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Intelligent transport systems — ITS Safety and emergency messages using any available wireless media — Data registry procedures

Systèmes intelligents de transport — Messages de sûreté et d'urgence pour les SIT utilisant tous les moyens de transmission sans fil disponibles — Procédures d'enregistrement des données

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 24978 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

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Introduction

The scale of death and injury on the roads of the world is recognized as a significant problem. To use a relatively safe continent, Europe, as an example, the European project Emerge calculated that in the EU, in 1998 (then including 15 countries), there were 43 000 dead and 1,7 million injured on the roads. By 2004, collated national statistics showed that the toll still exceeded 41 000 dead and 1,5 million injured. The death and injury toll in North America is at a similar level, and although, pro rata, the death and injury rates in Japan are at a slightly lower level, they remain unacceptable. Despite an aggressive road-safety policy, the statistics are slightly worse in Australia. In the emerging countries, the death and injury toll is significantly higher in almost every country.

As a result, in a series of initiatives around the world, governments have committed themselves to halving this carnage within a decade. In most of the developed world, where there have already been strenuous efforts to make the driving experience safer, it is becoming increasingly more difficult to make further improvements using traditional techniques. Intelligent transport systems (ITS) are therefore seen as being the key to achieving the ambitious targets that have been set.

Many ITS systems involve the exchange of data in order to provide services, and particularly safety services. Data is, and increasingly will be, sent from the infrastructure to the vehicle, from vehicle to infrastructure, from vehicle to vehicle, around the vehicle, and around the infrastructure. Much of this data remains within closed systems; however, an increasing amount of data can be shared to improve ITS service provision, and in particular, improve the safety of the driving experience and make a major contribution to the reduction of the death and injury toll. A number of intelligent transport systems/eSafety initiatives, such as "eCall" and "Automatic Crash Notification" crash messaging systems, are being developed. The European eCall project has an ambitious target to automatically provide, across the whole of Europe, a common 'minimum set of data' (MSD) to public service assistance providers (PSAPs) in the event of a crash.

Some of these data concepts, such as the MSD, are or will be defined and declared in International or Regional Standards, but much of the available and potentially useful data is not codified, and can be difficult to codify in standards because of differences between proprietary systems, and the speed at which the rapid evolution of systems provide data, which is much faster than the standardization process can agree and codify it.

Some of this data can be very useful to relevant third parties in crash, crash avoidance, crash mitigation and emergency systems. For example, a vehicle manufacturer can generate information about the number of persons in a vehicle, whether those persons are large or small (to ensure that airbags inflate safely), and they can monitor tyre pressure, speed of travel, etc. The available information can vary from vehicle model to vehicle model, can differ according to the manufacturer's market strategies, and will certainly differ and evolve over time so that the data available in a particular model in 2015 will be enhanced or different to that available in the same model in 2010. In these circumstances, it will be difficult or impossible to 'standardize' the available data as this would slow down the speed at which additional safety measures could be introduced, and interfere with the marketing incentives to provide additional safety services.

However, vehicle manufacturers might be able and willing to share that information with the emergency services, and might need an easy way to share information in collision avoidance and accident mitigation systems (such as ice and slippery-road alerts) and indeed might wish to collate data in order to more quickly identify and rectify design and software faults and reduce their exposure to liabilities. Road authorities might wish to make national data [such as variable message sign (VMS) information] available to vehicles in advance of international standardization of VMS messages or to deal with messages peculiar to that country.

While Europe can succeed in defining and codifying the common data concept known as the MSD, and can succeed in persuading vehicle manufacturers (by encouragement or legislation) to make this data available in the event of a crash or emergency, this will not pertain around the world. Other global initiatives, such as the 'Global Standards Cooperation' task force on automatic crash notification and emergency messages, can define additional or different data concepts. As described in the examples given in this introduction, vehicle manufacturers themselves will define data concepts that can be useful in the event of a crash or emergency, and to otherwise improve the safety of the driving experience.

