INTERNATIONAL STANDARD

ISO 14813-1

First edition
2007-02-15

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

Reference number
ISO 14813-1:2007(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 14813-1 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

This first edition cancels and replaces Technical Report ISO/TR 14813-1:1999, which has been technically revised.

ISO 14813 consists of the following parts, under the general title *Intelligent transport systems — Reference model architecture(s) for the ITS sector*:

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

— *Part 2: Core TICS reference architecture* [Technical Report]

— *Part 3: Example elaboration* [Technical Report]

— *Part 4: Reference model tutorial* [Technical Report]

— *Part 5: Requirements for architecture description in TICS standards* [Technical Report]

— *Part 6: Data presentation in ASN.1* [Technical Report]

Introduction

Originally referred to in ISO/TR 14813-1 as Fundamental Services, ITS service domains and groups reflect the evolution of technology-oriented transportation practices and applications. This has become of increasing importance and interest as the scope of Intelligent Transport Systems (ITS) expands beyond its original applications in road traffic management, traveller information and electronic payment systems. ITS is now also expected to address:

— Transport network operations and maintenance activities;

— Freight mobility and intermodal connectivity;

— Multi-modal travel including both pre-trip and on-trip information and journey planning;

— Variable road pricing strategies for freight and personal travel;

— Emergency and natural disaster-related response activities and coordination; and

— National security needs related to transportation infrastructure.

Additionally, ITS activities as described above will also interface with more generalized activities and environments outside the transport sector. For example, road pricing and revenue systems activities may interface with electronic commerce, or eCommerce activities, and may 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 addressing specific national standards related to civil defence, emergency communications and other procedures. These interfaces, while largely outside the scope of TC 204, are nevertheless critical external influences on the functionality of the various services supported by ITS service domains and groups.

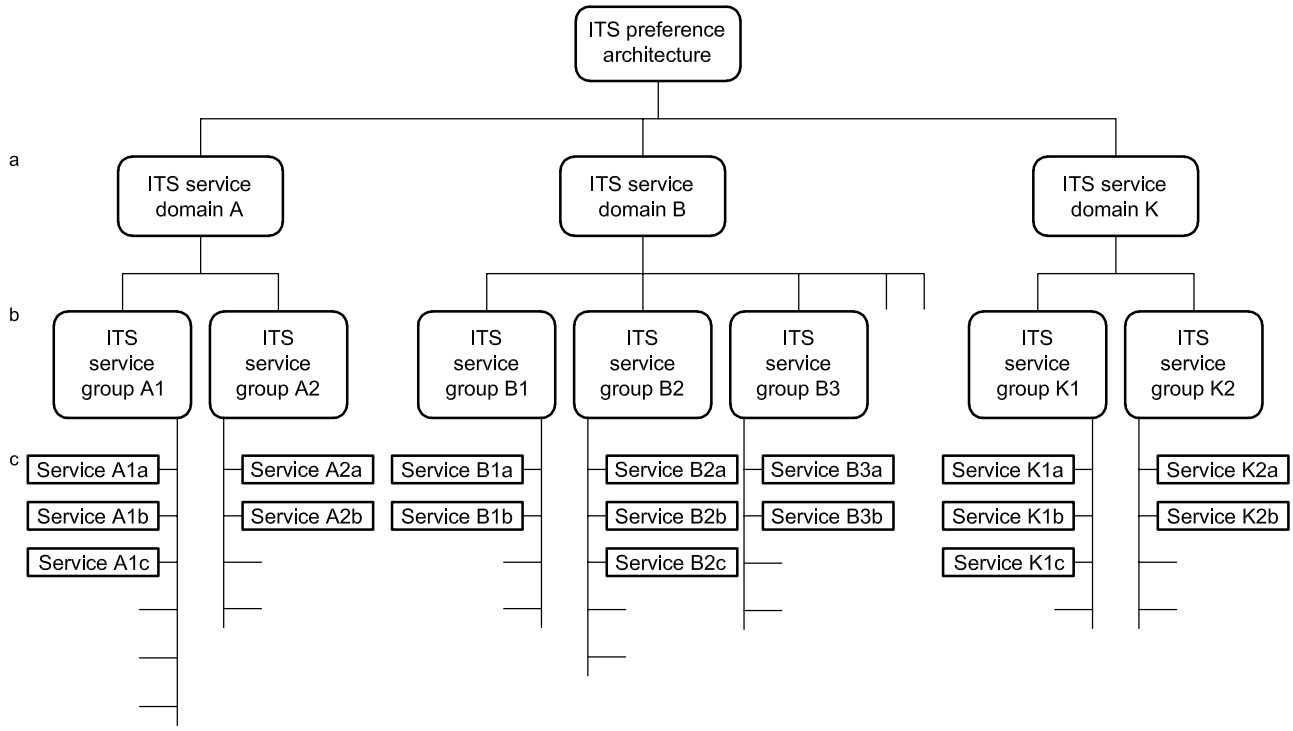
The standards that have been developed within TC 204 may all be mapped to one or more of the ITS service groups defined in this part of ISO 14813. At the same time, the applications for these standards are becoming broader. Additionally, the development of a standard international data dictionary and registry for ITS requires the ability to address both current and emerging applications.

