



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

Intelligent Transportation Systems Committee

Sponsored by the
IEEE Vehicular Technology Society

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

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**Intelligent Transportation Systems Committee
of the
IEEE Vehicular Technology Society**

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IEEE-SA Standards Board

Abstract: This standard addresses the exchange of vital data about public safety and emergency management issues involved in transportation-related events, through common incident management message sets. The message sets specified are consistent with the National Intelligent Transportation Systems Architecture and are described using Abstract Syntax Notation One ("ASN.1" or "ASN") syntax. This standard comprises the basic volume of the family of incident management standards, a multi-volume set of documents centered around this Base Standard. Other members of that family include three other companion volumes, specifying incident management message sets for transportation-management-related data exchange and hazardous-material- and cargo-related data exchange, etc. Collectively, that family of standards shall be referred to as the "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. 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.

Keywords: 911, Abstract Syntax Notation One (ASN.1), ATMS, computer-aided dispatch (CAD), center-to-center, commercial vehicles, dangerous goods, data exchange, emergency management center (EMC), emergency response, emergency services, emergency management service (EMS), fire, hazardous materials, hazmat, incidents, incident response, incident management, incident command, incident management system, intelligent transportation systems, law enforcement, message sets, police, public safety, traffic incidents, traffic incident management, traffic management, traffic management center (TMC), transportation system management

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Introduction

This introduction is not part of IEEE Std 1512-2006, IEEE Standard For Common Incident Management Message Sets for Use by Emergency Management Centers.

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

This standard is one of several related standards in this area and deals primarily with the communication of vital data of a public safety and/or emergency management nature involved in transportation-related events. It is the Base Standard. Other categories of communication, having to do with transportation management, hazardous material, and other cargo are addressed in other companion volumes generated by the Working Group. This Base Standard and other companion volumes together comprise what shall be known as the IEEE 1512 Family of Standards.

This Base Standard includes more general introductory material for the family of standards, including the other companion volumes and the relationship between the family of standards and other ITS standards and the National ITS Architecture.

Problem statement

In the course of a transportation-related event where multiple public safety agencies are involved, there is a critical need to coordinate the management of the event among those agencies. Involved public safety agencies may include law enforcement, fire and rescue, emergency medical services (EMS), hazardous material management, traffic management, towing and recovery, and others. Each agency has a separate set of tasks, resources, and communication gear; yet the agencies need to coordinate their separate actions.

The challenge to be met by the IEEE 1512 Family of Standards is to specify message sets to support communication to coordinate those separate actions. That coordination extends to five categories of information, as follows:

- a) Situation awareness: A common-format rendition of the situation, i.e., the spatial layout, general aspects such as smoke and fire, what each agency is doing, and tracking several variables in a summary way: injured, response personnel, response equipment, witnesses, perpetrators, involved vehicles, and cargo. And as a special subject area of this volume, detailed information relating to the cargo and any hazardous aspects that it may contain and of which others need to be aware.
- b) Each agency's plan of action: A flexible format for agencies to disseminate their plans, so that each agency can take all other agencies' plans into account in its own planning and management. That exchange can support the specification of a single incident-wide action plan, or simply each agency specifying its own plan, to be followed separately but accounting for the plans of the other agencies.
- c) Asset management: An effective way for the agencies to share information about availability of assets for inter-agency management, and then to facilitate the inter-agency use of those assets, i.e., where Agency A requests that an asset of Agency B be dispatched to the incident. This approach extends to informing other agencies of the need for services such as law enforcement, evacuation, medical treatment, rescue, fire suppression, and hazardous material management.
- d) Warning information: Emergency evacuation, responder distress, cautions for responders, and "be on lookout for" information.

- e) Messaging overhead: Message priority, drill/not-a-drill, acknowledgment, ability to address by function as opposed to by agency name, and determining whether a center is functioning.

That presents us with the basis for stating the goal.

Goal of this Base Standard

The goal of this Base Standard is to specify message sets to support the exchange of the five types of information just listed. More precisely, it is to specify the message sets that support that exchange, in combination with the message sets specified in the rest of the IEEE 1512 Family of Standards. As of this writing, that IEEE 1512 Family of Standards includes

- Base Standard: IEEE Std 1512-2006, IEEE Standard for Common Incident Management Message Sets for Use by Emergency Management Centers
- Companion Volume: IEEE Std 1512.1™-2003, IEEE Standard for Traffic Incident Management Message Sets for Use by Emergency Management Centers
- Companion Volume: IEEE Std 1512.2™-2004, IEEE Standard for Public Safety Incident Management Message Sets for Use by Emergency Management Centers
- Companion Volume: IEEE Std 1512.3™-2006, IEEE Standard for Hazardous Material Incident Management Message Sets for Use by Emergency Management Centers

As part of its support of that exchange, this Base Standard will support existing conventions and nomenclature for established practices in public safety incident management, in particular the National Incident Management System (NIMS)^a and existing formats for incident action plans. At the same time, the message sets will not require that the local implementation use NIMS or any particular format for an incident action plan. Although in some local implementations any multiagency incident is coordinated with a single plan, in other local implementations, conventions are oriented around each agency having its own plan without any single, explicitly integrated plan. Both of those cases are supported by this standard. References to ICS and UCS in this volume shall be taken to also refer to the NIMS.

This standard serves as a base standard for a family of standards in this area and deals primarily with the coordination and exchange of information regarding incidents among emergency management and related centers. More complex data and resource sharing, as well as message flows particular to transportation management, public safety, and hazardous materials, will be addressed in companion volumes to the standard developed by the Working Group. In addition, an Implementation Guide for this standard will provide an overview of the relationships between the messages and further examples of use with other ITS message sets that are not presented in the normative clauses of this standard.

The national ITS architecture standards requirements document identifies the requirements for message sets to exchange data about incidents among emergency management and related centers. Incident or emergency management is one ITS service identified with centers that perform functions such as transportation management, emergency management, transit management, and information service provider. The relevant architecture flows of the National ITS Architecture were identified and verified by the National ITS Architecture Team. The following problem statement forms the framework within which the message structures specification was developed.

The problem can be stated as follows: A wide variety of separate organizations, each independently dispatching its resources in the form of personnel and equipment, process incidents with a focus centric to its community requirements. Each has established operational procedures and methods tailored to meet both its industry and its local requirements. The communication systems used by such centers are typically not

^aU.S. Department of Homeland Security, www.dhs.gov, March 1, 2004. As of this writing, exact URL: <http://www.dhs.gov/interweb/assetlibrary/NIMS-90-web.pdf>.

commercial off-the-shelf in nature but have been developed to suit each center after an extensive procurement phase. Each center has a response territory, both geographic and administrative, intertwined with other centers' jurisdictions in complex ways. Each center has policies for dealing with the public-private release of information to others in unique ways. A degree of institutional distrust and concern for inadvertent release of information to the public prevents the full sharing of information in most cases.

NOTE—Matters of safeguarding privacy will occur in implementing this base standard, e.g., managing the chain of custody of incident data concerning individuals involved in an accident. Although beyond the scope of this base standard, such incident data concerning individuals should be protected through state and federal laws. Only authorized officials within the chain of custody with a "need to know" should be provided access. All data related to safeguarding privacy should be protected by data security technology and audit procedures of the receiving information system. All of the above changes dynamically in some localities based on workload and requirements.

These conditions vary considerably from state to state and among local jurisdictional implementations within a state. There is not a uniform model from which such incident management processes are built, making each a unique case. These issues are made more complex with the many communication alternatives among motorists and the mobile public that can report and inform all parties about the occurrence of an incident in real time. This situation leads to many centers learning about the same event from many sources and requires a coordinated process. The goal of this standard is to provide common incident management message sets in a uniform and open format that the local implementer can then tailor in a way that best suits its requirements and policies for communicating among those centers.