As technical capability improves and as more attention is given to safety-related services, it becomes imperative that transmitted messages can be quickly and clearly understood by the recipient, or by both parties in interactive safety systems.

There can be a wide variety of message recipients. In the case of emergency crash messages, this can be a public service answering point (PSAP) which can be highly automated, or it can be a simple human respondent whose requirement is to get some precise, and accurate, human readable data to support a telephone call to the emergency services. At the other end of the scale, in respect of automated collision-avoidance systems, and other automatic safety ITS services, this can be a vehicle-vehicle, infrastructure-vehicle, or vehicle-infrastructure communication. Throughout the whole range of such messages, it is crucial that safety-related messages be quickly, clearly and unambiguously understood by the recipient.

This requires that the definition of the data be not only precise, but also freely available, whether available to system designers at the point of system design/deployment, or immediately available to a PSAP or other relevant recipient in respect of situations such as emergency crash-notification systems. This requires the availability of a common data registry as a repository for these safety-related messages and data concepts.

This International Standard provides the framework for the standardized operation and quality of service for one or more freely available data registries for ITS safety messages and data concepts.

The definitions in this International Standard are consistent with ISO 14817 (ITS Data Registries) and ISO/IEC 11179 (General principles for data registries).

In respect of automatic safety systems, such messages are normally determined at the point of system specification. However, in practice, in-vehicle technology is already developing rapidly, and will continue to do so, and new and additional data can well become available during the life of a system. In case of emergency, vehicles will have available data on board that can be useful, indeed vital, to PSAPs. For liability reasons, now that vehicles are data rich, vehicle manufacturers can well equip vehicles with an "Event Data Recorder" (EVR), the equivalent of the aircraft "Black Box". Such a device can identify factors such as the speed of the vehicle immediately before the crash, acceleration/deceleration rates, whether anti-lock or traction control systems were activated, etc. Future vehicles can also carry data from collision-avoidance warnings and collision-avoidance technology: how many passengers, what gear the car was in, etc. Where these systems (or other useful and related information) are available, they can provide very useful and timely information to a relevant recipient such as a PSAP; it cannot, however, be "required" as part of a "Standard" message.

The resultant "ITS Emergency and Safety Data Registry/Registries" are therefore likely to contain a mix of standardized data concepts, proprietary data concepts, and data concepts designed for national or regional use.

Additionally, there is the important consideration that equipment introduced into vehicles in 2010 can still be operational in 2040, whereas wireless communications media have much shorter life expectations. So in addition to new and additional data concepts, the means of carrying these across wireless media will also change. This International Standard is therefore media independent. It does not specify any particular means of data transfer; it simply enables data that is transferred to be unambiguously understood by the recipient.

To improve the veracity of receipt of crash information, rather than relying on a single media, it is felt that, in many circumstances, such vital information is sent, where possible over multiple media, indeed using each and every available media.

It is also not the intention that there will necessarily be a single global ITS emergency and safety message data registry, although this can be desirable for specific reasons. Regional or national instantiations can also be supported by this International Standard.

This International Standard provides the framework in which to operate such a data registry. It does not mandate the use or provision of any data concepts, nor involve itself with the security of transmission, issues of privacy, nor technical means of data transfer. It simply provides the rules to operate, with a high quality of service, a data repository to enable relevant parties to immediately, usually by automatic means, understand the precise and unambiguous meaning of an emergency safety-related message.

It is recognized that, in most implementations, tools will be required to use the contents of the data registry. However, this International Standard defines only the procedures for such a registry and the definition of such tools is outside the scope of this International Standard.

Intelligent transport systems — ITS Safety and emergency messages using any available wireless media — Data registry procedures

1 Scope

This International Standard deals with intelligent transport systems.

This International Standard provides a standardized set of protocols, parameters, and a method of management of an updateable "Data Registry" to provide application layers for "ITS Safety messages" using any available wireless media.