To this end, the ITS service domains and groups 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 and standards necessary to deploy specific ITS applications. As the definition of transportation activities that utilize ITS tools has broadened, the original Fundamental Services developed by TC 204 are now revised and expanded into ITS service domains and groups.

Figure 1 illustrates the hierarchy of functional definitions, and the basis upon which user-oriented architecture views (known as use cases) are derived (refer to the other parts of ISO 14813, which further define the ITS applications of Unified Modeling Language, including use cases, to document the architecture).

In order to develop a cohesive reference architecture, and in order to establish the relationship and interdependencies of the various ITS services, it is beneficial to first determine the underlying ITS services. Thus, the purpose of this International Standard is to identify the ITS service groups and the domains within which the service groups reside, within the current perception of the ITS sector.

ITS service domains and groups, while they build upon existing US, European Union, Japanese, and other international and national taxonomies, or classification systems, can also provide a common descriptive basis for comparing these taxonomies, as well as others being developed throughout the world.



Key

a Service domains (A, B, C, etc.) define the nature of the activities provided.

b Service groups (N1, N2, N3, etc.) define more specific activities carried out in the service domain, but do not define the actors.

c Services further define activity in terms of the actors involved (e.g. users, travel modes). They also serve as a basis for most elemental use cases (user view of architecture).

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

ISO TC 204 Working Group 1

ISO TC 204 WG 1's prime objectives are to provide services to ISO TC 204 and its working groups.

The specific mission of WG 1 is to:

> *"Provide ISO TC 204, its working groups, related bodies and those involved in the ITS sector, with a reference model of conceptual reference architecture(s) that show the structure and inter-relationships of the sector…"*

There are multiple instantiations of ITS architecture to be considered. This deliverable embraces architecture concepts from the following participants:

— Other TC 204 working groups,

— CEN TC 278 working groups,

— Japanese initiatives,

— European Union initiatives,

— US ITS program,

— Australian initiatives,

— Canadian initiatives,

— Korean initiatives,

— Chinese Taipei initiatives, and

— Other architecture international activities.

Full documentation of all possible architectural approaches is obviously not feasible given the high level of resources required to carry this out. Indeed, full documentation and description of all possible approaches is undesirable as an item for standardization.

A defined and consistent approach is, however, required to facilitate reuse and interoperability.

By combining the work of major contributions such as the definitions of user services in the United States, Japan, Chinese Taipei and Korea, along with the European Union definition of user needs, the working group has used the basic hypothesis that it is possible to define a set of ITS service domains and groups that can be used in a variety of combinations and configurations, to provide an outline description of the different ITS architecture approaches. It is assumed that the scope of the ITS sector will always have a definable boundary (which will change over time).

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

Part 1: ITS service domains, service groups and services

1 Scope

This International Standard provides a definition of the primary services and application areas that can be provided to Intelligent Transport Systems (ITS) Users. Those with a common purpose can be collected together in ITS service domains, and within these there can be a number of ITS service groups for particular parts of the domain. This International Standard identifies 11 service domains, within which numerous groups are then defined. Within this framework, there are varying levels of detail related to definition of different services. These details differ from nation to nation, depending on whether the specific national architecture building blocks are based directly upon services or on groups of functions. Thus, the intent is to address groups of services and the respective domains within which they fit. As these domains and service groups evolve over time, it is intended that this International Standard be revised to include them.

This International Standard is applicable to the working groups of ISO TC 204 and other TCs which are developing International Standards for the ITS sector and associated sectors whose boundaries cross into the ITS sector (such as some aspects of urban light railways, intermodal freight and fleet). This International Standard is designed to provide information and explanation to those developing ITS International Standards and to those developing specifications, implementations and deployments for ITS.

