



BSI Standards Publication

Intelligent transport systems — Reference model architecture(s) for the ITS sector

Part 1: ITS service domains, service groups and services

National foreword

This British Standard is the UK implementation of ISO 14813-1:2024. It supersedes BS ISO 14813-1:2015, which is withdrawn.

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**Intelligent transport systems —
Reference model architecture(s) for
the ITS sector —**

**Part 1:
ITS service domains, service groups
and services**

*Systèmes intelligents de transport (ITS) — Architecture(s) de
modèle de référence pour le secteur ITS —*

Partie 1: Domaines de service, groupes de service et services ITS

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 14813-1:2015), which has been technically revised.

The main changes are as follows:

- the list of services has been reorganized (to reduce redundancy) and updated;
- in [Clauses 7](#) to [16](#) some services have been added and others deleted, whilst others have been modified to reflect the continual evolution of ITS; this has been reflected in [Table 2](#);
- in [Clauses 7](#) to [16](#), the structure of the description of each service has been revised to create a more consistent representation of the services;
- as a result of the above changes, the Introduction and content of [Clauses 1](#) to [5](#) have been updated;
- a mapping of the services to the US ITS reference architecture reference [Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT)], has been provided in [Annex A](#);
- a mapping of the services to the European ITS Framework Architecture (FRAME), has been provided in [Annex B](#).

A list of all parts in the ISO 14813 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Intelligent transport systems (ITS) service domains and groups reflect the evolution of technology-oriented transportation practices and applications. So far, this has been in the surface transport systems domain, but ITS is also beginning to appear in other domains, such as maritime and rail transport. This has become of increasing importance and interest as the scope of ITS expands beyond its original range of services in road traffic management, traveller information and electronic payment systems.

ITS addresses services in the following areas of the surface transport systems domain:

- transport network operations and maintenance activities;
- freight mobility and inter-modal connectivity;
- multi-modal travel, including both pre-trip and on-trip information and journey planning where the trip starts and/or finishes in the surface transport systems domain;
- variable road pricing strategies for freight and personal travel;
- response activities and coordination related to emergencies and natural disasters;
- national security needs related to transportation infrastructure;
- cooperative-ITS (sometimes referred to as “connected vehicles” or “connected vehicle/highway systems”).

Services in some of these areas also interface with more generalized activities and environments outside the surface transport systems domain. For example, it is possible for road pricing and revenue systems activities to interface with electronic commerce (eCommerce) activities, and thus utilize standards and principles associated with the banking industry along with generally accepted accounting principles. The addressing of national security and coordination issues also requires that specific national standards related to civil defence, emergency communications, and other procedures be addressed. These interfaces, while largely outside the scope of ISO/TC 204, are nevertheless critical external influences on the functionality of the various services supported by ITS service domains and groups.

This document has been developed to define ITS service domains, service groups and services into which ISO/TC 204 documents can be mapped for a more structured context. This structure can then assist in the identification of areas that are not yet fully addressed by the documents created and managed by ISO/TC 204.

To this end, the ITS service domains, ITS service groups and ITS services presented in this document serve as a framework for developing ITS-related concepts of operation, which in turn lead to the definition of the appropriate requirements, ITS architectures and standards necessary to deploy specific ITS services. As the range of transportation activities that utilize ITS tools has broadened, the ITS service domains and ITS service groups included in previous editions of this document have been revised.

In order to establish the relationship and interdependencies of the various ITS services, it is beneficial to firstly determine the ITS service domains and the groups that reside within them in the current perception of the scope of the ITS sector. Although these ITS service domains and groups build upon those used in existing US, European Union, Japanese and other international ITS implementations, they can also provide a common descriptive basis for comparing these implementations, as well as others under development throughout the world. It is possible to use a sub-set of the ITS services described in this document as the basis for a particular ITS implementation. It is also possible to add specific ITS services not found in this document that are particular to an ITS implementation so that the stakeholders get the services that they want.

[Figure 1](#) illustrates the hierarchy of ITS service domains and ITS service groups and the ITS services that they include. The ITS service domains that apply to ITS are listed in [6.1](#) together with a definition of the nature of the activities provided. Each of these ITS service domains is then covered by separate clauses of this document, each of which includes the descriptions of its own ITS service groups and ITS services. The ITS service groups describe more specific activities that are part of the ITS service domain and the ITS services provide the more detailed description of what is provided within each ITS service group.

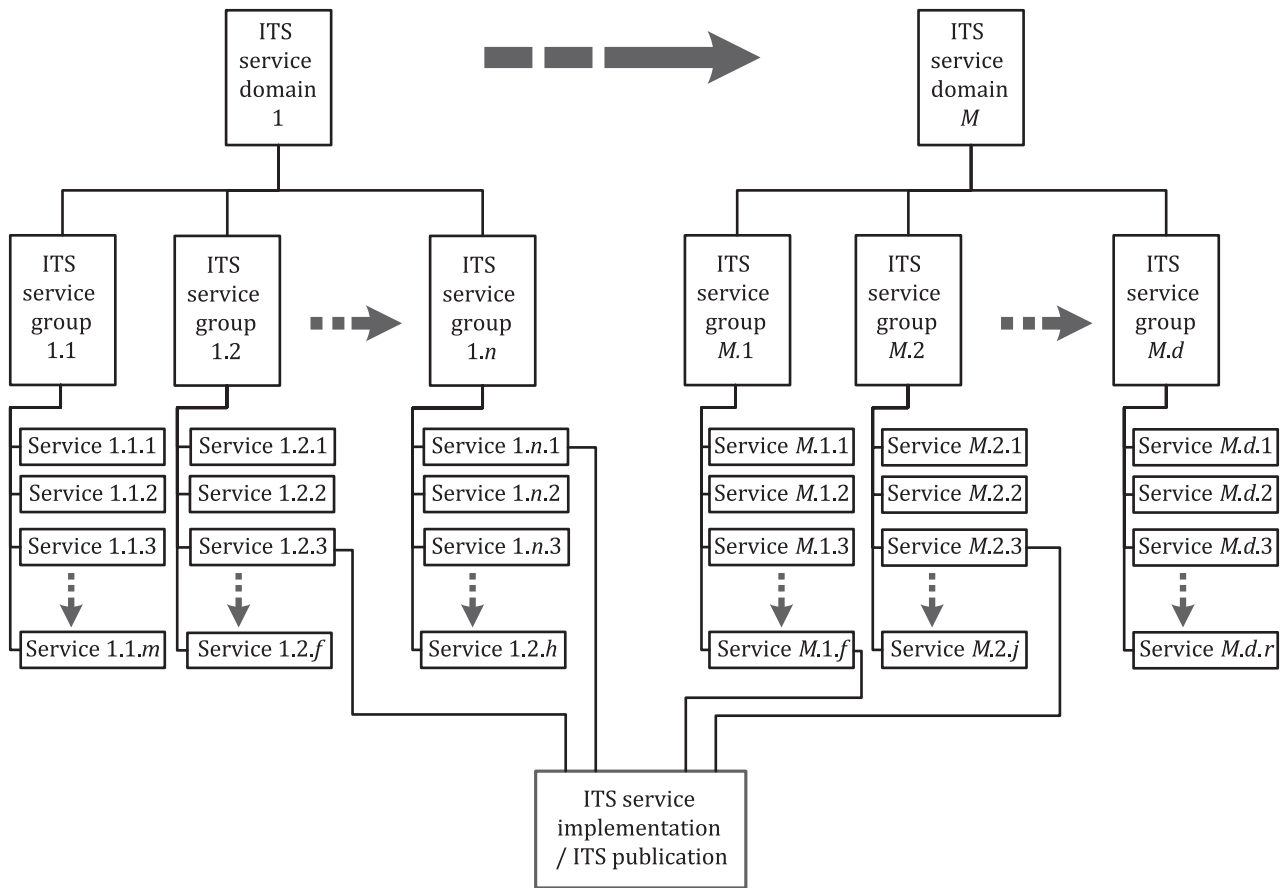


Figure 1 — ITS services — Hierarchy of definitions for ITS reference architecture

Currently there are many instantiations of ITS service implementations around the world, with some of them being used as the basis for several International Standards. This document embraces ITS services from the following sources:

- ITS service implementations from several parts of the world, including the US and the European Union;
- other ISO/TC 204 and CEN/TC 278 working groups.

Many ITS service implementations that are in use around the world are based on either the US National ITS Architecture or the European ITS Framework (FRAME) Architecture. Unfortunately, the terminology used by these two ITS architectures is similar but not identical. [Table 1](#) provides a high-level comparison between some of terms used in these two ITS architectures that are relevant to this document.