2 Conformance

In order to claim conformance with this International Standard, wireless communication shall be established in full compliance with local telecommunication regulations, procedures and protocols for that media using the appropriate International or Regional Standards, and shall be able to demonstrate that they provide the mandatory data, and can provide any standardized optional data elements to the extent that such data is available, and there is an available medium to transmit the message.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1000:1992, *SI units and recommendations for the use of their multiples and of certain other units*

ISO/IEC 8824-1:2002, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation — Part 1*

ISO/IEC 8824-2:2002, *Information technology — Abstract Syntax Notation One (ASN.1): Information object specification — Part 2*

ISO 11179 (all parts), *Information technology — Metadata registries (MDR)*

ISO 14817:2002, *Transport information and control systems — Requirements for an ITS/TICS central Data Registry and ITS/TICS Data Dictionaries*

IEEE 1489:1999, *IEEE standard for data dictionaries for intelligent transportation systems*

4 Terms and definitions

For the purposes of this document, the terms and definitions of ISO 14817 and ISO 11179 and the following apply.

4.1
automatic crash notification
automatic system to provide data notification to public-safety answering points, by means of any available wireless communications media, that a vehicle has crashed, and to provide coordinates and other relevant information in a message of standardized data concepts, not limited in length

4.2
eCall
⟨generic⟩ system to provide notification and relevant coordinate information to public-safety answering points, by means of wireless communications, that there has been an incident that requires a response from the emergency services

4.3
eCall
⟨ITS Specific⟩ user instigated or automatic system to provide notification to public-safety answering points, by means of wireless communications, that a vehicle has crashed, and to provide coordinates and a defined minimum set of data

5 Abbreviated terms

5.1
CCC
change control committee

5.2
ETSI
European Telecommunications Standards Institute

5.3
EU
European Union (EU15 implies the 15 countries that formed the European Union prior to 2005)

5.4
GPS
global positioning system

5.5
ID
identity

5.6
ITS
intelligent transport system

5.7
m
mandatory

5.8
o
optional

5.9
OID
object identifier

5.10
PSAP
public service answering point

6 Requirements for "ITS Safety Messages Data Registry" management

6.1 Concept of operation

This clause provides a summary overview of "ITS Safety messages" data dictionary and "Data Registry" operations. It identifies the parties involved in "ITS Safety messages" data dictionary and "Data Registry" operations, and specifies the responsibilities of each of the parties involved.

6.2 Summary

The "ITS Safety Messages Data Registry" shall support the harmonization of data concepts (e.g. data elements) from different stakeholder groups. It shall be consistent with ISO 14817 (Requirements for an ITS central "Data Registry" and ITS "Data Dictionaries"), and it and/or its entries are able to be submitted as (a) candidate(s) for an "ITS Data Registry" that is in accordance with ISO 14817.

The definition of key data elements may arise from numerous sources: PSAPs, automotive manufacturers, regulators, etc. Moreover, different groups will have an interest in the definition of the same data concept, which could lead to the prospect of duplicate or similar definitions being developed.

An ITS Safety or emergency data concept is data in a predefined and registered concept, recorded in such a manner that it is unambiguous and can be interpreted by reference to the data registry. The nature of form of the emergency or safety message is not defined by this International Standard, nor are the circumstances in which such a message is transmitted nor are the destination of the messages defined. This International Standard provides a specification of a process to register such data concepts in accordance with internationally recognized quality and implementation procedures as defined in International Standards, within the context of ITS. The procedures for submission and an acceptance process are defined herein.

A central "ITS Safety Messages Data Registry", or regional and national variants, of which the concept of operations are defined herein, supports standardization and harmonization processes that facilitate the different interested parties to share data element definitions and avoid duplication, yet enable the prompt admission of clearly defined and unambiguous entries from recognized sources, even where consensus and common data-concept definitions between interested parties have not yet been agreed upon.

The operational concept of the data registration is described in the following subclauses. See Annex C for specific procedural details.

NOTE   There may be regional and national variations of this concept for operations.

6.3 Framework

The overall framework for the "ITS Safety Messages Data Registry" and "ITS Safety messages data dictionaries" is presented in Figure 1. It illustrates the relationships between

— the ITS safety services architectures (and information models),

— the "ITS Safety messages data dictionaries" (that are intended to include all data concepts),

— an "ITS Safety Messages Data Registry", and

— the ITS safety services applications.