This standard specifically references a concurrently developed (and evolving) group of ITS standards that address transportation management centers, transit management centers, vehicles reporting Mayday events, and various preexisting public safety and incident response agencies, each with procedures and standards, e.g., the E911 community. This standard establishes ways for these separate groups to communicate with each other at the emergency management center level, with each continuing to use the primary methodologies already established and accepted among its constituency groups. Setting up such a communication system may require extant interagency agreements before implementing this standard. Those agreements may establish the communication protocols and messaging practices not specified in this standard and the actual messages, data frames, and data elements from this standard that should be used.

Companion volumes

This Base Standard provides definitions and use information on dialogs, messages, data frames, and data elements that are then also used in the companion volumes listed above. To make full use of this information, the Base Standard, companion volumes, and other references to ITS and industry standards may also need to be employed. That is particularly true 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 the public safety industries.

The standard and use with data registries

The standard was developed in conjunction with entries designed to be made into a 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 meta data fields are used and are equivalent to the named fields in a data 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 that 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 a data 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 ASN.1 defining code. In a data 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, whereas in the case of data frames and messages, this information is placed into the BODY field.

Other fields used in a data 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 1512.3-2006.

Notice to users

Errata

Errata, if any, for this and all other standards can be accessed at the following URL: <http://standards.ieee.org/reading/ieee/updates/errata/index.html>. Users are encouraged to check this URL for errata periodically.

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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.



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(www.groundzerospirit.org)

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 multijurisdictional communications.

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

1. Overview

The need for coordination among response agencies involved in the processing of various emergency or traffic-related incidents is self-evident, but a common set of established procedures and operational methods is required to exchange vital data among participating parties in a concise, unambiguous, and rapid fashion. This body of related standards addresses the communication of messages among affected emergency response agencies during and after the occurrence of an emergency incident. Within the duration of an incident, each involved agency has responsibilities that vary over time, based on the type of incident, local custom, and agreed upon responding resource allocations, which are often determined at the incident scene or at dispatching points within each agency. This standard addresses the exchange of information among such centers, and it has been carefully developed to allow a wide variation in local implementation, while still using the framework and the concepts of the National Intelligent Transportation System (ITS) Architecture. In addition, the work of prior standards, which this standard references, forms a portion of the messages in this standard.

This standard specifies a framework for exchange of data in message sets for use by centers involved in transportation-related incident management, in particular, for exchanges of data for coordination among public safety agencies, and between those agencies and Traffic Management Centers (TMCs).

This Base Standard supplements the three other companion volumes in the IEEE 1512™ Family of Standards. The external data entries, reused and taken from other standards efforts, are in general found listed in this volume.

In the course of managing many transportation-related events, there is a need for coordinating the actions of several different public safety and traffic management agencies. Although each agency may be in full control of its part of the management of the incident, it must coordinate with the other agencies in five different ways:

- a) Exchange information about the situation, “situation awareness,” so that all agencies know what every agency sees.
- b) Exchange each other’s plans, so every agency knows every other agency’s plans. This could be done by generating one overall plan based on each agency’s plan, or by simply exchanging all plans so each agency’s plan can be generated and adjusted taking into account all other agencies’ plans. Either way, plans must be exchanged among agencies.

IEEE Standard for Hazardous Material Incident Management Message Sets
for Use by Emergency Management Centers

- c) Exchange information about available assets, and then coordinate use of those assets. This involves sharing updates on each agency's assets availability and location, then exchanging information necessary of inter-agency requests for assets.
- d) Exchange warning information. This includes emergency evacuation, responder distress, cautions for responders and "be on lookout for" information.
- e) Manage the exchange of all of the above information. This includes message priority, drill/not-a-drill, acknowledgement, routing messages to centers based on their roles in the incident as opposed to by agency name, and determining whether or not a center is functioning.

Managing the operational complexities of collecting or generating that data, collating and analyzing it, and 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 public safety and traffic management agencies to provide a flexible basis for the five types of information exchange listed here.

1.1 Scope

This standard is the Base Standard for a family of related standards that address the intercommunication needs of emergency management centers and other types of centers engaged in transportation incident management. Incident in this standard includes information concerning any transportation-related event that is received by the emergency management system, including planned roadway closures and special events, whether or not the incident actually affects traffic flow and whether or not a response is required. This standard specifies common incident management message sets to allow vital data exchange for information and coordination. It provides a common mechanism for this data exchange within the defined National ITS Architecture, with latitude for local agencies to determine what level of cooperation, and hence message exchanges, best meets their requirements. This standard is independent of communication protocols used in any local implementation. It also assumes that the mechanics of communication, such as addressing, are handled by communication management, which is not addressed in this standard.

Other companion standards, herein referred to as companion volumes, will provide specific content and usage guidance for other types of centers that could participate in a local incident management system. Companion volumes dealing with the unique needs of transportation management, public safety, and hazardous materials centers have been developed as well.

The Base Standard specifies messages, data frames, and data elements (DEs) for the basic underlying communication involved in real-time interagency transportation-related incident management. Together, the Base Standard and companion volumes shall be referred to as the "IEEE 1512 Family of Standards."

Clause 6 and Clause 7 present the specified messages, data frames and data elements in ASN.1 format and in XML formats. A complete set of listing in ASN.1 and an XML schema are presented in the annexes.

1.2 Purpose

This standard provides a framework for the exchange of messages used in incident management between emergency management centers and other types of centers, e.g., transportation management centers (TMCs). A minimum set of messages to be accommodated by compliant systems is dictated. Within the framework, there is ample flexibility, in that many messages are in fact composed of lists of optional DEs, so those lists have the function of "vocabularies" of DEs. That is, the actual DEs specified in a local implementation can be selected from those lists. In addition, within some DEs, where there is a list of possible data values (e.g., possible center types and possible causes for evacuation), there are provisions for local implementers to add their own values. This provision provides for both a standardized lexicon for describing events as well as a local derivative list to be used. Because the dispatching systems of each

participating center may internally use radically different coding schemes for incidents, events, and resources that it wishes to exchange data about, this standard provides a flexible set of descriptive elements that can be implemented to provide differing levels of local, regional, and national interoperability. It remains the responsibility of participating local agencies to determine what level of interoperability is suitable for their own needs. In a local implementation, conformance with this standard may require extant interagency agreements to exchange particular messages using particular DEs selected from this standard. Those messages have been structured so that centers using different legacy systems, and centers with different data needs, can still use a set of common messages to exchange information with other centers.

Furthermore, this standard shall be implemented in conjunction with related ITS standards that provide other required portions of the entire architecture. The related ITS standards include detailed message formatting with specific center and domain field of use, center-to-center exchange protocols, and messaging processes, including message delivery, security, and gateway functions. This standard acts as a “wrapper,” incorporating such domain-specific knowledge in its own messages to allow exchange of information in each companion volume for each type of center.

2. Normative 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.

ASN.1:1997, Abstract Syntax Notation One.¹

Code of Federal Regulations pertaining federal hazmat transportation regulations, notably 49 CFR parts 100 to 185.²

IEEE Std 1488™-2000, IEEE Trial-Use Standard for Message Set Template for Intelligent Transportation Systems.^{3, 4}

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

IEEE Std 1512.1™-2003, IEEE Standard for Transportation Incident Management Message Sets for Use by Emergency Management Centers.

IEEE Std 1512.2™-2004, IEEE Standard for Public Safety Incident Management Message Sets for Use by Emergency Management Centers.