Table 1 — High-level comparison of ITS architecture terms

ISO 14813-1 (this document)	US Architecture	FRAME Architecture
Actor	Terminator	Terminator
ITS service domain	ITS Service Area	ITS Service Group
ITS service group	N/A	ITS Service Topic
ITS service	ITS Service Package	ITS Service

Full documentation of all possible approaches to ITS implementations is not feasible due to the high level of resources that would be necessary to carry this out. Indeed, full documentation and description of all possible approaches is undesirable as an item for standardization. Instead, a defined and consistent approach is required to facilitate reuse and interoperability.

Intelligent transport systems — Reference model architecture(s) for the ITS sector —

Part 1: ITS service domains, service groups and services

1 Scope

This document provides a description of the primary services that have been internationally defined to promote consistency among implementations. Implementations can provide any of these services in combination with any other services that are appropriate. This document organizes ITS services by defining service groups, which are placed into one of several service domains. Each service group contains one or more individual services, each of which is described.

This document is intended for use by at least two groups of people involved in the ITS sector:

- a) those who are looking for ideas about the services that ITS implementations can provide, and
- b) those who are developing International Standards.

For the first group, this document provides service descriptions that can act as the catalyst for more detailed descriptions. The level of detail can differ from one ITS implementation to another, depending on whether or not a national ITS architecture is involved, and whether or not this architecture is based directly on services, or on groups of functions. The service descriptions in this document are pitched at a high-level as too much detail can be prescriptive and reduces flexibility.

For standards developers, this document is applicable to Technical Committees who are developing International Standards for the ITS sector. This document is designed to provide information and explanations of services that can form the basis and reason for developing standards.

Due to its nature, this document is largely advisory and informative with minimal requirements. It is designed to assist the integration of services into a cohesive reference architecture, thereby promoting interoperability and the use of common data definitions. Specifically, services defined within the service groups can be the basis for defining “use cases”, “user needs” or “user service requirements” depending on the methodology being used to develop the resultant ITS architecture functionality. They can also assist with defining applicable data within data dictionaries, and applicable communications and data exchange standards.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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/TS 14812, *Intelligent transport systems — Vocabulary*

ISO 14817-3, *Intelligent transport systems — ITS data dictionaries — Part 3: Object identifier assignments for ITS data concepts*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14812 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

actor

entity that fulfils a role

3.2

application

mechanism for delivering some or all parts of an ITS service

3.3

dangerous goods

substances or articles which are potentially hazardous (for example, poisonous to humans, harmful to the environment, explosive, flammable or radioactive) that require regulatory control when transported

[SOURCE: ISO 15638-18:2017, 3.17, modified — permitted terms have been removed.]

3.4

dedicated transport network

transport mechanism that is able to carry people in special vehicles through a purpose-built network, which is usually separate from, but can be part of an existing road network

3.5

dispatch

action that requests specific resources to perform particular services

EXAMPLE The emergency communications centre dispatches an ambulance in response to an incident where it is determined that the victim needs be taken to a hospital.

3.6

electric vehicle

vehicle that is powered by its own on-board battery and does not use an internal combustion engine of any type

3.7

ITS service group

one or more similar or complementary ITS services provided to ITS users

3.8

ITS service domain

specific application area which comprises one or more ITS service groups

3.9

ITS stakeholder

individual or organization having a right, share, claim or interest in a system or in its possession of characteristics that meet their needs and expectations

Note 1 to entry: An ITS stakeholder's involvement can be through use, manufacture of products, provision of services, or regulation.

3.10

ITS user

individual who directly or indirectly receives output from and/or provides input to the transaction of an ITS service

Note 1 to entry: These individuals can be human, external systems or another source of data, e.g. detection equipment.

3.11

navigation

ITS service which provides directional information to an individual during a trip

3.12

mass

mass of a given heavy vehicle as measured by equipment affixed to the regulated vehicle

[SOURCE: ISO 15638-12:2014, 4.33]

3.13

route guidance

service which utilizes directional information, destination or real-time data to select an appropriate route, either prior to or during a trip

4 Abbreviated terms

ANPR	automatic number plate recognition
AVL	automatic vehicle location
C-ITS	cooperative ITS
CN	communications network
EFC	electronic fee collection
EV	electric vehicle
ETC	electronic toll collection
GVW	gross vehicle weight
HAZMAT	hazardous materials
HOV	high occupancy vehicle
ITS	intelligent transport systems
LPN	licence plate number
MaaS	mobility as a service
MOD	mobility on demand
OBE	on-board equipment
PT	public transport
RUC	road user charging
TARV	telematics applications for regulated commercial freight vehicles
WIM	weigh-in-motion

5 General requirements

5.1 ITS service domains, service groups and services

5.1.1 Characteristics of ITS service domains

Regardless of any specific ITS implementation, ITS services and groups of services are usually combined into different (although often interrelated) application areas called "service domains". These service domains have as their focus one or more groups of ITS users, such as travellers, road network operators, drivers (both

of all vehicles and of selected types), or those who move freight. They are the highest level of abstraction in an ITS architecture.

ITS services do not represent the technology that will be required by any of the one or more ITS applications that are required to deliver them. In fact, it is possible for the technology and functionality used by the ITS applications to vary from one ITS implementations to another and for the content of the ITS applications to vary because of the variances in the organizational structures used in different geographical areas.

There is no prescribed relationship between ITS service domains and the areas of common functionality that are included in different ITS architectures. Sometimes a relationship can appear to exist, but this is often illusory and a reflection of the choice of names for the areas of common functionality. For example, both the US National ITS Architecture and the European ITS Framework (FRAME) Architecture include an area of functionality called "Manage Traffic", which in both cases supports ITS services other than those included in the "Traffic Management and Operations" ITS service domain described in this document.

5.1.2 Characteristics of ITS service groups

A service domain comprises one or more types of ITS service. It shall be possible for each type of ITS service to comprise several instances of related services. These collations of related ITS service instances are called "ITS service groups." An ITS service group consists of one or more similar or complementary services that can be provided to ITS users.

There are several characteristics of 'ITS service groups' and the services contained within.

- a) Each "ITS service group" is oriented to a specific activity related to management or information of the surface transport systems network that is divided into specific services that should address particular users or modes.
- b) The name of each service group should reflect the type of activities supported (e.g. "pre-trip information").
- c) Each service within the service group should reference both the service group activity and the nature of the users or modes supported by the service (e.g. "pre-trip information – public transport").
- d) Each level of the hierarchy should be at an equivalent level of granularity.

5.1.3 Characteristics of ITS services

Within this document, an ITS service consists of a product or activity that can be provided to an ITS user. Thus, ITS services are considered as the elemental building blocks of any ITS architecture and the ITS implementations based upon its contents. ITS services are described in a way that is independent of the technologies that will be needed to deliver them. In fact, it is entirely possible that the technologies needed by an ITS service do not exist and thus the ITS service can provide the motivation for future ITS-related research and development activities. The language used in ITS service descriptions is non-technical so that they can be understood by a wide variety of ITS users, including those without any knowledge of the capabilities that ITS can provide.

The level of detail in this document is focused at the level of domains and service groups, and specific services. It is noted that different countries partition their reference architectures in different ways – some through more granular service or needs definition, others at a higher level of abstraction. However, in order to provide a level of consistency and to avoid ambiguities arising from different definitions of services with the same name, high-level or outline definitions are provided for specific services. Nevertheless, users can add to or replace some of the specific services described in this document in order to reflect particular location and/or jurisdictional and/or societal requirements. Whenever this is done, the names of these new or replacement services are not permitted to conflict or replicate the names of services used in this document.

The elaboration of specific ITS services shall be undertaken in a consistent manner throughout any specific architecture. There are several methodologies that assist the development of this consistent elaboration.

ISO 14813-5 provides guidance as to the requirements for architecture description in ITS International Standards.

5.2 ITS users

The general definition of the ITS user is that it represents an entity that is external to the ITS implementation and has a need for a surface transport system benefit that can be met with the use of information, communication, sensor and/or control. The “need” is met through interaction of the ITS user with applications in the ITS implementation. ITS users have elsewhere also been described as one of the sets of “stakeholders” who are involved in requesting and promoting ITS implementations. By definition, all human interaction with ITS implementations involves ITS users interfacing with applications across the boundary of the system.

NOTE Humans interacting with applications in an ITS implementation are sometimes called “external ITS users.”

6 The structure of ITS service domains

6.1 ITS service domains

Categorization of ITS activities is one of the first steps in defining the range of activities, some or all of which can be supported by any ITS implementation. It serves to delineate different sectors of the ITS industry.

The following lists and describes 10 “ITS service domains” covered by the services in this document.