For each of these physical elements, the diagram in Figure 1 also lists their key functions. For "Data Dictionaries", the "Data Registry" and the applications, it further identifies the key stakeholders or stakeholder groups that participate in or manage their operations. Finally, the diagram illustrates the information exchanged between these operational elements.

"ITS Safety messages data dictionaries" shall contain data concepts based on information flows documented in an "ITS Safety Messages Architecture". Each data concept in a data dictionary shall reference one or more

flows of information between specific objects documented in a specific version of an "ITS Safety Messages Architecture", the primary architecture being as defined in this International Standard. Regional and National architectures are permissible.

The "ITS Safety Messages Data Registry" shall be the repository for submitted data concepts. Through the efforts of the data "Stewards", the "Registrar" and the data registry "Change Control Committee" (CCC) support identification of harmonization opportunities, recommendations for harmonization, and promotion of data concepts to higher quality levels where warranted. Finally, the "Data Registry" can provide data concepts to developers and other users for use in ITS applications.

Where considered appropriate by the sponsors, the day-to-day operational role of the CCC may be delegated to a single registry administrator in order to efficiently maintain the registry in a timely manner and to assist users in uploading and downloading data concepts.

Developers and other users should preferably use data concepts from the "Data Registry" at the highest (Preferred) quality level. The data concepts at this level are described unambiguously, harmonized across ITS sectors, and are considered representative of published data standards.
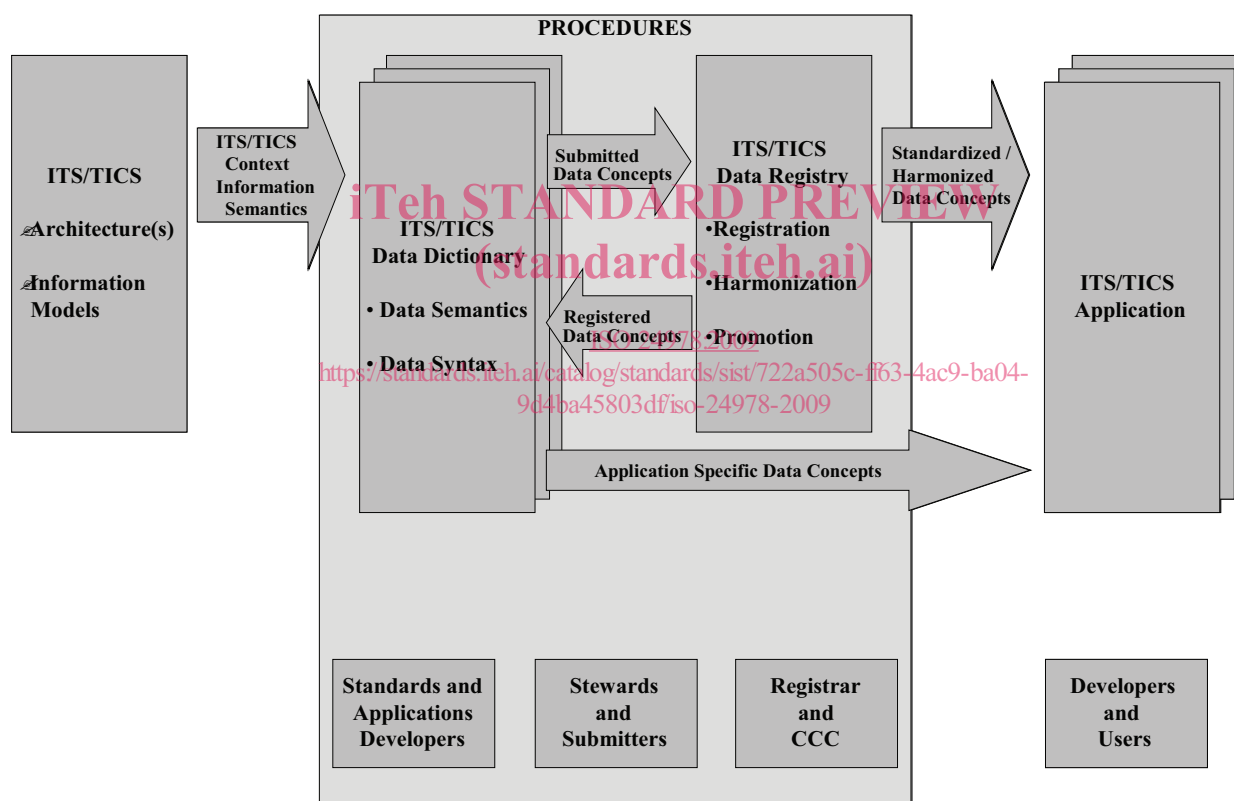