IEEE Std 1512.3™-2006, IEEE Standard for Hazardous Material Incident Management Message Sets for Use by Emergency Management Centers.

¹ ASN.1:1997 is available from the World Wide Web at the following site: <http://asn1.elibel.tm.fr>.

² CFR publications are available from the Superintendent of Documents, U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20013-7082, USA (<http://www.access.gpo.gov/>).

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 The IEEE standards or products referred to in this clause are trademarks of the Institute of Electrical and Electronics Engineers, Inc.

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ISO/IEC 8824-1:1998, Information technology—Abstract Syntax Notation One (ASN.1): Specification of basic notation.⁵

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.⁶

ITE TMDD, Standard for Functional Level Traffic Management Data Dictionary (TMDD), Standard TMDD Revision 2.1, December 2004.

NFPA 704, Standard for the Identification of the Fire Hazards of Materials for Emergency Response, 2001 Edition.⁷

NTCIP 2306, Application Profile for XML Message Encoding and Transport in ITS Center to Center Communications, v 00.50, User Comment Draft, March 2005.⁸

NTCIP 9010, XML in ITS Center-to-Center Communications, Recommended Information Report, November 2004.

SAE J2354, Message Sets for Advanced Traveler Information System (ATIS), Revision 3.⁹

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

SAE J2540-2, ITIS Phrase Lists (International Traveler Information Systems), Revision 3.

SAE J2630, Converting ATIS Message Standards From ASN.1 To XML, Revision 1.¹⁰

SAE J2735, Dedicated Short Range Communications (DSRC) Message Set Dictionary, Draft Standard Revision 11.

⁵ISO/IEC publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembe, 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/>).

⁶ITE 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>).

⁷NFPA publications are available from Publications Sales, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101, USA (<http://www.nfpa.org/>).

⁸ Copyright 2004 by the American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), and the National Electrical Manufacturers Association (NEMA) (<http://www.ntcip.org>).

⁹ SAE publications are available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096, USA (<http://www.sae.org/>).

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this standard, the following terms and definitions apply. *The Authoritative Dictionary of IEEE Standards* [B5]¹¹ should be referenced for terms not defined in this clause.

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).

NOTE—See 3.2.¹²

3.1.2 advanced traffic management system (ATMS): The hardware and software decision support system that provides the traffic management center its operational functionality. An ATMS system typically manages field devices, collects multiple formats and types of data, generates automated response plans, and manages the dissemination of information to interested parties. In a local Intelligent Transportation System (ITS) network environment, the ATMS is an intelligent node and often is the central node for ITS functions.

3.1.3 advanced traveler information systems (ATIS): A major message set of ITS that contains several 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 SAE.

3.1.4 agency data: Any data that are created by the center or its assets or come under the control of the center as per local data agreements and operating practices.

3.1.5 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.

3.1.6 application profile-common object request broker architecture (AP-CORBA): One of two communications protocols identified by the National Transportation Communications for ITS Protocol (NTCIP) Center-to-Center Working Group as an Intelligent Transportation System (ITS) standard protocol, sometimes more completely referred to as NTCIP AP-CORBA. The other protocol is Application Profile-Data Exchange-ASN.1 (AP-DATEX-ASN).

3.1.7 application profile-data exchange-ASN.1 (AP-DATEX-ASN): One of two communications protocols identified by the National Transportation Communications for ITS Protocol (NTCIP) Center-to-Center Working Group as an intelligent transportation system (ITS) standard protocol, sometimes more completely referred to as NTCIP AP-DATEX-ASN. The other protocol is NTCIP Application Profile-Common Object Request Broker Architecture (NTCIP AP-CORBA).

¹¹ The numbers in brackets correspond to those of the bibliography in Annex D.

¹² Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

3.1.8 asset: (A) 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 also: physical asset.* An asset can also be a data stream or data set, such as the video feed from a CCTV camera, or a data file containing loop data. *See also: data asset. (B)* A piece of equipment used for incident management. Examples include vehicles, traffic control equipment, and closed-circuit television cameras. It is a narrower term than *resource* in that it does not include teams of response personnel.

3.1.9 assisting agencies: This term refers to another agency (either public or private) that is called in at the request of the incident command to perform some task. Used within the scope of this standard, this term applies to other agencies which are presumed to NOT have access to 1512 message set information and who, therefore, may require additional assistance to understand the pertinent details of the current event.

3.1.10 available resources: This term refers to the resources of another center that are offered for use and assignment to an incident and that are mission ready to be assigned. Various local mutual aid agreements will typically cover whatever rules of use are required, including but not limited to, the coupling of additional resources as needed (e.g., town A may be willing to loan to town B an apparatus, but only with accompanying supervisory personnel as well).

3.1.11 center: Any point of communication used in the control of resources. Centers can communicate with one another and each have various rights to data access with each other. Centers cross boundaries of infrastructure ownership, response duties, jurisdictional responsibility, etc., in various ways. A center is a connection point on a network capable of exchanging IEEE 1512 formatted messages with other centers. More practically, a center can range in complexity from large multi-computer environments to a simple laptop, and it may be associated with a similar wide range or span of command and control in any given local government agreement or incident deployment.

NOTE—Facilitating the exchange of messages among centers for coordinating incident management (IM) is the primary task of this standard.

3.1.12 command post: The location where the primary command functions are executed. Designated area at the incident scene that functions as the centralized point for multi-agency coordination, on-scene communication, command and control of resources, and information gathering. The command post may be colocated with the incident base or other incident facilities.

3.1.13 Communications On Wheels (COW): A term used to refer to small mobile communications sites, often including cellular phone sites, which are used in larger incidents and for public events. A COW is often dragged on-site during the event until normal communications levels are resorted. In the Incident Management family, a COW is most often referred to in the context of its staging area.

3.1.14 data asset: An asset that is in particular a data stream or data file, as opposed to a physical asset. Examples include the video feed from a CCTV camera, and a data file containing loop data. *See also: asset.*

3.1.15 data concepts: Any of a group of data dictionary structures defined by IEEE Std 1489-1999 (e.g., data element, data element concept, entity type, property, value domain, and generic property domain) referring to abstraction or things in the natural world that can be identified with explicit boundaries and meaning, and whose properties and behavior all follow the same rules.

3.1.16 data dictionary: A collection of descriptions and definitions for documenting, storing and retrieving the syntactical form (i.e., representational form) and some semantics of data elements (DEs).

NOTE—Refer to IEEE Std 1489-1999.¹³

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

3.1.18 data frame (DF): (A) Also called a *data structure*, it is any construct (including data elements) used to represent the contents of a data dictionary. From a computer science perspective, data structures are viewed as logical groupings of data elements, such as “messages” or parts of messages. The data structures comprised the data elements defined in this standard. **(B)** A grouping of data elements (DEs) primarily for the purpose of referring to the group with a single name, and thereby efficiently reusing groups of DEs that commonly appear together (as an ASN.1 sequence, sequence of, set, set of, or choice) in a message body specification. This data concept type may, however, be used to specify groups of DEs for other purposes as well.

3.1.19 dedicated short-range communications (DSRC): A communication system developed for use between the roadside and vehicles, and between vehicles while mobile, and used to communicate a wide variety of ITS related information. Chief among this information is message content dealing with “public safety” type messages.

3.1.20 dispatch: The operation of asking an agency to perform a specified role concerning a specified incident. In some cases, but not all, the operation includes receiving acknowledgment that that role will be performed.