This International Standard is advisory and informative. It is designed to assist the integration of services into a cohesive reference architecture, assist interoperability and common data definition. Specifically, services defined within the service groups will be the basis for definition of use cases and the resultant reference architecture functionality, along with definition of applicable data within data dictionaries, as well as applicable communications and data exchange standards.

2 Terms and definitions

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

2.1
actor
one who enables or influences an action or for whom an action has been completed

2.2
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 the victim must be taken to a hospital.

2.3
ITS service
product or activity targeted to a specific type of ITS user

2.4
ITS service domain
specific application area which comprises one or more service groups

2.5
ITS service group
one or more similar or complementary services provided to ITS users

2.6
ITS stakeholder
person or organization involved in some way in the deployment of ITS

NOTE Their involvement can be through use, manufacture of products, provision of services or regulation.

2.7
ITS user
one who directly receives and can act on ITS data or control products

NOTE An ITS user is one who receives, directly or indirectly, or provides to, the transaction of an ITS service; these users of ITS services may be human, systems or environment monitoring.

2.8
navigation
ITS service which provides directional information to an individual during a trip

2.9
paratransit
non-scheduled, non-fixed route public transport services for customers requiring special assistance and access to specific destinations at a user-requested time (e.g. disabled or elderly persons)

2.10
probe data
vehicle sensor information that is processed, formatted and transmitted to a land-based centre for processing to create a good understanding of the driving environment

2.11
probe vehicle system
vehicle probe
comprises vehicles which collect and transmit probe data, and land-based centres which do probe processing

NOTE 1 Probe processing builds an accurate understanding of the overall roadway and driving environment by fusing and analyzing probe data sent from multiple vehicles and data from other data sources.

NOTE 2 This processed probe data can then be delivered back to vehicles to help them and their drivers perform better, to public authorities to help them manage the transportation system, and to other users for a variety of purposes.

2.12
route guidance
service which utilizes directional information, destination or real-time data to select an appropriate route, either prior to or during a trip

3 Abbreviated terms

HAZMAT
HAZardous MATerials

ITS
Intelligent Transport Systems

TICS
Transport Information and Control Systems
(old term for ITS)

UML
Unified Modeling Language

4 General requirements

4.1 ITS service domains, service groups and services

4.1.1 Characteristics of ITS service domains

ITS systems vary in their implementation either because of the organization within a specific geographic region, or according to the perception of any actor.

This is regardless of any specific implementation services and groups of services which are provided in functionally different (although often interrelated) application areas. These application areas are the highest level of abstraction in an ITS architecture, and are called service domains.

ITS services do not represent the technology or the functionality of an ITS system included in any ITS applications.

Examples of ITS service domains include traffic management, traveller information, freight and fleet management, etc.

4.1.2 Characteristics of ITS service groups

A service domain comprises one or more types of ITS service. Each type of ITS service may comprise several instances of related services. These collations of related ITS service instances are called ITS service groups. Therefore, an ITS service group consists of one or more similar or complementary services provided to ITS users.

There are several characteristics of ITS service groups and services contained within:

a) Each ITS service group is oriented to a specific activity related to management of or information about the road transport 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.

4.1.3 Characteristics of ITS services

An ITS service consists of a product or activity provided to a specific ITS user. ITS services may therefore be considered as the elemental building blocks of any ITS architecture/system.

The level of detail in this part of ISO 14813 is focused at the level of domains and service groups, and not specific services. Different countries partition their reference architectures in different ways: some through more granular service or needs definition, others at a higher level of abstraction. Thus, elaboration of specific ITS services are not defined in this International Standard, although examples are provided.

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 consistent elaboration.

Elementary services can be elaborated by using particularization about service groups. Different viewpoints may result in different elaborations.

Parts 2, 3 and 4 of ISO 14813 provide one methodology using the UML. However, the ISO ITS architecture standards that do not require the use of a specific methodology and other techniques, such as process decomposition, may also be used.

ISO 14813-5 provides guidance as to the requirements for architecture description in ITS standards; ISO 17452 provides further assistance and guidance.

4.2 ITS users

In general, one may say that ITS users are partners, one who receives an ITS service through interaction with the ITS system. They have elsewhere been described as *"those who want the benefit of ITS systems, those who use ITS systems, those who manufacture or operate ITS systems, and those who regulate and control transport using ITS systems"*. By definition, all human interaction with ITS systems involves external actors interfacing at the boundary of the system.