Figure 1 — "ITS Data Registry" operational framework

Table 1 presents a summary of the distinguishing characteristics between a "Data Dictionary" and a "Data Registry".

Table 1 — "Data Dictionary"/"Data Registry" distinguishing characteristics

"ITS Safety messages data dictionary"	"ITS Safety Messages Data Registry"
Multiple "Data Dictionaries"	One (International) "Data Registry"
Covers single functional area	Covers multiple sources
Managed by a functional area steward	Managed by the CCC
Harmonized within the functional area	Harmonized across the ITS sector
Unique ID within functional area	Unique ID across the ITS sector

6.4 Organizational roles

6.4.1 Overview

Organizational roles associated with the ITS safety messages data registration process shall be established. The organizational roles shall include the "ITS safety Messages data registry" "Executive Board" (EB), the ITS safety messages Change Control Committee (CCC), the ITS safety messages "Registrar", ITS safety messages "Stewards" and ITS safety messages "Submitters". A summary of each role is provided in this subclause. Annex C provides a description of the purpose, specific responsibilities, and membership or selection criteria for each role.

Figure 1 provides a high-level view of how these organizational roles are related within the context of the "ITS Safety Messages Data Registry".

6.4.2 Registration authority

The "ITS Safety Messages Registration Authority" shall be in accordance with the ISO/IEC Directives, Part 1 (2008), H.4.

6.4.3 Registrar

The "Registrar" shall be an organizational element, expert in data registration processes, responsible for facilitating the registration of ITS safety messages data concepts and making those data concepts widely accessible and available to the ITS safety messages community. The "ITS Safety Messages Registration Authority" shall appoint the "ITS Safety Messages Registrar".

6.4.4 Steward

An "ITS Safety Messages Steward" shall be an organizational element of the ITS safety messages community, such as an ISO WG Convenor or his designated representative. "Stewards" are responsible for the accuracy, reliability, and currency of descriptive metadata for data concepts at a registration status level of "Qualified" or above within an assigned functional, regional or national area. "ITS Safety Messages Stewards" are approved by a process defined by the registration authority.

6.4.5 Submitter

An "ITS Safety Messages Submitter" shall be an organizational element recommended by an "ITS Safety Messages Steward" and approved by a process defined by the "ITS Safety Messages Registration Authority". A "Submitter" is authorized to identify and report data concepts suitable for registration. Such "ITS Safety Messages Submitters" may be organizations representing Regional or National Governments, organizations representing PSAPs, organizations representing automotive manufacturers, or automotive manufacturers directly. Publication of a "Card" level submission shall be at the discretion of the "ITS Safety Messages Steward".

6.4.6 Read-only user

An "ITS Safety Messages Read-only User" shall be an organizational element or individual that is approved to review the contents of the "ITS Safety Messages Data Registry". A read-only user submits a request for access. Access is approved by the CCC or organizational element designated by the executive board. A read-only user has access to all the ITS Sector contents in the "ITS Safety Messages Data Registry", but is not permitted to submit, alter or delete the contents.

6.4.7 ITS safety messages change control committee

The "ITS Safety Messages Change Control Committee" (CCC) shall be the organizational element that is constituted to provide technical direction and harmonization of data contents for the "ITS Safety Messages Data Registry". The structure, staffing, procedures and membership of the CCC are determined by the ITS safety messages executive board. The membership of the CCC is to include the "ITS Safety Messages Stewards".