3.1.21 down level client: This term is a terminal or CAD seat of some type that does not support the complete exchange of IEEE 1512 messages; rather, it depends on the existence of another device (typically a server servicing multiple such clients) to conduct any protocol translations needed, and to produce fully IEEE 1512 compliant outputs. All centers speak to each other in strict IEEE 1512 compliant messages. A down level client may, in fact, use a great portion of the IEEE 1512 messages (this is often much easier than inventing unique message structures for such limited use) but may not be able to do so. Any device that requires another device to provide further translation to meet IEEE 1512 standards is a down level client. A PDA or a cellular phone interacting with a remote center would be such a situation. Similarly, laptops deployed in field vehicles may be either a down level client or a complete peer center, depending on the embodiment meeting the needs determined by the local deployment.

3.1.22 enhanced 911 (E911): This term implies the additional functionality 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 extended in many ways (both mandated and voluntary) to cover the need to determine the position/location of wireless callers.

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

¹³ Information on references can be found in Clause 2.

3.1.24 emergency medical service: A system represented by one or more agencies that provides 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.

3.1.25 evacuation: The operation of systematically removing the public from an area for reasons of 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.

3.1.26 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.

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

3.1.28 event: A term covering any of three kinds of events: transportation-related incidents, planned roadway closures, and special events. The term covers any event of the three, including information about which is received by an incident management system, whether or not the event actually affects traffic flow or whether or not it requires a response.

3.1.29 external message: A message comprising data elements (DEs) that is imported into a standard by reference to another standard where it is precisely defined.

3.1.30 general staff: This term refers to personnel and assets involved in the incident but not directly, e.g., in a supporting role such as the CAD operator or personnel at a maintenance facility. They may, in fact, not be at the scene of the event.

NOTE—This concept differs from the Model Procedures Guide used by Fire ICS, which tends to focus more on the on-scene personnel and includes a command structure for items like “financial officer,” which exceeds the operational concerns of the IEEE 1512 Family of Standards.

3.1.31 hand off: The operation of asking a secondary dispatcher or other center to take over a specified management role at a specified incident. In some local implementations, but not all, a hand off includes receiving acknowledgment that that role will be performed.

3.1.32 hazard classes and divisions: Many hazardous materials are required to be identified in transportation by the hazard class or division definitions they meet.

NOTE—A complete discussion of this area and how it is used in the IEEE 1512 Family of Standards can be found in IEEE Std 1512.3-2006.

3.1.33 header: A particular data frame (DF) that is included in every message specified in this standard. It conveys identification information about the incident in question. It uses three data elements (DEs) to provide a means for unambiguous identification of the incident, even among centers that are each identifying the incident in a different way.

3.1.34 incident: Events that are not planned roadway closures or special events, i.e., events about which there is no advance notice, such as emergencies, accidents, disasters caused by humans, and natural disasters. A non-reoccurring or planned event impacting transportation services.

3.1.35 incident command post (ICP): A (temporary) command site established at or near the scene of the incident where the ranking on-scene authority operates from and establishes local control of assets and resources assigned to the incident. In some jurisdictions, the ICP can function as a dispatch center for a period of time and issue and receive messages as a peer with other centers. In other (and most) environments, the ICP receives messages through an Intelligent Transportation System (ITS) agency dispatch center and is, therefore, not directly visible to the messages of this standard. Visible or not, the ICP forms a primary collection and dissemination point for information regarding the incident itself. Therefore, reuse of common message formats is desirable.

3.1.36 incident response: The response from public safety agencies to an incident as distinguished from the response from traffic agencies. It can include a response to an incident that occurs at a planned road closure or special event.

3.1.37 incident response vehicle: Responds to incidents with specific equipment, such as towing capability or surplus of traffic control devices, to assist in the mitigation and clearance of incidents. Typically, vehicles are held at strategic locations for a specific response action. These vehicles and their associated programs go by numerous names in different regions. *See also:* **service patrol vehicle**.

3.1.38 incident response vehicle: A vehicle that is specially equipped to facilitate the control of traffic in the immediate vicinity or upstream of an incident site. Incident response vehicles may be equipped with Automatic Vehicle Location, sign board, changeable message sign, and/or mobile CCTV equipment.

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

3.1.40 instance: An individual occurrence of a data element (DE), such as a value. When a DE is used and assigned a value (from its value domain), an instance of that DE is obtained.

3.1.41 international traveler information system (ITIS): The term commonly associated with the standard for incident phrases developed by the SAE ATIS Committee in conjunction with ITE Transportation Management Data Dictionary (TMDD) and other standards. This work contains a wide variety of standard phrases to describe incidents and is expected to be used throughout the ITS industry. The codes found there can be used for sorting and classifying types of incident events as well as for creating uniform human readable phrases. In the capacity of classifying incident types, ITIS phrases are required for use in many areas. ITIS phrases can also be freely mixed with text and used to describe many incidents.

3.1.42 issuing authority: **(A)** The standards development organization (SDO) that is in control of maintaining a given standard, which contains a data element (DE), or message cited for reuse when referring to the messages and DEs used. Implementers must coordinate (ideally by way of a registry process) to ensure that they are aware of any changes made by the owner (issuing authority) of such a DE. There are many such borrowed DEs in this standard. Implementers are advised to consider local methods to ensure that its DEs remain consistent and current as time passes. **(B)** Identification of the issuing center of a message (typically an IDX message).

3.1.43 issuing center: The center that has issued or sent the message under consideration. *Syn:* **sending center.**

3.1.44 lead center: The center with apparent authority over other centers in the case of a specific type of incident. In some communities, lead center determination varies based on the type of incident, the location, or other criteria. In other communities, it is never fully resolved.

3.1.45 logical role: A logical role is a specific role in the incident that an asset (typically a person or possibly a group of persons) is fulfilling. Examples would include such things as traffic control, high angle rescue team, IC, PIO, triage officer, etc. A person may have more than one such role (such as being both the incident commander and the public information officer). Typically, the operating practices and procedures for these roles are well understood, both by the participants and between the agencies involved. Often, standard equipment and supplies are associated with each role as well. Logical roles are used to direct and send messages to parties as part of the exchange of information supporting the command structure.

3.1.46 Mayday: Generic term in the context of the Intelligent Transportation System (ITS) community that refers to some type of automated vehicle alert system, wherein equipment on the vehicle connects with a dispatching center (i.e., private or public 911) after an incident in which it was involved (although manual activation is also possible). Originally from the World War I French phrase “M’aidez” lit, “help me.” The term is used in mixed cases to increase readability. Mayday systems are becoming increasingly popular in new vehicles.

3.1.47 message: A grouping of data elements (DEs) and message attributes, used to convey information. A message is an abstract description using a message set template, not a specific instance.

NOTE—See IEEE Std 1488-2000 and IEEE Std 1489-1999.

3.1.48 message set: A collection of messages based on the Intelligent Transportation System (ITS) class names.

3.1.49 participating center: *See:* **using center.**

3.1.50 physical asset: An asset that is physical as opposed to a data asset. *See also:* **asset.**

3.1.51 planned event: Any event that is planned in advance, as opposed to one precipitated by an unplanned event such as a roadway accident. A planned event can include either an event such as a sporting event or a planned road closure.

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

3.1.53 preverification: The period of time in the life of an incident when it has been detected but not yet verified. Reports of an incident can originate from the Emergency Telephone System, Mayday systems, the transportation management center (TMC), and other Emergency Management Subsystems. In the preverification phase, before an incident is verified by the Emergency Management Systems (EMS), it is to be treated as simply one or more reports. A key feature of verification, especially in the transportation context, is that often a single incident is reported through several reports, often 911 calls. It takes a deliberate verification effort to recognize that several 911 calls all refer to the same incident. *See also:* **verification.**

3.1.54 private data: Any data that an issuing or possessing center does not wish to share with others. Any data that an issuing or possessing center does not wish to share with others.