- 1) Traveller Information – this service domain addresses the provision of both static and dynamic information about the surface transport systems network to users prior to and during their trips, including inter-modal options and transfers and the status of other transport modes.
- 2) Traffic Management and Operations – this service domain addresses the management of the movement of all types of vehicles, travellers and pedestrians throughout the road network, and includes both automated monitoring and control activities as well as decision-making processes (both automated and manual) that respond to the transport-related impacts of real-time incidents and other disturbances on the transportation network, as well as managing travel demand as needed to maintain overall mobility.
- 3) Vehicle Services – this service domain has as its focus the enhancement of safety, security and efficiency in vehicle operations, by warnings and assistance to users or input to the operation of the vehicle. These services use information from on-board sensing devices, and/or from wireless communications with other sources.
- 4) Freight Transport – this service domain addresses the management of the operation of commercial vehicle fleets and the movement of freight, including activities that expedite the authorization process for freight to move across national and jurisdictional boundaries, activities that expedite inter-modal transfers of freight and the operation of freight vehicles that use telematics applications to enhance their operation and management. The movement of freight within other transport modes, e.g. maritime and rail, is not generally considered a part of ITS but intermodal transfers, storage and road freight is considered an integral part of ITS.
- 5) Public Transport – this service domain addresses the management of public transport (i.e. publicly accessible transport whether publicly operated or privately operated) to enable the provision of services that operate in a more timely and efficient way and the provision of operational information to the operators and the public that are its users. This information for users also includes details of services provided by different operators and other transport modes.
- 6) Emergency Service – this service domain includes ITS services that assist emergency responders to provide their services in a quicker, safer, more informed and more efficient manner through the surface transport systems network.
- 7) Payment for Transport-Related Services – this service domain covers the payments that travellers make for using the transport network and mobility services and includes road user charging.

- 8) Weather and Environmental Conditions Monitoring – this service domain is responsible for activities that monitor and notify users and transport network managers of weather and environmental conditions that are likely to have an impact on the surface transport systems network and its users.
- 9) Disaster Response Management and Coordination – this service domain is concerned with surface transport systems-based activities that manage resources from multiple jurisdictions in their responses to natural disasters, civil disturbances or terror attacks.
- 10) Performance Management – this service domain is responsible for the on-line and off-line simulation, management and planning of surface transport systems network operation, using archived and/or live data that has been obtained from monitoring of the surface transport systems network.

The categorization of the services into 10 domains does not imply that all ITS architectures and the implementations deployed from them should be required to include one or more services from each and every one of these domains. The ITS services that ITS architectures include should be those that are best suited to the ultimate goals of the ITS deployment the ITS architectures are supporting.

ITS services are often dependent upon, or are key enablers of other services that can be external to ITS and/or within an ITS service group. In ITS implementations based on these services, it is important for the proposed classification schema included in the ITS architectures that supported the implementation to identify the entities that are responsible for the provision of the ITS service.

6.2 Cooperative-ITS

The advent of cooperative-ITS (C-ITS) is seen by many as providing the need for a completely new set of ITS services and ITS service groups. However, closer study reveals that much of what C-ITS provides is just a use of new technologies and methodologies to achieve the same service goals as traditional ITS. So, for example, providing travel information in a vehicle through communication with the roadside infrastructure and/or other vehicles, belongs in the "Traveller Information" group. The important attributes that C-ITS does provide are improved ways of communication, both for collecting surface transport systems data from which information can be derived, and for providing the information in real-time to the vehicle occupants. It also enables data to be shared between vehicles and with other entities within an ITS implementation. These points have been included in some of the new ITS service groups and services. The agreed definition of cooperative-ITS is provided in ISO/TS 14812.

6.3 Service domain structure

[Table 2](#) shows the structure of each of the 10 service domains identified in [6.1](#). Within each domain are a number of groups, each of which can have one or more constituent ITS service(s). The domain and group structure provides an easy way to find individual services, which are the core of this document.

The following points apply when selecting services to be included in any ITS implementation.

- 1) Within many of the services there are attributes defined by "(a)", "(b)", "(c)", etc., at least one of which shall be selected for use in an application, or standard.
- 2) It is expected that any number of services can be selected and implemented in any combination depending on the goal(s) of the individual ITS implementations in which they are to be included. This particularly applies to the Traveller Information domain.

Table 2 — Structure of ITS service domains and groups

Service domain	Service group	Service	See sub-clause
Traveller Information	Real-time transport status information	Traffic information	7.2.2.1
		Roadway information	7.2.2.2
		Multi-modal transport information — available services	7.2.2.3

Table 2 (continued)

Service domain	Service group	Service	See sub-clause
		Multi-modal transport information — current situation information	7.2.2.4
		Multi-modal transport information — trip planning service	7.2.2.5
		Multi-modal transport information — user access	7.2.2.6
		Multi-modal transport information — modal transfer information	7.2.2.7
		Dynamic parking information — external to facilities	7.2.2.8
		Static parking information — external to facilities	7.2.2.9
	Real-time in-vehicle display	In-vehicle signage — route guidance and regulatory	7.3.2.1
		In-vehicle signage — parking information	7.3.2.2
		In-vehicle signage — speed and lane control	7.3.2.3
		In-vehicle signage — advance warning and advisory	7.3.2.4
		Specific public transport vehicle related information	7.3.2.5
	Real-time route guidance and information	Dynamic in-vehicle route guidance using real-time information	7.4.2.1
		Dynamic personal route guidance using real-time information	7.4.2.2
		Public transport-specific trip guidance	7.4.2.3
	Guidance to EV charging facilities	Route guidance to nearest available appropriate EV charging station	7.5.2.1
		Route guidance if no charging facility available	7.5.2.2
	Multi-modal trip planning	Multi-modal comparative trip guidance	7.6.2.1
		Centralized trip planning using real-time and policy inputs	7.6.2.2
	Travel services information	Travel services information — destination	7.7.2.1
		Travel services information — current location	7.7.2.2
Traffic Management and Operations	Traffic management and control	Traffic monitoring	8.2.2.1
		Surface street traffic management	8.2.2.2
		Freeway traffic control — ramp management	8.2.2.3
		Freeway traffic control — mainline speed and lane management	8.2.2.4
		Preferential treatment for specific vehicle types (signal priority and pre-emption)	8.2.2.5
		Reversible lane management	8.2.2.6
		Coordination of surface street and freeway management	8.2.2.7
		Multi-modal highway junction management	8.2.2.8
		Parking management	8.2.2.9
		Work zone traffic management	8.2.2.10
		Traffic advisory and warning information	8.2.2.11
		Vehicle oversize/overweight warning and re-routing	8.2.2.12
		Queue detection and information management	8.2.2.13
		Tunnel access management and re-routing	8.2.2.14
		Bridge access management and re-routing	8.2.2.15
	Transport related incident management	Incident monitoring and confirmation	8.3.2.1
		Incident on-site driver assistance	8.3.2.2
		Incident on-site traveller assistance	8.3.2.3

Table 2 (continued)

Service domain	Service group	Service	See sub-clause
		Incident co-ordination and clearance	8.3.2.4
		Hazardous materials monitoring and management	8.3.2.5
		Collection of incident details from other transport modes	8.3.2.6
	Demand management	Variable road pricing – dedicated lane	8.4.2.1
		Variable road pricing – entire facility	8.4.2.2
		Cordon and zone-based congestion pricing	8.4.2.3
		Access management	8.4.2.4
		High-occupancy lane management	8.4.2.5
		Air quality and pollution-based surface transport systems management	8.4.2.6
	Surface transport systems infrastructure maintenance management	Winter maintenance	8.5.2.1
		Roadway maintenance management	8.5.2.2
		Work zone safety management	8.5.2.3
		Maintenance fleet and equipment management	8.5.2.4
	Policing/enforcing traffic regulations	Restricted zone access enforcement	8.6.2.1
		Vehicle overweight enforcement	8.6.2.2
		High-occupancy vehicle facility usage	8.6.2.3
		Parking regulation enforcement	8.6.2.4
		Speed limit enforcement	8.6.2.5
		Signal enforcement	8.6.2.6
	Safety enhancements for vulnerable road users	Non-motorized vehicle and pedestrian monitoring	8.7.2.1
		Systems to monitor specialized vehicles	8.7.2.2
		Access to roadway crossings for vulnerable road users	8.7.2.3
	Safety provisions for pedestrians using intelligent junctions and links	Provide pedestrian access at intelligent junctions	8.8.2.1
		Monitor pedestrians using intelligent links	8.8.2.2
	Advanced warnings provided by intelligent junctions	Signal display advance warning	8.9.2.1
		Non-signalized advance warning	8.9.2.2
	Monitoring and management of suspicious vehicles	Detection and identification of suspicious vehicles	8.10.2.1
		Road traffic management for suspicious vehicles	8.10.2.2
		Emergency notification to key agencies of suspicious vehicles	8.10.2.3
		Management of the impact of suspicious vehicles on their surroundings	8.10.2.4
Vehicle Services	Automated vehicle operation	Automated highway operation	9.2.2.1
		Automated low-speed vehicle operations assistance	9.2.2.2
		Automated parking	9.2.2.3
		Adaptive cruise control	9.2.2.4
		Cooperative adaptive cruise control	9.2.2.5
		Vehicle platooning	9.2.2.6
		Automated lane keeping	9.2.2.7
		Automated road departure prevention	9.2.2.8