6.4.8 ITS safety messages executive board

The "ITS Safety Messages Executive Board" shall be an organizational element established by ISO/TC 204 and/or the sponsors of the data registry, or by the operators of an ITS safety messages data registry. In the case of an ISO/TC 204 official ITS safety messages data registry, it shall be responsible for administering responsibilities and authority delegated by ISO/TC 204. Responsibilities of the executive board shall include overall metadata registration policies and business direction of the "ITS Safety Messages Data Registry". In the case of an ISO/TC 204 official ITS safety messages data registry, the reporting responsibilities to ISO/TC 204 shall be specified and approval of executive board procedures and practices shall be subject to review and approval by ISO/TC 204 or its designated organizational component.
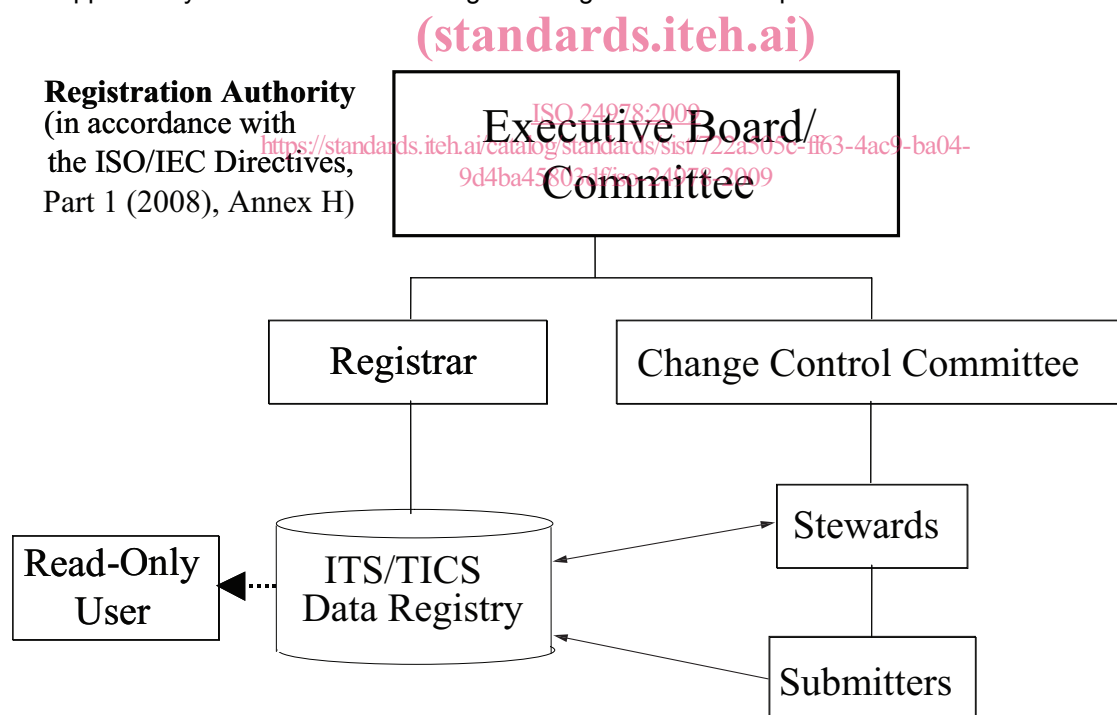

Figure 2 — Organizational roles to the "ITS Data Registries" and their relationships
(Source ISO 14817:2002)

6.5 Registration status levels

6.5.1 Summary of registration status levels

Registration status levels shall apply to individual data concepts that have been entered into the "ITS Safety Messages Data Registry". There shall be five data-concept registration status levels:

- "Card"
- "Draft"
- "Recorded"
- "Qualified"
- "Preferred"

The relationships between these status levels, along with the requirements for a data concept to achieve a particular registration status level, are presented in Table 2.