NOTE Humans interacting with an ITS system are sometimes called external ITS users.

5 ITS service domains

Categorization of ITS activities is one of the first steps in defining the universe of activities supported by the reference architecture. It serves to delineate different sectors of the ITS industry (and are roughly parallel with current TC 204 working group activities).

The following lists and describes 11 ITS service domains. These are:

— Traveller information: Provision of both static and dynamic information about the transport network to users, including modal options and transfers.

— Traffic management and operations: The management of the movement of vehicles, travellers and pedestrians throughout the road transport network.

— Vehicle services: Enhancement of safety, security and efficiency in vehicle operations, by warnings and assistances to users or control vehicle operations.

— Freight transport: The management of commercial vehicle operations, freight and fleet management, and activities that expedite the authorization process for cargo at national and jurisdictional boundaries and expedite cross-modal transfers for authorized cargo.

— Public transport: Operation of public transport services and the provision of operational information to the operator and user, including multi-modal aspects.

— Emergency: Services delivered in response to incidents that are categorized as emergencies.

— Transport-related electronic payment: Transactions and reservations for transport-related services.

— Road transport-related personal safety: Protection of transport users including pedestrians and vulnerable users.

— Weather and environmental conditions monitoring: Activities that monitor and notify weather and environmental conditions.

— Disaster response management and coordination: Road transport-based activities in response to natural disasters, civil disturbances or terror attacks.

— National security: Activities that directly protect or mitigate physical or operational harm to persons and facilities due to natural disasters, civil disturbances or terror attacks.

The categorization of the services into 11 domains does not imply that all ITS architectures should be required to follow this construction. The construction that they use should be that which is best suited to their ultimate use and should be independent of the services that they support.

Services are often interdependent on, or providers to, other services within a service group, or are key enablers for the provision of services in other service groups. In architecture elaborations based on these services, it is important that the proposed classification schema identify who is responsible for the provision of the service.

6 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 above. The delineation specifically addresses different types of activities carried out within the domain. The service groups as described below by domain 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 as example services. This permits the transport operator (state, municipality or authority) to select which specific services within each service group are relevant to their needs. This also permits a more modular definition of specific architecture needs that may be applicable to a particular project or system.

ITS standards (as defined by ISO TC 204 and approved by member bodies) are focused on the road transport 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. (Similarly, there will be standards for other transport modes that affect the ITS sector.) This particularly applies in the area of traveller information, scheduling and traffic control.

6.1 Traveller information service groups

The service groups within the traveller information domain address the provision of both static and dynamic information about the transport network and services for users prior to and during the trip, and provide tools for transport professionals to collect, archive and manage information for future trip planning activities.

6.1.1 Pre-trip information

This service group encompasses travel information received at home, work, hotels, major public locations such as shopping centres and portable terminals prior to travel.

Pre-trip information services may target road facilities, public transport, freight and intermodal users, and non-motorized travel.

Depending on the service provided, pre-trip information includes 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.

Examples of services include:

— Pre-trip information — Traffic and roadway;

— Pre-trip information — Public transport (bus and rail);

— Pre-trip information — Commercial vehicle;

— Pre-trip information — Personal interactive; and

— Pre-trip information — Modal changes and multi-modal information.

6.1.2 On-trip information

This service group encompasses information provided to travellers in the vehicle (either provided for a mass audience or tailored to the specific vehicle or traveller location) or along the travel route, provided as advisory information. Such information may include real-time travel information, including estimated time to a destination based on current conditions, as well as work zones, incidents, weather, tolls, parking availability and other information of use to the traveller.

Examples of services include:

— On-trip information — Roadside;

— On-trip information — In-vehicle signing;

— On-trip information — Public transport vehicle;

— On-trip Information — Parking information; and

— On-trip information — Mobile devices.

6.1.3 Route guidance and navigation — Pre-trip

This service group is categorized as a planning service undertaken pre-trip, and provides information on community and/or individual user optimum route options for specified destinations. Best route options may be calculated taking account of network and public transport information, and may incorporate multi-modal options such as park and ride.

This service also includes the provision of route guidance to pedestrians, cyclists and motorcyclists.

Examples of services include:

— Dynamic in-vehicle route guidance and navigation programming/setup;

— Integrated multi-modal trip guidance; and

— Pedestrian or bicycle route guidance.