3.1.55 profile: The term used in the location reference message set (LRMS) work to refer to one of numerous ways to express location. Each method is further divided into several submessage types, which specify, at the bit level, of what the data frames (DFs) are composed. These profiles were developed to fulfill specific user needs by location for each Intelligent Transportation System (ITS) application community.

3.1.56 public data: 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**; **private data**.

3.1.57 public safety: 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.

3.1.58 receiving center: The center that has received the message under consideration.

3.1.59 resource: A piece of equipment or teams of response personnel used for incident management. Examples include vehicles, traffic control equipment, closed-circuit televisions (CCTVs), and hazardous material (hazmat) cleanup teams. It is a broader term than asset in that it includes teams of response personnel.

3.1.60 response: Any action or combination of actions to reduce the impacts of an incident.

3.1.61 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.

3.1.62 response team: A specialized interdisciplinary group of individuals established to provide technical support and response at major roadway incidents.

3.1.63 scene management: The part of incident management that deals with coordination of responding agencies, the supervision of on-scene personnel, and the application of traffic management strategies.

3.1.64 sending center: *See:* **issuing center**.

3.1.65 service provider: An Intelligent Transportation System (ITS) term for any entity that provides some service, such as a Mayday service.

NOTE—For further context regarding Mayday within the National ITS Architecture, please refer to SAE J2313.

3.1.66 single resource: A single resource is an individual or a piece of equipment (an asset) of some sort, which is used or committed to an incident.

3.1.67 staging area: A zone that is any geographically defined area of interest in responding to the event. The use of the term can also vary depending on the incident command approach used. Any area, zone, route, or geospatial location can be considered a staging area and be both described and have various uses assigned to it.

3.1.68 stringify: The process of converting an internal computer value used to reference a data object to a human readable-printable string that can be viewed and exchanged. A term common in COBRA, JAVA, and other object referencing systems. Often used to exchange a reference between different types of systems.

3.1.69 traffic management data dictionary: One major message set of ITS that contains several message structures used to convey information to the transportation professionals and to control roadsides devices.

NOTE—This standard makes reuse of portions of this work. It is available, in several volumes, from either ITE and AASHTO.

3.1.70 transportation-related incident: Either one of two types of events. The first type: 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). The second type: 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.

3.1.71 using center: A center that is using a message or using a specific resource (and that may or may not own or command that resource). *Syn:* **participating center.**

3.1.72 value domain: An expression of specific and explicit representational values of some information, about something of interest within the Intelligent Transportation System (ITS) domain.

3.1.73 verification: The operation of establishing that a detection indication (e.g., detection, call to 911) or a set of indications is one incident. Verification can involve anything from simply declaring that a report describes an incident to dispatching a police officer to the site to determine whether it is in fact an incident. The particular process of verification is left to the individual application. In terms of the messaging specified, verification may involve taking several incident description (IDX) messages and combining them into a single IDX using a merge incident event (MIE) message.

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

3.1.75 wrecker: Truck designed for hoisting and towing disabled vehicles.

3.1.76 XML (eXtensible 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 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. It uses user-defined tags. With a Document Type Definition 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 1512 message set using this method.

NOTE—Commentary on the implementation of IEEE Std 1512 using this methodology is provided in a later clause of this standard.

3.2 Abbreviations and acronyms

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
AHO	available for hand off
ASN.1	abstract syntax notation one
ATIS	advanced traveler information systems
AVL	automatic vehicle location
BS	Base Standard, in this case, IEEE Std 1512-2006
CAD	computer-aided dispatch
CCP	change center properties
CIE	close incident event
CORBA	common object request broker architecture
DCO	disable center on-line
DE	data element
DF	data frame
DHS	Department of Homeland Security
DOJ	Department of Justice
DOT	Department of Transportation
DSRC	dedicated short range communications
DTD	document type definition
E911	enhanced 911
ECO	establish center on-line
ECP	establish center properties
EMS	emergency medical service
EOC	emergency operations center
EPA	Environmental Protection Agency
ERM	event reporting message
FBI	Federal Bureau of Investigation
GHO	grant hand off
GPS	global positioning system
hazmat	hazardous materials (slang)
IAP	incident action plan
ICP	intelligent clearance practices
ID	identification
IDX	incident description

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for Use by Emergency Management Centers

IM	incident management
IMS	incident management system
ISO	International Standards Organization
ISP	information service provider
ITE	Institute of Transportation Engineers
ITIS	international traveler information system
ITS	intelligent transportation system
LAN	local area network
LRMS	location reference message set
MIE	merge incident event
NIE	new incident event
NTCIP	National Transportation Communications for ITS Protocol
PD	police department
PHO	poll for hand off
PID	public incident description
PIO	public information officer
PSAP	public safety answering point
RCP	response plan between centers
RF	radio frequency
RHO	request hand off
RIN	request information
RUI	request unverified incidents
RVI	request verified incidents
SAE	Society of Automotive Engineers
SDO	standards development organization
SIE	split incident event
TCC	traffic control center
TCIP	transit communications interface profiles
TCP/IP	transmission control protocol / internet protocol
TMC	traffic management center
TMDD	Transportation Management Data Dictionary
TOC	traffic operations center
VIN	vehicle identification number
W3C	World Wide Web Consortium
WSDL	Web services description language

WZ	work zone
XML	eXtensible markup language
XSL	eXtensible style sheet language

4. Structure of the standard

This clause describes how the remaining clauses present the DEs, DFs, and message elements of the standard, the syntax used in those clauses to describe those elements, the conditions of conformance to the standard, and the relationship of this standard to other standards in the IEEE 1512 companion volumes and related standards.

- Subclause 4.1 introduces a methodology and syntax notation used to refer to other messages and DEs in other standards that are referenced in this family of standards.
- Subclause 4.2 provides guidance on conformance of messages specified in the Base Standard.
- Subclause 4.3 outlines what content is contained in the companion volumes and explains in greater detail the concept of volumes for each type of center.
- Subclause 4.4 provides details of the IM message structure and a brief description of the messages used in the IEEE 1512 Family of Standards.
- Clause 5 provides details of message exchanges and dialog patterns used in the standard between centers. It is intended to issue a set of WSDL files here in future editions.
- Clause 6 provides the precise message structures and usage of each message in turn, and it defines the elements that make up each message. It provides a modest taxonomy of related message families to introduce the reader to the conceptual grouping of the messages. Based on this formal description, it becomes straightforward to add local message definitions and any supporting DEs and DFs needed to handle unique requirements. This is done in each companion volume to focus on the needs of specific center functions (e.g., traffic incident management, public safety coordination, and hazardous materials incident management). The precise message definitions that result may reference additional DEs that are provided in the companion volumes. The definitions that are provided are used by every center. For DEs appearing in Clause 5 that are adopted from other functional areas, their source names and standards are referenced directly in Clause 5. The Base Standard uses module definitions where groups of elements taken from a single standard are all placed in a similar module. In addition, the ASN.1 is presented in a section called “ASN.1 Representation.” In a similar manner, the equivalent XML expression is presented in a section called “XML Representation,” which follows the translation rule set cited in Clause 2.
- Clause 7 provides the definition and usage guidelines of those DFs defined by this standard. Any message specified in Clause 6 shall have all of its DFs specified in this clause, except those that are adopted from other functional areas, or defined in other volumes of the family of standards. Where those DFs include DEs defined by other functional areas, their source names and standards are cited. Implementers shall refer to the cited source standard in each case, which is the definitive issuing authority.
- Clause 8 provides the definition and usage guidelines of the DEs defined by this standard. Any message or DF specified in Clause 6 and Clause 7 shall have all of its DEs specified in this clause, except those DEs that are primitive ASN.1 data types or those that are adopted from other functional areas, or defined in other volumes of the family of standards.
- Clause 9 defines the external entries specified in Clause 6 and Clause 7 that are composed of message elements defined by other standards bodies. The referenced standards shall be

consulted for further information regarding their proper use. The ASN.1 and XML definitions used in this standard shall be taken as the governing definition unless otherwise noted in each entry. Caution needs to be exercised during deployment if and when these “foreign” or external elements are used.