Table 2 — ITS safety messages registration status levels and criteria

Data-concept status level	Status criteria
Preferred	"Change Control Committee" confirmation that a data concept is "Preferred" for use in the ITS safety messages community.
Qualified	"Change Control Committee" confirmation that all mandatory attributes are completed and conform to quality requirements.
Recorded	All mandatory meta-attributes for the data concept have been input.
Draft	At least the meta-attributes "Descriptive Name" and "Submitter Organization" have been completed.
Card	At least the meta-attributes "Descriptive Name", "Submitter Organization", "Submitter Phone Number" have been completed.

While the general intention is to progress as many data concepts as possible from "Draft" to the "Preferred" registration status, progression to a status higher than "Recorded" or "Qualified" may not always be appropriate. That is, necessary meta-attribute documentation for a data concept may not be available to establish required documentation for the "Recorded" status, may not be of the quality necessary for the "Qualified" status, or identification as the "Preferred" data concept may not be appropriate. Such data concepts shall be held at their current status level in the "ITS Safety Messages Data Registry" to facilitate understanding of and access to these data concepts by the ITS safety messages community.

6.5.2 Description of registration status levels

The status level of a data-concept entry shall be based upon the completeness of the data entered, its accuracy, and its conformance to the established format and syntax. The registration status levels shall be as listed below.

a) **Card** A data concept in the "Card" status shall indicate that the "Submitter" wishes to make the ITS safety messages community aware of the existence of a data concept in their local domain. A data concept in the status of "Card" in the "ITS Safety Messages Data Registry" shall be maintained under version control within the "Submitters" data dictionary. The "Submitter" may remove a data concept in the status of "Card" from the "ITS Safety Messages Data Registry" at any time. The minimum meta-attribute documentation for the "Card" status in the "ITS Safety Messages Data Registry" shall be: "Descriptive Name", "Submitter Organization Name", "Submitter Phone Number", and "Submitter Email Address".

b) **Draft** A data concept in the "Draft" status shall indicate that the "Submitter" wishes to propose it for progression up the "ITS Safety Messages Data Registry" registration levels. Data concepts in the "Draft" status are not maintained under version control, which means that updates will completely replace the

original entry without retaining a record of the original. The "Submitter" may request the retirement of a data concept in the "Draft" status at any time, which will completely remove the data concept from the active "ITS Safety Messages Data Registry". The minimum meta-attribute documentation for the "Draft" status is "Descriptive Name" and "Submitter Organization Name".

c) **Recorded** A data concept in the "Recorded" status shall indicate that the "Submitter" has completed entries in all mandatory meta-attributes. A data concept in the "Recorded" status implies that the data concept may be shared across ITS domains. The contents of the mandatory meta-attributes may not conform to quality requirements. The "Submitter" may retire a data concept in the registration status of "Recorded" at any time. Data concepts in "Recorded" registration status, or higher, are maintained under version control.

d) **Qualified** A data concept in the "Qualified" status shall indicate that the CCC has confirmed that the mandatory meta-attributes are complete and conform to applicable quality requirements. In the event that a data concept is not approved by the CCC for the "Qualified" registration status level, it shall remain at the "Recorded" registration status level.

e) **Preferred** A data concept in the "Preferred" status indicates that the CCC confirms that the data concept is "Preferred" for use in the ITS safety messages community. The "Descriptive Name" and "ASN.1 Name" shall both conform to the ITS safety messages requirements.