Table 2 (continued)

Service domain	Service group	Service	See sub-clause
		Automated lane change systems	9.2.2.9
		Automatic weigh-in-motion (WIM)	9.2.2.10
	Collision mitigation / avoidance	Roadway collision mitigation/avoidance	9.3.2.1
		Intersection collision mitigation/avoidance	9.3.2.2
		Automatic vulnerable road user mitigation systems	9.3.2.3
	Driver warning or advisory	Lane departure warning system	9.4.2.1
		Emergency breaking assistance	9.4.2.2
		External hazard detection and notification	9.4.2.3
		Driver advisory	9.4.2.4
	Safety warning	Special vehicle alert	9.5.2.1
	Management of suspicious vehicles	Identification of suspicious vehicles	9.6.2.1
		Disablement of vehicles believed to be suspicious	9.6.2.2
Freight Transport	Commercial vehicle pre-clearance	Weigh-in-motion	10.2.2.1
		Non-stop pre-clearance	10.2.2.2
		Vehicle safety records monitoring	10.2.2.3
	Commercial vehicle administrative processes	Freight movement information exchange	10.3.2.1
		Automatically identify, monitor and exchange emergency response information for dangerous goods	10.3.2.2
		Automated credential filing	10.3.2.3
		Automated commercial vehicle administration	10.3.2.3
		Automated border crossings	10.3.2.5
	Automated roadside safety inspection	Remote access to commercial vehicle safety data	10.4.2.1
		Remote access to commercial vehicle driver data	10.4.2.2
	Commercial vehicle on-board safety monitoring	Commercial vehicle internal systems monitoring	10.5.2.2
		Commercial vehicle driver alertness monitoring	10.5.2.2
		Commercial vehicle cargo state monitoring	10.5.2.3
	Intercity freight transport fleet management	Intercity commercial vehicle fleet tracking	10.6.2.1
		Intercity commercial vehicle fleet dispatching	10.6.2.2
	Intermodal information management	Vehicle and container arrival information exchange	10.7.2.3
		Customer freight information access	10.7.2.4
		Freight container tracking	10.7.2.5
	Management and control of intermodal centres	Intermodal centre facility management	10.8.2.1
		Intermodal vehicle and container control	10.8.2.2
	Management of dangerous freight	Dangerous goods movement data collection and sharing	10.9.2.1
		Dangerous goods movement data registry	10.9.2.2
		Dangerous goods movement fleet coordination	10.9.2.3
		Dangerous goods movement police/safety coordination	10.9.2.4
		Dangerous goods movement location monitoring	10.9.2.5
	Management of heavy goods vehicles	Heavy goods vehicle data collection and sharing	10.10.2.1
		Heavy goods vehicle registration and route planning	10.10.2.2
		Heavy goods vehicle location monitoring	10.10.2.3

Table 2 (continued)

Service domain	Service group	Service	See sub-clause
	Management of local delivery vehicles	Delivery vehicle fleet tracking	10.11.2.1
		Delivery vehicle fleet dispatching	10.11.2.2
		Delivery zone and parking information services	10.11.2.3
	Telematics applications for regulated commercial freight vehicles (TARV)	Procedures, and enforcement provisions for the providers of regulated services	10.12.2.2
		Provision of system security	10.12.2.2
		Provision of vehicle information	10.12.2.3
		Provision of vehicle access management	10.12.2.4
		Provision of remote tachograph monitoring	10.12.2.5
		Provision of emergency messaging system/eCall	10.12.2.6
		Provision of driver work records	10.12.2.7
		Provision of vehicle "mass" monitoring	10.12.2.8
		Provision of vehicle location, speed and consignment data	10.12.2.9
		Provision of vehicle parking facilities	10.12.2.10
	Freight transport content management	Collection of freight transport content data	10.13.2.1
		Communication of freight transport content data	10.13.2.2
		Monitoring of freight for tampering and security	10.13.2.3
Public Transport	Public transport management	Public transport operational management	11.2.2.1
		Public transport fleet management	11.2.2.2
		Public transport vehicle monitoring	11.2.2.3
		Public transport service monitoring and scheduling	11.2.2.4
		Public transport operational strategies	11.2.2.5
		Public transport wayside status	11.2.2.6
	Demand responsive and shared transport	On-demand public transport fleet management	11.3.2.1
		On-demand ridesharing management	11.3.2.2
		On-demand movement of freight by public transport	11.3.2.3
	Automated vehicle operation	Precision docking for public transport vehicles	11.4.2.1
	Public travel security	Silent alarm	11.5.2.1
		Emergency call/mayday alert for public transport	11.5.2.2
Emergency Services	Transport related emergency notification and personal security	User-initiated distress calls	12.2.2.1
		Automated emergency call and mayday (eCall) dispatch	12.2.2.2
	After-theft vehicle recovery	Stolen vehicle tracking	12.3.2.1
		Remote vehicle immobilization	12.3.2.2
	Emergency vehicle management	Emergency vehicle fleet tracking	12.4.2.1
		Emergency vehicle fleet management	12.4.2.2
		Emergency vehicle traffic management coordination	12.4.2.3
	Hazardous materials and incident notification	HAZMAT vehicle tracking and monitoring	12.5.2.1
		HAZMAT vehicle route management	12.5.2.2
		Automated HAZMAT emergency call/mayday notification	12.5.2.3
		HAZMAT preclearance services	12.5.2.4

Table 2 (continued)

Service domain	Service group	Service	See sub-clause
Payment for Transport Related Services	Transport Infrastructure usage	Electronic fee collection (EFC) and electronic toll collection – (ETC)	13.2.2.2
		Road user charging (RUC)	13.2.2.2
	Mobility service usage	Fee and fare collection for mobility services	13.3.2.1
		Parking payment	13.3.2.2
	Transport related services	Payment for transport-related services	13.4.2.1
		Payment for additional non-transport related services	13.4.2.2
Weather and Environmental Conditions Monitoring	Weather monitoring	Road weather information monitoring	14.2.2.1
		Road weather prediction	14.2.2.2
	Environmental conditions monitoring	Water level/tidal monitoring and prediction	14.3.2.1
		Seismic monitoring	14.3.2.2
		Pollution monitoring	14.3.2.3
		Avalanche, mud slide and fallen rock monitoring	14.3.2.4
Disaster Response Management and Coordination	Disaster data management	Disaster and emergency data collection	15.2.2.1
		Disaster and emergency data sharing	15.2.2.2
	Disaster response and evacuation management	Disaster response planning for the transport network	15.3.2.1
		Evacuation planning for the transport network	15.3.2.2
		Disaster response implementation	15.3.2.3
		Evacuation and re-entry management	15.3.2.4
	Coordination with emergency agencies	Disaster response coordination	15.4.2.1
Traffic Management Performance	Data storage	Data archiving warehousing	16.2.2.1
		Provide access to data archive and warehouse to interested organizations	16.2.2.2
	Simulation	System performance simulation (online)	16.3.2.1
		System performance simulation (offline)	16.3.2.2

6.4 ITS service groups for each domain

ITS service groups represent a further delineation of the various sectors of ITS activity represented by the domains described in 6.1. The delineation specifically addresses different types of activities carried out within the domain. The service groups as described by domain in the following subclauses do not necessarily address specific users, modes or audiences for these activities. That level of detail is provided by the specific services, which are defined under each service group. This permits the transport operator (state, municipality or authority) to select which specific services within each service group are relevant to their needs and to add extra location and/or jurisdictional specific services if and when required.

ITS International Standards prepared by ISO/TC 204 are focused on the surface transport systems sector and the interfaces with other transport modes. Other committees define standards and practices for rail, air and waterways. However, there are many "grey" areas where ITS standards embrace aspects that affect both road and other transport modes. Conversely, there are also standards for other transport modes that affect the ITS sector. This particularly applies in the area of traveller information, scheduling and traffic control.