The implementation guide for this standard will outline several key concepts and provide implementation advice. It describes additional, useful messages that are not part of this standard and would provide a more complete understanding of an implemented message set. It will also contain example scenarios that show the message set in operation and will therefore be useful in understanding how the messages interoperate to effect center-to-center communication.

4.1 Syntax used in the standard

The messages in this standard are defined in accordance with ASN.1:1997, an internationally recognized method for defining message structures independent of the computer languages and transmission encoding rules used in implementation. The ITS community (here composed of both the ANSI community of standards development organizations [SDOs] and the U.S. Federal Government in its position as a treaty member of international standards bodies) has adopted this method for use across the various domains of ITS implementation. This standard makes extensive use of comments to specify a variety of other message elements incorporated by reference into the messages of this standard. Because all cited references are not available in an ASN.1 format, it is problematic to include them directly. Therefore, a consistent naming structure and a series of comments to refer to the incorporated message elements in question have been used. Several standards that claim to be ASN.1:1997 compliant use the underscore character “_” in the message names. In such cases, this standard replaces the underscore character with a dash “-”.

IM message sets for the Base Standard consist of the following message sets and data frames. Each message set is further divided into specific messages and elements defined in Clause 6. Typically, these messages are made up of message content external to this standard (from other functional areas and companion volumes).

For DEs incorporated by reference into the messages of this standard, the specific DE in the specific source document can be found by referring to the path specified in the bracketed area found in a comment line of the source code. A path approach with an abbreviated name of each source document (established in Clause 2) has been used in conjunction with an unambiguous set of names to refer to the final DE itself. The period character “.” is used to delimit between the taxonomy of names leading to the element.

An additional DE identifier is provided for reference in this standard where available. In the adjacent comments, any additional information is provided that is needed. When the incorporation by reference is to an external message, as opposed to an external DE, it is designated by the colon character “:” used to delimit among the taxonomy of names leading to the message. The path is specified in brackets in a comment line.

DEs specified in this standard (as opposed to those incorporated by reference) are composed of atomic types with generally self-explanatory names such as INTEGER or ENUMERATED (a numbered list of names) or BIT STRING (a logical bit field). The keyword IA5String is the ASN.1 term for an ASCII string; the range of possible lengths is appended. Like most programming languages, new types can be defined from previously defined DFs and given a unique name after which objects of this type can be instantiated into the specification with their own name. An example is the ‘Header’, which is the complex object (defined in detail in Clause 7 and used in message definitions in Clause 6). In the previous example, the specific instance of the ‘Header’ DF is named ‘Header.’ For a more complete discussion of the ASN.1 syntax, consult Clause 2.

This latest version of the Base Standard uses module definitions where groups of elements taken from a single standard are all placed in a similar module. Also, the ASN.1 is presented in a section called “ASN.1 Representation.” In a similar manner, the equivalent XML expression is presented in a section called

“XML Representation,” which follows the translation rule set cited in Clause 2. The XML productions used in this standard follow the conversion rules between ASN.1 and XML developed by the SAE ATIS committee and published by the SAE as J2560. At this time, the different message sets exchanged between centers of ITS have been converted to XML following these same rules to ensure interoperability.

XML, the eXtensible Markup Language,¹⁴ is a standard of the World Wide Web Consortium (W3C). XML is a means by which one computer can encode some information (data) so that another computer receiving that encoded information will be able to understand its contents and act on that content (e.g., process the information, display the information to a human, store the information in a database, issue a command to a field device, etc.).

Once information is described (encoded) using XML, it is called a document. An XML document comprises primarily of elements. An element is delimited by tags. Usually, a tag comprises the name of the element it delimits, enclosed between a pair of angle brackets (“<” and “>”). Tags usually come in pairs—a start-tag and an end-tag. The element name in the start and end tag are identical except that the latter has a forward slash (“/”) at its beginning. A start-tag may optionally include attributes of the element. An attribute name is followed by an equal sign and a value for that attribute. The content of an element is the text that appears between its start-tag and its end-tag. Elements may be nested—the content of an element can include other elements.

Nesting allows for complex information structures. In the above example, nesting could be used to show that an element (a piece of information) called “SignalController” is made up of other elements (HardwareType, FirmwareType, FirmwareVersion, Section, and Detector), and that Detector information in turn comprises other elements (HardwareType, Lane, Dimensions), and that Dimension information in turn comprises still other elements (Width, Length).

The encoding rules, or grammar, for a particular application are usually defined using an XML Schema.¹⁵ This is a definition of things such as the set of allowable tags (e.g., element types), attributes of each element type (if any), default values (if any), and how elements can be nested (data structure). A message or document describing a traffic signal would use a different XML schema than a message or document describing an incident. If desired, the schema can be included within the document, to enable a receiving computer to validate the encoding. XML schemas are defined using the XML schema language.

An XML schema is extendable. Additional element types can be added at any time in the future without invalidating earlier versions of the schema. The XML standard requires software that reads and interprets an XML document (called an XML parser) to ignore any tags (and elements thus delimited) that are not included in the version of the schema currently used by that parser.

The eXtensible style sheet language (XSL) can be used to enable a computer to automatically translate the information content of an XML document, into another formatted document (must be in text format) including XML.

4.2 Conformance with the standard

A message shall be considered conformant to the IEEE 1512 Family of Standards when the message syntax specified in the standards, as defined by the XML schema and/or ASN.1 syntax as referenced in the standard, is used. It should be noted that the use of local data extensions are permitted by the standard.

¹⁴ Referenced from the NTCIP Information Report, Center-to-Center Communications Working Group.

¹⁵ XML Schema is a standard of the World Wide Web Consortium and becoming the preferred method of defining the grammar for an XML document type, replacing the original method called Document Type Definition (DTD).

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.

In cases where a conflict exists between the textual description of a message and the XML syntax of the message and ASN.1 syntax is not present, the XML syntax shall take precedence.

4.3 Relationship with the companion volumes

This Base Standard sets requirements for all emergency management centers. The companion volumes extend the message functionality with additional content and operating requirements as needed. This does not eliminate the need for local agreements and further profiling of the resulting message sets. Rather, it provides implementation insights and requirements that any center of a specific type must follow to remain interoperable with other centers.

The relationship of the existing and future companion volumes to the Base Standard in the IEEE 1512 Family of Standards is illustrated in Figure 1.