6.6 Procedures

The "ITS Safety Messages Registration Authority" shall establish the necessary procedures to accomplish the following functional activities.

a) **Submission of data concepts for registration** "Submitters" shall submit data concepts for entry into the "ITS Safety Messages Data Registry". These data concepts may be "Recorded" as "Card" or "Draft" registration status, as the "Submitter" deems appropriate. A registration status of "Card" implies usage restricted to the "Submitter's" domain while being posted for informational purposes. The "Draft" status implies that the "Submitter" intends to progress the data concept to higher ITS safety messages registration status levels. "Submitters" or "Stewards" may progress data concepts in the "Draft" status to the "Recorded" registration status by completing all mandatory meta-attributes required for that data concept.

b) **Progression of data concepts** "Submitters" shall progress data concepts to "Recorded" status. Progression of data concepts to registration status of "Qualified" or higher shall require the sponsorship of a "Steward" and approval of the "Change Control Committee".

c) **Harmonization of data concepts** The objective of harmonization is to resolve any potential duplicate or overlapping of data concepts. Procedures shall be established to facilitate data-concept harmonization and reuse.

d) **Modification of data concepts** Procedures shall be established to change data concepts.

e) **Retirement of data concepts** Procedures shall be established to retire data concepts.

f) **Administrative processing** The "ITS Safety Messages Data Registrar" may assign administrative registration statuses in order to track an interim state of a data concept.

NOTE   This subclause introduces the requirements for procedures associated with the "ITS Safety Messages Data Registry" and "ITS Safety messages data dictionaries". These procedures require organizational participation of certain roles, as specified in 6.3, in dealing with data concepts to be registered in the "ITS Safety Messages Data Registry", as identified in Clause 7. Annex C provides representative procedures to address these functional requirements. Annex E provides guidance on the documentation of data concepts in preparation for submission to the "ITS Safety Messages Data Registry" for registration.

6.7 Version control

6.7.1 Version maintenance

This subclause presents the requirements for synchronization of the meta-attribute structures of the "ITS Safety messages data dictionaries" and "ITS Safety Messages Data Registry".

Configuration versions of the "ITS Safety Messages Data Registry" shall be maintained for meta-attributes.

A 'Current Version' and a 'Development Version' shall be established and maintained for attributes of the "ITS Safety Messages Data Registry". The versioning procedures in 6.7.2 and 6.7.3 shall apply.

6.7.2 Current version

The current version shall consist of those attributes approved by the CCC for current use in "ITS Safety messages data dictionaries" and the "ITS Safety Messages Data Registry".

6.7.3 Development version

The development version shall consist of those meta-attributes under development, together with pertinent current version meta-attributes, for use in "ITS Safety messages data dictionaries" and the "ITS Safety Messages Data Registry" as the next current version. The CCC controls the release of each development version as the new current version.

6.8 Summary of data concepts

NOTE   The term 'data concept(s)' is used throughout the document to mean 'types of data concept(s)'.

This subclause defines and explains the nine data concepts applicable to this International Standard. These data concepts are consistent with ISO 14817. Data concepts refer to abstractions and things in the natural world that can be identified with explicit boundaries and meaning. The properties and behaviour of these fundamental constructs all follow the same set of rules. Within ITS, there may be data concepts to represent, for example, a Bus "Route" and relevant information about it. Specifically within ITS safety messages, they relate to information that may be of use to PSAPs in responding to an emergency situation which has been alerted via an ITS safety-messages message.

Data concepts include interface dialogue, message, data frame, object class, association, property, data element concept, value domain, and data element. See Figure 3 for an ASN.1 Information Object Specification (IOS) for an ITS safety messages data concept. Figure 3 presents a framework for data concepts and how they relate to one another. For illustration purposes, the braces, i.e. { and }, portray the particular relationships between the data concepts. The numeric annotation associated with each brace indicates the number of each data concept that may be realized. For example, there may be from 2 to n messages within an interface dialog, where n is any integer number. As another example, a message may consist of 0 to n data elements and 0 to n data frames.

Figure 4 presents interface data concepts and their relationships. Information interchange between two ITS safety messages system components shall be characterized from the top down as an interface dialogue or a set thereof. Interface dialogues shall be a set of messages whose order and timing for transmission is predicated upon a defined operational concept or scenario containing timing information. Messages shall be a collection of data elements and/or data frames which contain the substantial data to be exchanged.

Figure 5 presents model data concepts and their relationships. In support of the information interchange data concepts, additional data concepts for modelling are provided. These modelling concepts support the realization of the organization of the various data concepts by characterizing key relationships between the data concepts. See Annex E.