6.5 Use of ITS services to provide Object Identifiers for data concepts

A unique Object Identifier (OID) for data concepts shall be used in other ITS International Standards prepared by ISO/TC 204. The format of this OID shall be defined through the use of the ITS domain and

service number in which the data concept shall be used and the format shall be defined according to the procedures for OIDs that are described in ISO 14817-3.

7 Traveller Information service domain

7.1 Overview

The scope of this domain shall include the provision of both static and dynamic information about the surface transport systems network to its users both prior to and during their trips. It includes information about inter-modal options and transfers and the status of other transport modes for use by some users.

Within this scope, the domain shall include the following groups of services:

- a) Real-time transport status information — see [7.2](#);
- b) Real-time in-vehicle display — see [7.3](#);
- c) Real-time route guidance and information — see [7.4](#);
- d) Guidance to EV charging facilities — see [7.5](#);
- e) Multi-modal trip planning — see [7.6](#);
- f) Travel services information — see [7.7](#).

7.2 Real-time transport status information

7.2.1 Overview

This service group has the following characteristics.

- It shall encompass travel information received at home, work, hotels, major public locations, such as shopping centres, and on portable terminals prior to travel.
- It shall be possible for pre-trip information services to target road facilities, public transport, freight and intermodal users, and non-motorized travel.
- Depending on the service provided, pre-trip information shall include current information on traffic conditions, schedule adherence and location of public transport vehicles relative to the user's location, road and weather information, prevailing traffic regulations and tolls.
- In geographic terms, it shall relate to those parts of the travel network that are near to the current location of the traveller and shall not be dependent on the route and modes of a trip that the traveller is currently undertaking.

7.2.2 Constituent ITS services

7.2.2.1 Traffic information

The scope of this service shall include the provision of information to the traveller about the current state of traffic and shall comprise the following:

- a) the current real-time state of traffic flows, including such things as speed, headway and congestion state;
- b) queues at toll stations, bridges and road ferry terminals.

7.2.2.2 Roadway information

The scope of this service shall include the provision of information to the traveller about the current state of the roadway and comprise the following:

- a) the presence of ice, snow or surface water;
- b) any other conditions that have the possibility to affect the freedom of movement for road vehicles.

7.2.2.3 Multi-modal transport information — available services

The scope of this service shall include the provision of available services information including:

- a) types and modes of transport services available at each stop;
- b) location of stops;
- c) schedules for all transport services available at each stop;
- d) historical performance (schedule adherence and “vertical” mode performance) for each service at each stop;
- e) fares for each transport service at each stop.

7.2.2.4 Multi-modal transport information — current situation information

The scope of this service shall include the provision of the current situation information including:

- a) the current status (arrivals and departures) of the transport services provided;
- b) temporary and special services that are in operation;
- c) current known and expected delays (current and near-term situational status) and cancellations;
- d) currently available parking nearby.

7.2.2.5 Multi-modal transport information — trip planning service

The scope of this service shall include the provision of trip planning for current or upcoming passenger trips including calculating itinerary and end-to-end navigation from origin to destination (including walking directions).

7.2.2.6 Multi-modal transport information — user access

The scope of this service shall include the provision of information about user channels for accessing planning and real-time information on available services, current situational status and trip planning.

7.2.2.7 Multi-modal transport information — modal transfer information

The scope of this service shall include the provision of information about the facilities that are available for a traveller to transfer their mode of travel between different transport modes and shall include the following:

- a) modal transfer options available;
- b) recommended transfer locations between transport modes;
- c) be based on static information, which shall be provided by those who own, operate and manage the transport infrastructure and include:
 - 1) location of inter-modal transfer points,
 - 2) hours of operation,
 - 3) modes between which transfers can be made,

- 4) transfer facilities, e.g. lifts, stairs and escalators;
- d) be based on real-time dynamic information, which shall be provided by those who own, operate and manage the transport infrastructure and include:
 - 1) current service availability,
 - 2) next scheduled departure times for available services,
 - 3) current transfer time.

The types of information shown in c) and d) shall be available through a variety of mechanisms, such as local information outputs, the Internet, in-vehicle displays and personal devices.

7.2.2.8 Dynamic parking information — external to facilities

The scope of this service shall include the provision of real-time dynamic information at one or more locations outside of the facility itself that comprises:

- a) current number of available spaces;
- b) predicted number of available spaces.

This information shall be provided for each type of parking, e.g. long stay, short stay and valet parking. It shall be available through a variety of mechanisms, including the Internet at locations that are remote from the parking facilities.

7.2.2.9 Static parking information — external to facilities

The scope of this service shall include the provision of static information at one or more locations outside of the facility itself that comprises:

- a) directions to the parking facility;
- b) type of parking available, e.g. long stay, short stay and valet parking;
- c) allowable length of stay;
- d) restrictions, e.g. no camping or overnight parking;
- e) parking charges.

This information shall be provided for each type of parking, e.g. long stay, short stay and valet parking. It shall be available through a variety of mechanisms, including the Internet at locations that are remote from the parking facilities.

7.3 Real-time in-vehicle display

7.3.1 Overview

This service group has the following characteristics.

- It shall encompass information provided to travellers in the vehicle, either for a mass audience or tailored to the specific vehicle or traveller location, or along the travel route.
- It shall be possible for the scopes of the services to enable information to be provided as advisories and for it to comprise:
 - real-time travel information, including estimated time to a destination based on current conditions;
 - work zones;
 - incidents;

- weather;
- tolls;
- parking availability;
- other information of use to the traveller.

7.3.2 Constituent ITS services

7.3.2.1 In-vehicle signage — route guidance and regulatory

The scope of this service shall include the provision of the facility for the following information to be displayed to drivers in their vehicles:

- a) route guidance: this information shall be based on some or all of the following data that are provided by drivers before the start of their trips:
 - 1) trip origin and destination,
 - 2) route preferences,
 - 3) requested arrival time,
 - 4) vehicle characteristics;
- b) regulatory: this information shall include weight, height and entry restrictions.

It shall be possible within the scope of this service for some of these data to be automatically provided by the vehicle, and other items such as origin, destination and route preferences can be sourced from a pre-defined list of those used most often by the driver.

7.3.2.2 In-vehicle signage — parking information

The scope of this service shall include the provision of the facility for parking information to be displayed to drivers in their vehicles and shall include some or all of the following:

- a) location of available parking spaces, either as the location of a parking area, or spaces within a parking area;
- b) cost of parking;
- c) maximum allowable duration of stay and any other limitations, e.g. no camping, or maximum size of vehicle;
- d) level of security and its type, e.g. entry/exit detection, car parking attendant and video monitoring.

It shall be possible within the scope of this service for this information to be displayed for:

- 1) one or more parking area(s) in the vicinity of the vehicle or at a location that is defined by the driver, e.g. the trip destination;
- 2) as part of booking facilities that must be used before a space can be occupied.

7.3.2.3 In-vehicle signage — speed and lane control

The scope of this service shall include the provision of the facility for speed and lane control information to be displayed to drivers in their vehicles and shall comprise some or all of the following:

- a) current speed limit;
- b) speed limit in the road ahead of the vehicle when different from the current speed limit;
- c) vehicle staying out of lane;

- d) vehicle in a lane not appropriate for its type and/or number of occupants;
- e) vehicle headway is unsafe for current speed, vehicle and road conditions.

It shall be possible within the scope of this service for the content of this information to be influenced by:

- f) the type of vehicle;
- g) the size of the vehicle;
- h) the current condition of the vehicle;
- i) the current state of the driver that has been detected by sensors in the vehicle.

7.3.2.4 In-vehicle signage — advance warning and advisory

The scope of this service shall include the provision of the facility for advance warning and advisory information not included in other services in this group to be displayed to drivers in their vehicles and for this information to comprise warnings and advisories about:

- a) adverse road conditions on the planned route, or in the predicted vehicle trajectory;
- b) changes in speed limits;
- c) changes in weather conditions;
- d) entry into a tolled section and/or imminent arrival at a toll plaza/charging zone;
- e) restricted access to the road ahead;
- f) erratic driving, e.g. due to tiredness;
- g) problems with the condition of the vehicle.

It shall be possible within the scope of this service for the content of this information to be influenced by:

- 1) the type of vehicle;
- 2) its size;
- 3) its current condition.

7.3.2.5 Specific public transport vehicle related information

The scope of this service shall include the provision of travellers with real-time public transport vehicle information integrating information from different transport modes and presenting it to travellers for decision making. It shall consist of the following functions;

- a) information distribution: this provides real-time situational information to travellers based on their needs, for example “in the right place, at the right time, for a reasonable ‘cost’”, including providing through signs or announcements current and next stop information on-board public transport vehicles;
- b) information receipt: this includes provision of the following:
 - 1) information on mobile devices, equipment at a fixed location where passengers board or alight from a public transport vehicle, or on a public transport conveyance,
 - 2) interactive or static on-trip information dissemination via visual or audio media channels,
 - 3) current situational status and/or predictive information about current public transport services;
- c) information processing: this provides services to reserve, confirm and pay for public transport services, including connection protection, rideshare, fixed route deviation, parking and other public transport services (or multimodal services connected with public transport trips).