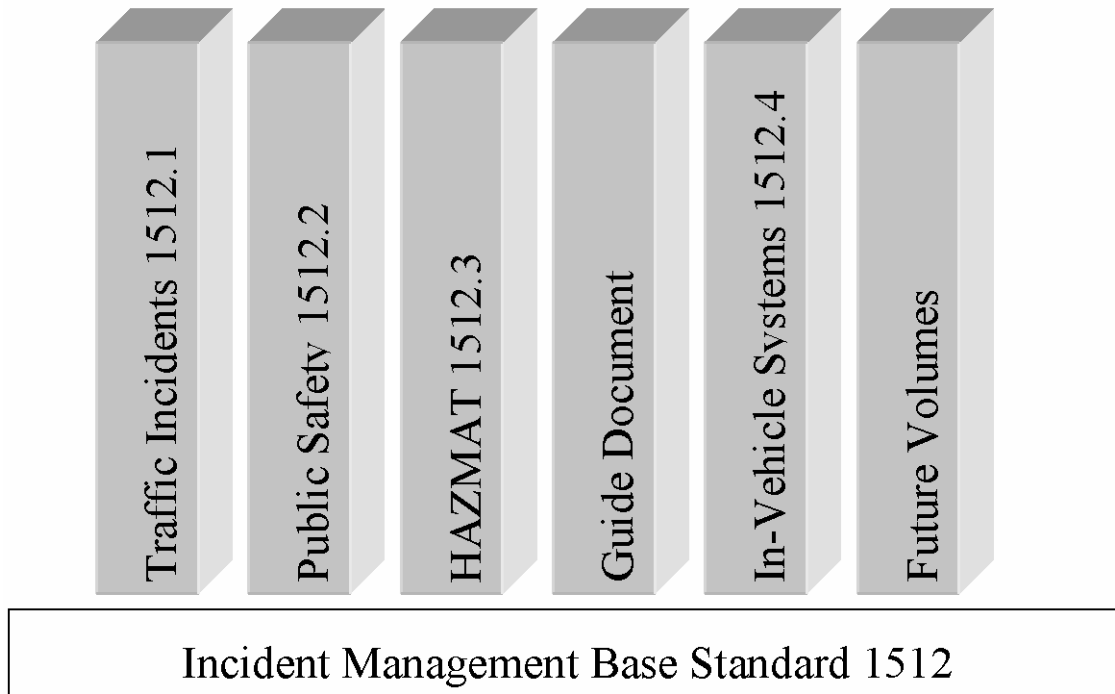


Figure 1—Concept of related companion volumes for IEEE Std 1512

This Base Standard contains some messaging for managing centers on- and off-line (changing operational status) and for coordination of incident creation, management, and numbering. These features can be used in a local implementation to define a lead agency for any incident, according to practices agreed upon in that local implementation. These message sets are not further profiled in the companion volumes because all centers use them in a similar way.

A related area of interest is the protocol under which the community of centers communicates. Within ITS, there is a standard-making activity referred to as the National Transportation Communications for ITS Protocol (NTCIP) “Center-to-Center” Working Group. Two protocols (applicable to IEEE Std 1512) have been defined for the exchange of ASN.1 and XML messages between centers. One is entitled “Application Profile for DATEX-ASN (NTCIP 2304),” and another separate protocol (currently a User Comment Draft) entitled “Application Profile for XML Message Encoding and Transport for ITS Center to Center Communications (NTCIP 2306)” is being defined for the exchange of XML messages. Currently, an information report entitled “XML in ITS Center-to-Center Communications (NTCIP 9010)” is available. Conceptually, that protocol work fits “below” or “closer to the metal” than the center-to-center end-application message definitions for incident management, which is the subject of this standard. Use of the NTCIP methods is likely to gain wide acceptance among ITS centers. However, a wide variety of legacy public safety center computer-aided dispatch (CAD) systems do not have any awareness of the NTCIP center-to-center efforts and have little compulsion to adhere to them. Therefore, this standard remains neutral in this specific area to encompass the widest possible accommodation of legacy systems.

The companion volumes contain different levels of detail and message content depending on which of three types of centers (i.e., traffic, public safety, or HAZMAT) is involved. The companion volume detailing Traffic Incident Management message sets for use by Emergency Management Centers (IEEE Std 1512.1-2003) has been developed. This companion volume has, in general, made use of the prior work (adopting it, referencing it) rather than replicating it.

The ideal case of this first type of center participates in the ITS traffic management community, which is in the process of developing a wide set of encompassing message sets and data dictionary standards related to this standard. Due to the availability of draft versions of the data dictionary, many of the objectives of IEEE Std 1512-2000, when applied specifically to TMCs, were met by including the TMC standards by reference. A TMC (unlike many other types of centers) often shares data with other centers, which stimulated the development of a rich set of preexisting messages. Incident description (IDX) (the principal information exchanging message) was designed to reuse many of these messages as shown in the first companion volume, IEEE Std 1512.1-2003.

An example of the second type of center is a public safety center, such as where 9-1-1 public safety access points and fire dispatch would be located. Larger operations are typically supported by CAD and records management systems (RMS), which tightly integrate these centers with other internal nodes (stations, apparatus, and support and administrative locations). Integration between different systems is much rarer and much more difficult to achieve. Although there are established and standardized information exchange practices dealing with external systems, most are concerned with after-the-fact reporting of various types of incident information to higher echelons or record-keeping systems. This standard differentiates between criminal justice management systems and real-time asset management systems, such as CAD. Criminal justice systems are more concerned with the flow of crime incidents through the court and corrections systems and not with getting assets to an incident scene.

The scope of all of these systems greatly exceeds that of the TMC, as public safety deals not only with the highway and traffic, but also much more formally with persons, places, and things. Some of this subject matter is reusable in ITS. As a result of these factors, the IDX information to be found in the public safety volume may be both larger and more diverse than the TMC volume and suitable for inclusion in IEEE Std 1512.2-2004. The justice community is also looking at harmonization of data between these types of systems.

Finally, there is a third general type of center—a hazmat center. Because a hazmat situation has specific personnel, equipment, response plans, and serious implications, IEEE Std 1512.3-2006 was created with messages specifically for a hazmat volume. Hazmat centers usually operate on a much narrower scope than traffic or public safety centers, are a division of the Fire Department, and participate from a remote location in a consultative mode.¹⁶ Voice coordination procedures are well understood and commonly practiced; however, automated hazmat information exchange would be new to the community.

¹⁶The primary national coordination centers are listed inside the back cover of the North American Emergency Response Guide [B10]

The Implementation Guide will incorporate all messages from the standards into the User's specific communication systems. As the Implementation Guide will be created by the User, certain data elements that are designed to be modified for local conditions will be defined for that User.

A future volume for In-Vehicle Systems will be created to relay information to deployed vehicles and resources of appropriate local centers. The message sets would be created to correspond with all general messages defined in the IEEE 1512 Family of Standards, so that local vehicles involved in incident management activities can communicate with other local centers.

In summary, each companion volume will include detailed IDX message formats unique to the needs or data content of the centers covered by that volume. If those centers have a prior reference work that can be used and cited, then the companion volume will do so and tailor the messages with further information. If no suitable prior reference work or message sets exist about the community using the message formats, then the companion volume will establish messages as required to fulfill the unique messaging needs of that community in such a way that it will remain interoperable with other centers covered by the other companion volumes of this standard.

4.4 Message structures

In some embodiments, it is useful to enclose the incident management (IM) messages in a wrapper comprising a "CHOICE" statement in ASN.1:1997. This provides benefits to some users (and is superfluous to others) depending on the underlying communications methods employed by a center. The IDX message is the working message that communicates with other users/centers or interested parties. Most of these messages are very flexible. The structure of this IM message is provided in the example message below. Table 1 is a list of all IM messages. Table 2 includes a list of all IDX submessages.

and include CHEMTREC and CHEM_TEL (for U.S. hazmat incidents). Serving as large information repositories, hazmat centers can provide detailed information on demand regarding characteristics of hazardous materials, public hazards, response guidelines, and manufacturer and shipper information.

