clauses of this standard, but it is the intention of the committee to request that they be integrated with the other entries of ITIS when it is next revised along with the entries in Table B.1. On the presumption that this will occur at a future date, these two list categories have been numbered such that they would fit with and become sub ranges for groups 40 and 41, that is, with enumeration values from (10240..10495) and (10496..10751), respectively. With this step, early deployments will not have to revise their own numbering use when the tables are added.

Annex C

(normative)

Use of the standard with XML

In Table C.1, definitive advice is given regarding the naming to be used of the tags for each data frame and message when XML is employed. The conversion rules for translation from ASN.1 to XML shall be as per SAE J2540. The results of applying these rules is presented for the data element in Clause 6 and in Clause 7. Similar advice for the more complex data structures of Clause 5 is not available at this time but can be developed by following the same rules and using the tags given below.

The proper use and nesting of these tags in messages shall follow both the ASN.1 developed in this and the base standard document and the rules for XML use cited in the documents listed in Clause 2 of this standard. The ordering of elements found in data structures expressed in XML shall follow that order specified in the ASN.1 source listing provided in prior clauses. Notably the “optional” keyword in ASN.1 shall imply that the XML tags and content may also be optional in transmitted messages. In order to ensure interoperation with others, the rendering of phrases and codes into XML found in IEEE 1512 technology (both the ITIS code and others) must also be agreed upon by implementers. In order to successfully interoperate with other deployments using XML in this way a number of other issues must also be considered and agreed upon. These are beyond the scope of this standard.

Table C.1 provides the XML tags used by data frames and by messages. Each of these complex structures is in turn made up of other data frames or data elements (each of which also have tags). The lowest level of this hierarchy is the atomic data elements. The data element tags and the format used for their content is provide in Clauses 6 and Clause 7 for elements defined or first used in this standard. Elements taken from the rest of the IEEE 1512 family of standards follow similar formats.

Table C.1—XML tags for data frames and messages

Name	XML tag
DF_AssetDescription	AssetDescription
DF_CleanUpPlan	CleanUpPlan
DF_DSRC_UsePlan	DSRC-UsePlan
DF_HAR_UsePlan	HAR-UsePlan
DF_LaneDescriptions	LaneDescription
DF_RepairPlan	RepairPlan
DF_RestrictionSet	RestrictionSet
DF_Tail	TailSet
DF_VehicleSummary	VehicleSummary
DF_VMS_UsePlan	VMS-UsePlan
MSG_Assigned-Resources	Assigned-Resources

Table C.1—XML tags for data frames and messages *(continued)*

Name	XML tag
MSG_ClearOrRepairPlan	ClearOrRepairPlan
MSG_InfrastructureReport	InfrastructureReport
MSG_NetworkConditions	NetworkConditions
MSG_PhysicalAssetStatus	PhysicalAssetStatus
MSG_PreemptionUserData	PreemptionUserData
MSG_ReqTrafficCntrlPlan	ReqTrafficControlPlan
MSG_RequestNetworkConditions	RequestNetworkConditions
MSG_RequestPhysicalAsset	RequestPhysicalAsset
MSG_RequestPhysicalAssetStatus	RequestPhysicalAssetStatus
MSG_RequestPreemptionUserData	RequestPreemptionUserData
MSG_RequestRouteAdvice	RequestRouteAdvice
MSG_RequestWorkZoneData	RequestWorkZoneData
MSG_RouteAdvice	RouteAdvice
MSG_TrafficCntrlPlan	TrafficControlPlan
MSG_WorkZoneData	WorkZoneData

At this time, an XML schema is not available to represent the complete ASN.1 encoding of this standard. It is envisioned that such a document will be produced as a function of the next revision of the base standard and will at that time include listing for content covered in this standard.

Annex D

(informative)

Bibliography

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[B4] IEEE P1512.2™, Draft Standard for Public Safety Incident Management Message Sets for Use by Emergency Management Centers.[11]

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[B6] *Merriam-Webster's Collegiate® Dictionary, Tenth Edition*.[13]

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[B9] SAE Draft J2354, Revision to SAE J2354, Message Sets for Advanced Traveler Information System (ATIS), November 1999.[16]

[9]Available from the World Wide Web at the following Web site: http://www.asn1.elibel.tm.fr.

[10]Available from the World Wide Web at the following Web site: http://www.nas.edu/trb/.

[11]This IEEE standards project was not approved by the IEEE-SA Standards Board at the time this publication went to press. For information about obtaining a draft, contact the IEEE at http://standards.ieee.org.

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