7.4 Real-time route guidance and information

7.4.1 Overview

This service group has the following characteristics.

- It shall be categorized as a planning service and includes services provided during a trip to enable the traveller to complete the trip as planned.
- It shall be possible for the scopes of the services in this group to enable the best route options to be calculated taking account of network and public transport information and to incorporate multi-modal options such as "Park and Ride".

7.4.2 Constituent ITS services

7.4.2.1 Dynamic in-vehicle route guidance using real-time information

The scope of this service shall include providing drivers of vehicles with route guidance information in their vehicles that shall have the following characteristics:

- a) dynamically updated as the trip progresses;
- b) based on some or all of the following data that is to be provided by drivers before the start of their trips:
 - 1) the trip origin and destination,
 - 2) route preferences,
 - 3) requested arrival time,
 - 4) vehicle characteristics;
- c) some of the previous data may be automatically provided by the vehicle;
- d) other items of data such as origin, destination and route preferences may be sourced from a pre-defined list of those used most often by the driver;
- e) modified as the trip progresses from that originally produced to take account of real-time changes to one or more of the following:
 - 1) road conditions, e.g. ice and snow,
 - 2) traffic conditions, e.g. congestion and incidents,
 - 3) the condition of the vehicle, e.g. brakes becoming worn down,
 - 4) the driver's state, e.g. tiredness causing lack of concentration that has been detected by sensors in the vehicle.

The changes to the route guidance shall enable the driver to avoid and/or compensate for the above.

- f) possibility for the route guidance to provide direction to a nearby rest area if the state of the driver is such that to continue to drive the vehicle is likely to present a danger to other road users.

7.4.2.2 Dynamic personal route guidance using real-time information

The scope of this service shall include providing travellers with route guidance information for any surface transport mode. It shall be:

- a) available through a portable device that is dynamically updated as the trip progresses;

- b) based on some or all of the following data that is to be provided by drivers before the start of their trips:
 - 1) trip origin and destination,
 - 2) route preferences,
 - 3) requested arrival time,
 - 4) requested preferences for transport modes to be used,
 - 5) the traveller's state, e.g. disabled, elderly,
 - 6) characteristics of the traveller's own transport means, e.g. car, bicycle and motor cycle.
- c) possible for some of the content to be automatically provided from a pre-defined list of those used most often by the driver, e.g. origin and destination plus route and mode preferences;
- d) modified as the trip progresses from that originally produced to take account of real-time changes to one or more of the following:
 - 1) travel conditions, e.g. ice, snow, congestion, availability of other transport modes,
 - 2) the condition of the traveller's own transport means,
 - 3) the traveller's state, e.g. tiredness causing lack of concentration that has been detected by sensors in the vehicle.

The changes to the route guidance shall enable the traveller to avoid and/or compensate for the above.

- e) possible for the content to include:
 - 1) unexpected changes to the availability of transport modes;
 - 2) guidance to a place where rest can be taken be it from driving, cycling, walking or the use of public transport.

7.4.2.3 Public transport-specific trip guidance

The scope of this service shall include the provision of travellers with route guidance information through information displays that are available on public transport vehicles or at other public transport-related facilities. The route guidance information shall:

- a) be generic in the sense that it does not necessarily relate to the trip being made by each traveller;
- b) have the possibility of including some or all of the following information:
 - 1) expected time of arrival of the next service and subsequent services,
 - 2) current service performance, e.g. running late or early,
 - 3) other services available at the next stop and their time(s) of departure,
 - 4) other transport modes available at the next stop.

The availability of this information and the display mechanism that is used shall depend on the physical location where it is being displayed.

7.5 Guidance to EV charging facilities

7.5.1 Overview

This service group has the following characteristics.

- It shall enable drivers to plan trips so that they can make use of the appropriate electric vehicle charging facilities along their route.
- It shall take account of the vehicle type, make and model so that the most appropriate charging facilities can be found.
- It shall provide guidance to safety if charging is not possible.

7.5.2 Constituent ITS services

7.5.2.1 Route guidance to nearest available appropriate EV charging station

The scope of this service shall include the provision of dynamic route guidance information to drivers in their vehicles to guide them to the nearest most appropriate charging facilities to be utilized when required. The content of the information shall take account of the following:

- a) type of vehicle;
- b) make and model of vehicle, so that a facility with the appropriate connections can be found;
- c) current state of charge of the battery that is used for the movement of the vehicle, from which the distance the vehicle can travel before running out of power can be determined;
- d) the availability of the charging facility, e.g. is it operational and are there any available charging points.

The route guidance information shall give the driver the option to choose and be guided to any of the available charging facilities that are within range of the vehicle given the current state of its battery, even if one or more of these facilities is not on the route that is being followed by the driver.

7.5.2.2 Route guidance if no charging facility available

The scope of this service shall enable the provision of dynamic route guidance information that is provided to drivers in their vehicles to guide them to a place of safety if no suitable charging facilities are available within range of the vehicle given the current state of its battery.

7.6 Multi-modal trip planning

7.6.1 Overview

This service group has the following characteristics.

- It shall enable travellers to plan trips that involve the use of two or more modes of transport.
- It shall be possible for scopes of the services in this group to enable the best route options to be calculated taking account of network and public transport information and to incorporate multi-modal options such as Park and Ride.

7.6.2 Constituent ITS services

7.6.2.1 Multi-modal comparative trip guidance

The scope of this service shall enable travellers to plan different trips and then compare them in the following ways.

- a) The trips shall involve the use of two or more modes of transport, at least one of which shall involve the use of the managed road network, either for walking, cycling, motor cycling, car driving or using public transport.
- b) The comparison shall be made by the traveller selecting one or more of the following parameters:
 - 1) cost;
 - 2) total trip time, i.e. including waiting time at modal transfers;
 - 3) number of modes used;
 - 4) number of mode changes.
- c) As a result of the comparison, the traveller shall be able to refine the details of some or all of the trips and re-run the comparison. Once the traveller is satisfied, the trip can be retained for immediate or future use.

7.6.2.2 Centralized trip planning using real-time and policy inputs

The scope of this service shall include the provision of trip planning that takes place using a "centralized" system belonging to an organization that has access to the following:

Real-time travel data that shall include some or all of the following:

- a) traffic data, to include speeds and congestion;
- b) public transport service data, to include current and expected schedule deviations;
- c) weather data, to include both current conditions and forecast changes that have the potential to adversely affect road travel;
- d) policy inputs that are either obtained from other organizations, or created by the organization that provides the service and include such things as the requirement for trips to use particular transport modes in preference to others or for the use of some transport modes to be prohibited.

Where the modes chosen by the traveller are not those used in the trip plan because of policy restrictions, the traveller shall be informed of the changes.

7.7 Travel services information

7.7.1 Introduction

This service group has the following characteristics.

- It shall include the provision of services other than actual travel that have the potential to be of use to a traveller before or during a trip.
- The information made available from services in this group shall relate to the proposed destination of the trip, to the trip origin, or to the current location of the traveller.

7.7.2 Constituent ITS services

7.7.2.1 Travel services information — destination

The scope of this service shall include the provision of information about the services that are available to the traveller at the destination of a trip, either before the trip is made, or whilst the trip is in progress. It shall be possible within the scope of this service for the information to be both static and real-time dynamic, the traveller being provided with a suitable indication for each piece of information.

- a) static information shall include any of the following:
 - 1) hotels,
 - 2) restaurants and fast or take-away food outlets,
 - 3) places of entertainment,
 - 4) medical facilities,
 - 5) points of Interest, e.g. land marks and places of historical interest,
 - 6) places offering other services, e.g. banking and currency exchange;
- b) real-time dynamic information shall include any of the following:
 - 1) hotel availability and costs,
 - 2) restaurant availability and costs,
 - 3) current and predicted state of the weather and other phenomena such as tides, canal lock operating times, etc.

The availability of this information and the display mechanism that is used shall depend on the physical location from where it is being displayed, which could be:

- c) a static device;
- d) computer equipment;
- e) vehicles;
- f) personal devices.

Where the information is available from computers and personal devices, the scope of this service shall enable the traveller to pre-book hotels and restaurants and to place orders in advance.