Table 1—List of IM messages

IM message	Description
Basic center-to-center management messages	
ChangeCenterProperties	Change the properties and abilities of a center
DisableCenterOnLine	Inform the other participating centers that the sending center is now going off-line and will no longer take, or participate in, any messages (until it goes back to being on-line)
EstablishCenterOnLine	Establish the presence of a center as being on-line and ready for business
EstablishCenterProperties	Establish a variety of properties and abilities for the center
Event creation management messages	
AvailableForHandOff	Reply to a PHO message with the availability result (yes, no, or not possible, and any conditions) of the responding center
CloseIncidentEvent	Close an incident event from the perspective of the issuing center
GrantHandOff	Reply to an RHO message with an acceptance or rejection of the hand off and any conditional data required to be exchanged
MergeIncidentEvent	Declare and broadcast to other participating centers that two or more existing incident events have been merged into one incident event
NewIncidentEvent	Declare and broadcast to other centers that a new incident event has been created
PollForHandOff	Bid among centers regarding ownership and responsibility for an incident
RequestHandOff	Directly contact a single center that the requesting center desires to hand off an incident to that center
SplitIncidentEvent	Declare and broadcast to other centers that an existing incident event has now been split into two or more new incidents
Event information dialogs (IDX messages)	
IncidentDescription	Generally applicable message for all incident-related exchange of data
PublicIncidentDescription	Convey the same information as the IDX message; however, it shall only be populated with information that the local implementer considers to be suitable for dissemination to the intended target center of public users
Messages for filtering and for information exchange about incident event by type/center/asset	
RequestInformation	Request all types of information about an incident or about the properties of the receiving center
CenterPlans	Exchange response plans and other action plans among participating centers
Information exchanged outside the scope of a specific incident event by the center	
ClearOrRepairPlan	Inform other centers of a plan of action to repair or clean-up an infrastructure-related issue
InfrastructureReport	Send information to another center regarding its infrastructure and report damage or otherwise out of normal operations
NetworkConditions	Send information to another center regarding current traffic network conditions (flow rates etc.)
RequestForExternalInformation	Get data about any index based database

Table 1—List of IM messages (continued)

IM message	Description
RequestNetworkConditions	Sent to another center to request a reply containing current network conditions of various kinds that meet the passed search criteria
RequestRouteAdvice	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
RequestTrafficControlPlan	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
RequestWorkZoneData	Indicate any event on or nearby the roadway that is pre-planned or known to the center receiving the request
RouteAdvice	Provides a complex set of routing instructions suitable for use in public safety response
TrafficControlPlan	Send information to another center regarding what the current Traffic control plan for an events
WorkZoneData	Contains information on pre-planned events such as, but not limited to, a work zone
AssignedResources	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
DifferentialGPSCorrections	Encapsulate and send differential GPS satellite corrections to field and mobile assets, to improve their positional and time accuracy
PhysicalAssetStatus	Reply to a RequestPhysicalAsset message asking for assets which meet selected criteria
PreemptionUserData	Relate information about a vehicle engaged in using the local priority / preemption network
RequestPhysicalAsset	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
RequestPhysicalAssetStatus	Request the last known current status of an asset
RequestPreemptionUserData	Request information about a vehicle engaged in using the local priority / preemption network
Messages that are free-standing and used inside the IDX	
ManageCommandStructure	To publish and update the current incident command structure in use at an event and the assignments of roles within it
WatchFor	Refer back to it with sightings or with improved (or different) information about the item in question
WatchForResponse	Allows the reporting of either a location and heading for the group of requested objects, or the updating of information about the objects in question

Table 2—List of IDX submessages

IDX submessage	Description
CargoDocs	Summary of cargo shipping papers and manifest data
CargoUnits	Data about the type of cargo units carried and their condition
CargoVehicle	Descriptions of a cargo-carrying vehicle and/or cargo container
CautionsForResponders	Publish cautions and possible dangers for responders to be aware of about an event
CenterPlans	Exchange response plans and other action plans among participating centers
Description	Provides a general purpose description of events, used as many basic message exchanges between center as well as summary ITIS codes about the event
Evacuation	Convey the information regarding a real or potential evacuation event.
Facilities	Describes care and treatment facilities to which victims and other involved persons have been taken
FileTransfer	Used to send all types of files between centers. Send scene photos back to the center to be exchanged with other centers, mostly commonly used to send a files in any format to other centers
HazardousMaterialIncidentReport	Convey the information requirements found in Form DOT F 5800.1 (09-2004) (form approval OMB 2137-0039) and outlined in the 49 CFR Part 171 Hazardous Materials: Revisions to Incident Reporting Requirements and the Hazardous Materials Incident Report Form
ImmediateSiteEvacuation	Advise all personnel to immediately evacuate (immediate site evacuation or pull back)
Impact	Describe the impact of the event on local traffic and transportation services
ManageCommandStructure	Publish and update the current incident command structure in use at an event and the assignments of roles within it
MaterialRelease	Allows a description of where the material is coming from and going to (both in LRMS profiles and in generic ITIS natural language codes). Then the type of material, the quantity and how this is estimated can be described
NeedEMS	Inform others of the need for emergency medical services, provides a basic triage count of persons using one of several triage level codes
NeedFireSuppression	Inform others of the need for fire suppression or other fire-related responses
NeedLawEnforcement	Inform others of the need for law enforcement
NeedOtherServices	Inform others of the need for other (nonspecific) services
NeedRescueServices	Inform others of the need for emergency rescue services
NetworkConditions	Meet the requirements for the reply data from a message
PlacardsLabelsSignage	Denote markings found outside a vehicle or container pertaining to contents
PreemptionUserData	Relate information about a vehicle engaged in using the local priority / preemption network
RequestImmediateAssistance	A request for immediate emergency assistance (a "help" alert message) for a group of persons (one or more) in a related situation
RequestNetworkConditions	Gather current information about the transportation network status

Table 2—List of IDX submessages (continued)

IDX submessage	Description
RequestPhysicalAsset	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
RequestPhysicalAssetStatus	Request the last known current status of an asset
RequestPreemptionUserData	Request information about a vehicle engaged in using the local priority/preemption network
RequestRouteAdvice	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
RequestTrafficControlPlan	Request from 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)
RequestWorkZoneData	Indicate any event on or nearby the roadway that is pre-planned or known to the center receiving the request; used to gather information about pre-planned events, categorized using ITIS codes
ResourceAssignment	Describe when a center's assets have been assigned to some task as part of the incident
Response	Convey a planned response of the event to other centers
RouteAdvice	Provides a complex set of routing instructions suitable for use in public safety response
SceneStaging	Create and describe a zone in and around the event which will be used for various staging by the response centers
Severity	Describe the overall severity of the event and provide basic triage information about the count of victims or involved persons, and their injury levels and treatment needs for each
TrackInvolvedPerson	Track persons or vehicles, specifically to track involved persons (participants in the event)
TrackInvolvedVehicle	Track persons or vehicles, specifically to track data regarding vehicles involved in the event
TrackResponsePersonnel	Track persons or vehicles, specifically to track involved response personnel who are on scene at the event
TrackSpecialCircumstances	Track persons or vehicles, specifically to track involved response personnel in special circumstances
TrafficControlPlan	Sent in reply to a request for a traffic control plan
TransitEventSource	Uses the ImEventSource data frame from the work of the TCIP standards and is added to the collection of IDX submessages to allow sending a "native" message form TCIP into the IEEE 1512 system
TransitVehicleInvolved	Uses the ImEventSource data frame from the work of the TCIP standards and is added to the collection of IDX submessages to allow sending a "native" message form TCIP into the IEEE 1512 system about the transit vehicle involved in an event