6.1.4 Route guidance and navigation — On-trip

This service group covers services categorized as those that are used on-trip (i.e. dynamic services undertaken whilst the trip is in progress). Similar to its pre-trip counterpart, it provides information on community and/or individual user optimum route options for specified destinations. Best route options may be calculated taking account of network and public transport information and may incorporate multi-modal options such as park and ride. Services during the trip can include congestion avoidance and route guidance.

This service also includes the provision of route guidance to pedestrians, cyclists and motorcyclists.

Examples of services include:

— Autonomous in-vehicle navigation;

— Dynamic-vehicle route guidance and navigation (based on real-time network information);

— Integrated multi-modal trip guidance; and

— Pedestrian and bicycle route guidance.

6.1.5 Trip planning support

This service group covers the use of ITS systems to provide data regarding traffic flows and travel demand for trip planning purposes, including collection, archiving and retrieval of system data. Examples of such system data include:

— Current traffic flow data from traffic management systems;

— Current utilization levels from public transport information systems;

— Origin and destination data from route guidance systems or vehicle probes;

— Route choice data from route guidance systems or vehicle probes; and

— Travel demand data from pre-trip information systems.

Examples of services include:

— Individual trip planning; and

— Centralized trip planning.

These services may require access to (for example):

— Data archiving; and

— Data warehouse.

6.1.6 Travel services information

This service group contains activities that support travellers either in a pre-trip or on-trip context. This information provides yellow pages type functions that can be allocated to different services based on the nature of information and/or the customer of the information. Examples of the type of functions about which information could be provided under various services include hospitals, hotels, fuel stations, restaurants, truck stops, reservation services and vehicle maintenance facilities.

Examples of services include:

— Travel services information — In-vehicle;

— Travel services information — Personal interactive; and

— Travel services information — Dedicated location.

6.2 Traffic management and operations service groups

The service groups under the traffic management and operations domain specifically address maintaining the movement of people, goods and vehicles throughout the transportation network, and include both automated monitoring and control activities, as well as decision-making processes (both automated and manual) that address real-time incidents and other disturbances on the transportation network, as well as managing travel demand as needed to maintain overall mobility. This service group includes the activities that have become known as intelligent highway and cooperative driving.

6.2.1 Traffic management and control

The service group addresses the management and control of traffic flows through the use of ITS technologies. It includes traffic control both for urban (e.g. arterial streets, central business districts) and interurban (e.g. freeway, motorway, autobahn) facilities as well as corridors, which include operation of both types of facilities. Such control strategies include real-time variation of traffic signal timing, traffic-responsive control of ramp entrances to freeways/motorways (e.g. ramp metering), dynamic rerouting of traffic around incidents or closures on the roadway network, and tidal flows (control of direction of traffic using specific lanes), along with variable speed control relative to real-time congestion, incident or environmental conditions. Also included may be traffic control priority for public transport and emergency vehicles using urban routes; management of access to parking facilities; control and monitoring of at grade railroad–highway junctions to reduce potential for accidents and collisions; and management of access to and operations within tunnel and bridge facilities, including bridges with movable spans. Also of interest includes specific traffic management activities within road work zones. Many of these services are interdependent on, or providers to, other services within this service group or are key enablers for the provision of services in other service groups.

Examples of services include:

- Traffic monitoring;
- Surface street traffic management:
  - Adaptive traffic signal control;
- Freeway traffic management;
- Preferential treatment for specific vehicle types (signal priority and pre-emption);
- Reversible lane management;
- Coordination of surface street and freeway traffic management;
- Intermodal highway junction management;
- Parking management;
- Work zone traffic management;
- Data archiving;
- Data warehouse; and
- Traffic information dissemination.

6.2.2 Transport-related incident management

This service group provides the capability for detecting and responding 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). Examples of incident management activities include the following:

- Response to on-site incident information;
- Detection and confirmation of incident presence;
- Service patrols in circulation in the road network to spot and provide on-site assistance to stalled vehicles or accidents to be removed from the travelled way;

— Dispatch of police, emergency and maintenance vehicles to address injuries, remove the incident and restore normal operation in a timely fashion;

— Monitoring of hazardous materials movements along transportation network in conjunction with hazardous materials and incident notification service group in 6.6.4.

Examples of services include:

— Incident monitoring and confirmation;

— Incident on-site motorist assistance;

— Incident on-site traveller assistance;

— Incident coordination and clearance; and

— Hazardous materials monitoring and management.

6.2.3 Demand management

This service group covers the development and implementation of management and control strategies designed to influence the demand for travel.