7.7.2.2 Travel services information — current location

The scope of this service shall include the provision of information about the services that are available to the traveller at the place where they are currently located, which may be the trip origin or a place that is en-route in the trip. If this information is being provided before a trip commences then it shall be about the trip origin. It shall be possible within the scope of this service for the information to be both static and real-time dynamic, the traveller being provided with a suitable indication for each piece of information.

- a) Static information shall include any of the following:
 - 1) restaurants and take-away food outlets,
 - 2) places of entertainment,
 - 3) medical facilities,

- 4) places offering other services, e.g. banking and currency exchange.
- b) Real-time dynamic information shall include any of the following:
 - 1) current and predicted arrivals and departures of available public transport modes,
 - 2) current and predicted state of the weather and other phenomena such as tides, canal lock operating times, etc.

The availability of this information and the display mechanism that is used shall depend on the physical location from where it is being displayed, which could be:

- c) a static device;
- d) computer equipment;
- e) vehicles;
- f) personal devices.

Where the information is available from computers and personal devices, the scope of this service shall enable the traveller to pre-book restaurants and place orders in advance at take-away food outlets.

8 Traffic management and operations service domain

8.1 Overview

The scope of this domain shall include the management of the movement of all types of vehicles, travellers and pedestrians throughout the surface transport systems network, and includes both automated monitoring and control activities, decision-making processes (both automated and manual) that address real-time incidents and other disturbances on the transportation network, plus managing travel demand as needed to maintain overall mobility, safety enhancements for vulnerable and disabled road users, managing the use of intelligent junctions and dealing with suspicious vehicles.

Within this scope, the domain shall include the following groups of services:

- a) traffic management and control — see [8.2](#);
- b) transport-related incident management — see [8.3](#);
- c) demand management — see [8.4](#);
- d) surface transport systems infrastructure maintenance management — see [8.5](#);
- e) policing/enforcing traffic regulations — see [8.6](#);
- f) safety enhancements for vulnerable road users — see [8.7](#);
- g) safety enhancements for disabled road users — see [8.8](#);
- h) safety provisions for pedestrians using intelligent junctions and links — see [8.9](#);
- i) monitoring and management of suspicious vehicles — see [8.10](#).

8.2 Traffic management and control

8.2.1 Overview

The service group has the following characteristics.

- It shall address the management of traffic flows through the managed road network.

- It shall include the use of various mechanisms to monitor and manage traffic using the managed road network, including facilities to give preference to the movement of specific types of vehicles such as buses and taxis, plus vehicles belonging to the emergency services.
- It shall include the management of the physical road network, modal interfaces and parking.

8.2.2 Constituent ITS services

8.2.2.1 Traffic monitoring

The scope of this service shall enable the monitoring of the traffic conditions that currently exist in the road network being managed by ITS. The data to be monitored shall include some or all of the following:

- a) traffic flow rate (a measure that shows the numbers of vehicles passing particular points);
- b) traffic speed (for vehicles passing particular points);
- c) headway between vehicles (at particular points and in particular lanes at those points);
- d) congestion (defined as the location of stationary traffic at particular points).

It shall be possible within the scope of this service for the above data items to be:

- 1) measured at one or more points in the managed road network;
- 2) classified by type of road vehicle, e.g. car, bus, freight vehicle and bicycle;
- 3) made available for use by other services.

8.2.2.2 Surface street traffic management

The scope of this service shall enable the flow of traffic in surface streets to be managed in one or more of the following ways:

- a) local control, using traffic signal controllers that only take account of local conditions;
- b) vehicle-actuated control, using traffic signal controllers that use their own detection of vehicle presence;
- c) fixed time control, using pre-programmed traffic signal controllers;
- d) pedestrian control using:
 - 1) traffic signal controllers that can respond to demands from pedestrians to be allowed to cross the roadway,
 - 2) without input from pedestrians in conjunction with other traffic management measures;
- e) adaptive control, using traffic signal controllers subject to one or more different methodologies;
- f) no control – traffic is allowed to flow without being managed.

It shall be possible for each of these methods of management to be applied to some parts or the entire managed road network at different times or the day and days of the year.

8.2.2.3 Freeway traffic control — ramp management

The scope of this service shall enable the control of ramps that give access for vehicles to freeways to be applied in the following ways:

- a) to restrict the access of vehicles to freeways to limit the impact of joining traffic on the flow of vehicles that are already using the freeways;

- b) to decide whether or not vehicles shall have access to the freeway based on the current traffic slow conditions, e.g. vehicle density and speed, on the freeway in the vicinity of the ramp entrance onto the freeway;
- c) to decide whether or not vehicles shall have access to the freeway based on the current traffic slow conditions, e.g. vehicle density and speed, in the surface street networks adjacent to the freeway ramps;
- d) to apply the first two of these criteria by freeway lane and/or vehicle type;
- e) to apply all access restrictions by time of day, day of week, and/or day or year;
- f) to be able to modify an existing access restriction or impose a new access restriction without any reference to the current freeway traffic conditions, e.g. in the event of some kind of incident, or emergency.

Any changes in control shall be applied in a safe manner that does not lead to a reduction in the safety of vehicles using the surface street network.

8.2.2.4 Freeway traffic control — mainline speed and lane management

The scope of this service shall enable the flow of traffic using freeways to be managed in a way that is based on one or both of the following:

- a) mainline speed, i.e. the average speed of vehicles using the freeway;
- b) lane management, i.e. the use that is made of each lane of the freeway.

It shall be possible within the scope of this service for either of these control methods to be applied;

- c) to one or more of the lanes provided by the freeway;
- d) to vary from one location to another;
- e) to be applied in different ways to different types of vehicles.

Any changes in control shall be applied in a safe manner that does not lead to a diminution in the safety of vehicles using the freeway network.

8.2.2.5 Preferential treatment for specific vehicle types (signal priority and pre-emption)

The scope of this service shall enable priority to be given to the way in which particular types of vehicles are able to move through the managed road network. It shall mainly be applied to the surface street part of the managed road network as this is where the most beneficial effects are able to be produced.

The types of vehicles for which priority shall be available shall include some or all of the following:

- a) bicycles;
- b) public transport vehicles, including buses and trams plus light rail vehicles where their routes interact with the managed road network;
- c) emergency vehicles, i.e. police, fire and ambulance;
- d) freight vehicles;
- e) special vehicles, e.g. military vehicles or those carrying “hazardous goods”.

It shall be possible within the scope of this service for priority to be given to each vehicle type at the same location and to different types of vehicles at specific locations throughout the managed road network.

8.2.2.6 Reversible lane management

The scope of this service shall enable the direction of the flow of traffic in a lane of the managed road network to be changed and for it to be applied:

- a) on a very selective basis;
- b) made in such a way that:
 - 1) it does not lead to a diminution in the safety of vehicles using the road network,
 - 2) it causes the minimum of disruption to the current flow of traffic,
 - 3) the lanes for which the direction of traffic flow is to be changed are clearly identified in a way that can be understood by all drivers.

These changes to the direction of traffic shall apply to all drivers using the part(s) of the managed road network in which the affected lane exists and drivers joining the affected lane from other parts of the road network, e.g. from side roads.

Any change in the direction of traffic flow shall:

- c) be preceded by a closure of the use of the lane to ensure that the traffic that is currently using it has been cleared;
- d) not be made at frequent intervals, i.e. at intervals of less than one hour.

8.2.2.7 Coordination of surface street and freeway traffic management

The scope of this service shall make it possible for the management of traffic using the surface streets in the managed road network to be co-ordinated with the management of traffic using the freeway part of the managed road network in any of the following ways:

- a) switching of traffic between surface streets and freeway parts of the network to enable traffic use to be balanced;
- b) switching of traffic between surface streets and freeway parts of the network to reduce congestion in one part of the network if there is spare capacity in the other;
- c) switching of traffic between surface streets and freeway parts of the network when some or all of one part of the network has been closed;
- d) temporary restriction of access for one or more types of vehicles to either the surface streets or freeway parts of the network.

It shall be possible within the scope of this service for any of these activities to be applied:

- e) to some or all of either the surface streets or freeway parts of the managed road network;
- f) where the some or all of the surface streets and freeway parts of the managed road network are managed and/or operated by different authorities and/or jurisdictions.

8.2.2.8 Multi-modal highway junction management

The scope of this service shall enable the management of inter-modal highway junctions using either of the following measures:

- a) the stoppage of one of the modes of travel to give priority to one or more other modes (e.g. stopping road traffic to permit heavy or light rail vehicles to move through the junction) or the closure of part of the managed road network to permit a bridge over a river or canal to open to water borne traffic;
- b) the application of a temporary speed restriction to one or more modes so that they are not brought to a physical stop by the passage of vehicles using one or more of the other modes.

These measures shall be applied so that any temporary restriction on the operation of one mode is managed in such a way that the disruption to the other mode is minimized.

It shall be possible within the scope of this service for each of these activities;

- 1) to be applied to one, some or all of the modes that use a particular inter-modal junction;
- 2) to be accompanied by the provision of appropriate and adequate warning to drivers of all effective modes well in advance of the inter-modal crossing that either of the activities is in progress.

For the managed road network, where possible and appropriate, the warning that the activity is in progress shall include advice about the temporary use of one or more alternative routes.

8.2.2.9 Parking management

The scope of this service shall enable the use of parking facilities within the managed road network to be managed using one or more of the following measures:

NOTE The service for the collection of payment for parking is described in [13.2.2](#).

- a) the opening and/or closing of some or all of a parking facility, either permanently or for a temporary period;
- b) the provision of real-time and static information to drivers at a parking facility about the number of vacant spaces, the cost to use them and the maximum time for which they can be used;
- c) the real-time monitoring of the usage of a parking facility to establish how many vacant spaces exist at any point in time;
- d) the real-time monitoring of a parking facility in total and/or some or all of the individual spaces within a parking facility to identify vehicles that have stayed longer than the time for which they have paid and/or the maximum time allowed.

It shall be possible within the scope of this service for one or some of these measures to be applied:

- 1) to some or all of the parking facilities in some or the entire managed road network;
- 2) at each parking facility;
- 3) to one or more different types of vehicles at each parking facility.

8.2.2.10 Work zone traffic management

The scope of this service shall enable the flow of traffic passing work zones (road works) to be managed using one or more of the following measures:

- a) application of speed restrictions for some or all of the part of the managed road network where the work zone (road works) is (are) active;
- b) application of different speed restrictions for some or all of the part of the managed road network where the work zone (road works) is (are) active;
- c) provision of appropriate lane management to ensure the safety of both the road workers and the passing traffic;
- d) where possible and appropriate, the provision of physical barriers to ensure the safety of both the road workers and the passing traffic;
- e) the temporary closure of the part of the managed road network in which the work zone (road works) is (area) present;
- f) the provision of appropriate and safe access for road workers and equipment and construction materials to the work zone (road works);

- g) the provision of the appropriate advanced warning to drivers that any of the above measures have been implemented on the managed road network ahead in the direction of travel.

It shall be possible within the scope of this service for:

- h) each of these measures to be implemented at some or all of the work zones (road works) present in the managed road network;
- i) different measures to be implemented at each work zone (road works).

8.2.2.11 Traffic advisory and warning information

The scope of this service shall enable the provision of traffic advisory and warning information to drivers comprising one or more of the following.

- a) Advisory messages which shall include advice about:
 - 1) the onset of adverse traffic conditions that are causing delays,
 - 2) alternative routes for any of the previously defined advisories and warnings,
 - 3) the likely effects of congestion and/or adverse weather on speeds and/or journey times.
- b) Warning messages which shall include warning of:
 - 1) impending adverse weather and in the current location and/or in the direction of travel,
 - 2) a work zone (road works) ahead, including any temporary speed limits,
 - 3) highway restrictions ahead, such as narrow lanes, bridges, severe curves, weight restrictions,
 - 4) road closure in the direction of travel.

The advisory and warning information shall:

- 1) be provided in a form that is easily readable in all expected types of lighting conditions, whether due to the natural progression of day and night or due to bad weather;
- 2) be at the prevailing average vehicle speeds;
- 3) take into consideration any local regulations that are in force;
- 4) be presented in a timely manner and at locations where drivers are able to make decisions about what alternative route choices to make, depending on what is available.

8.2.2.12 Vehicle oversize/overweight warning and re-routing

The scope of this service shall enable the use of sensors to detect a vehicle with the following characteristics:

- a) one or more of its dimensions, i.e. length, width or height, exceed those that are defined for “normal” vehicles by the authority responsible for managing the operation of the road network;
- b) its weight exceeds that defined for “normal” vehicles by the authority responsible for managing the operation of the road network.

If either, or both, of a) and b) are detected, then the driver of the vehicle shall be provided with one or both of the following mechanisms:

- 1) a visible and audible warning that the vehicle is oversize and/or overweight;
- 2) instructions for an alternative route for the driver to follow so that the current journey can continue.

These warnings and instructions may be provided through one or both of the following mechanisms:

- in-vehicle displays and audio devices;
- devices located at the roadside.

8.2.2.13 Queue detection and information management

The scope of this service shall enable the presence of queues to be detected and for information about the queues to be provided to drivers. The detection of the presence of queues can be provided by one or both of the following mechanisms:

- a) sensors located in the carriageway that detect the presence and passage of vehicles;
- b) sensors located at the roadside that detect the presence and passage of vehicles;
- c) data about vehicle movement provided by in-vehicle systems and/or sensors provided through C-ITS.

When a queue is detected, drivers located upstream of where the queue has formed, i.e. approaching the back of the queue, shall be informed of the presence of the queue using one or more of the following mechanisms:

- 1) in-vehicle displays;
- 2) displays on devices located at the roadside and/or above the carriageway.

8.2.2.14 Tunnel access management and re-routing

The scope of this service shall enable the conditions inside road tunnels that form part of the road network to be detected and monitored and for information about any closures or restricted access to be provided to drivers. The monitoring can be achieved using a variety of mechanisms including but not limited to:

- a) inputs provided by tunnel monitoring systems;
- b) sensors that are able to monitor conditions in the tunnels, e.g. air quality, smoke and excessive heat;
- c) traffic flow sensors that can detect queues of vehicles at tunnel entrances and/or lack of vehicles at tunnel exits.

If any of these sensors detect problems, i.e. interruptions to the flow of traffic through a tunnel, drivers of all vehicles approaching the tunnel shall be provided with one or both of the following mechanisms:

- 1) a visible and audible warning that the tunnel is closed for use by road traffic;
- 2) instructions for an alternative route for the driver to follow so that the current journey can continue but avoiding the tunnel for which problems have been detected.

These warnings and instructions may be provided through one or both of the following mechanisms:

- in-vehicle displays and audio devices;
- displays on devices located at the roadside and/or above the carriageway.

8.2.2.15 Bridge access management and re-routing

The scope of this service shall enable the conditions on bridges that form part of the road network to be detected and monitored and for information about any closures or restricted access to be provided to drivers, pedestrians and cyclists. The monitoring can be achieved using a variety of mechanisms including but not limited to:

- a) inputs provided by bridge monitoring systems;
- b) sensors that are able to monitor travel conditions on the bridges, e.g. wind speed and direction and temperature;

- c) traffic flow sensors that can detect queues of vehicles at the on-ramps for bridges and/or lack of vehicles at off-ramps for bridges.

If any of these sensors detect problems, i.e. interruptions to the flow of traffic across a bridge, drivers of all vehicles approaching the bridge shall be provided with one or both of the following mechanisms:

- 1) a visible and audible warning that the bridge is closed for use by road traffic;
- 2) instructions for an alternative route for the driver to follow so that the current journey can continue but avoiding the bridge for which problems have been detected.

These warnings and instructions may be provided through one or both of the following mechanisms:

- in-vehicle displays and audio devices;
- displays on devices located at the roadside and/or above the carriageway.

In addition to the above, the service may also provide similar warnings and alternative route instructions to other travellers such as pedestrians and cyclists using one or both of the following mechanisms:

- displays adjacent to the walkways used by pedestrians and cyclists;
- messages that can be displayed by mobile devices.

8.3 Transport-related incident management

8.3.1 Overview

This service group provides the capability for the detection of possible incidents, the confirmation that an incident has occurred, and response to various incidents in the transport network, which specifically involve conditions initiated in the network itself rather than purely from external sources (e.g. natural disasters, terrorist attacks).

The scope of the services in this group shall enable the detection of some incidents to be provided by systems responsible for the management of other transport modes, e.g. rail and air.

8.3.2 Constituent ITS services

8.3.2.1 Incident monitoring and confirmation

The scope of this service shall enable the monitoring of data and its use to detect and confirm that an incident has occurred that affects the movement of vehicles in the managed road network.

It shall be possible within the scope of this service for the detection of incidents to be by one or more of the following mechanisms:

- a) traffic flow monitoring;
- b) congestion monitoring;
- c) changes in public transport service running times away from the expected times;
- d) failure of roadside equipment;
- e) reports from police or other emergency services;
- f) reports from travellers and persons who have sight of the managed road network but are not actually travelling;
- g) reports from drivers, e.g. using eCall, OnStar or similar public or proprietary services;
- h) automatic reports from ITS stations, whether on-board vehicles or at the roadside.