These strategies influence the overall level of demand for travel at different times of the day and the relative demand for different modes of transport, through the management of pricing structures, area access control or zone entry regulations. Demand management functions may include:

— Access control;

— Air quality-based zone pricing;

— Congestion pricing;

— High-occupancy vehicle facility management;

— Parking pricing; and

— Public transport fares management.

Examples of services include:

— Variable road pricing;

— Access management;

— High-occupancy lane management; and

— Air quality-based road transport management.

6.2.4 Transport infrastructure maintenance management

This service group covers the application of ITS technologies to the management of road network maintenance, plus the maintenance of the communication and computer infrastructures used to support travellers using the road network. Included in this service group are:

— Highway maintenance management;

— Location and maintenance of utilities used by ITS equipment;

— Use of probe data to guide timing and location of planned road works and road closures;

— Highway sign maintenance management; and

— Coordination with weather and environmental conditions monitoring service groups with respect to collection of condition information related to weather and road conditions that are needed as input to infrastructure maintenance management.

Examples of services include:

— Roadway construction and maintenance management;

— Winter maintenance;

— Pavement management;

— Automated road management; and

— Work zone safety management.

6.2.5 Policing/enforcing traffic regulations

This service covers the application of ITS technologies to the enforcement of traffic laws and regulations. Examples include the following:

— Access control;

— High-occupancy vehicle facility usage;

— Parking regulation enforcement;

— Speed limit enforcement;

— Signal enforcement (e.g. red light violation); and

— Emissions monitoring.

6.3 Vehicle service groups

The service groups in the vehicle services domain focus on specific services that improve the operational safety of vehicles. There are both services which use external information, as well as services which use in-vehicle information only.

NOTE The lead on standardization for the onboard issues will be agreed between TC 204 and TC 22.

6.3.1 Transport-related vision enhancement

The service group covers the application of ITS technologies to the enhancement of driver perception through the use of in-vehicle equipment.

Examples of services include:

— In-vehicle driver vision management.

6.3.2 Automated vehicle operation

This service group is the application of ITS functionality to completely automate the driving process, creating a hands-off driving environment, or may be partially automated operation supporting drivers. For public transport, specific tools can be used to permit vehicles to be aligned properly at stops, assuring access either to same-height platforms or specific access for disabled travellers (e.g. wheelchair lifts, bus lowering mechanisms). Examples include the following:

— Automatic lane keeping;

— Automatic parking operation;

— Vehicle platooning; and

— Very low speed cruise control (inching).

Examples of services include:

— Automated highway operation;

— Automated low-speed manoeuvring;

— Precision docking for public transport vehicles; and

— Automated cruise control.

6.3.3 Collision avoidance

The collision avoidance service group includes the use of sensors and control systems to detect potential for collisions either prompting the driver to take action or automatically initiate avoiding action. Longitudinal collision avoidance includes the application of obstacle detection systems. Lateral collision avoidance is the use of systems (such as sensors and control systems) to monitor the potential hazards involved in lane keeping, lane changing, entering and leaving high-speed roads and overtaking.

Examples of services include:

— Longitudinal collision avoidance;

— Lateral collision avoidance; and

— Intersection collision avoidance.

6.3.4 Safety readiness

The safety readiness service group covers the use of monitoring and warning systems for both private car driver and vehicle. Examples include the following:

— Critical component monitoring;

— Driver alertness monitoring;

— Engine temperature;

— Oil pressure;

— Road condition monitoring; and

— Weather and visibility monitoring.

NOTE The lead on standardization for the onboard issues will be agreed between TC 204 and TC 22.

Examples of services include:

— Vehicle internal systems monitoring; and

— Vehicle external conditions monitoring.

6.3.5 Pre-crash restraint deployment

This service group uses ITS functionality to determine the velocity, mass and direction of vehicle and objects involved in a potential collision and the number, location and major physical characteristics of occupants. A system's use of this data to determine a response strategy may include the following elements:

— Arming and deploying air bags;

— Deploying lateral protection systems;

— Deploying rollbars; and

— Tightening seatbelts.

NOTE The lead on standardization for the onboard issues will be agreed between TC 204 and TC 22.

Examples of services include:

— Pre-crash restraint deployment.

6.4 Freight transport service groups

The service groups addressed in the freight transport domain specifically address activities that facilitate both commercial vehicle operations and multi-modal logistics, including inter-jurisdictional coordination. 6.4.1 through 6.4.4 constitute administrative functions, while 6.4.5 through 6.4.8 constitute commercial functions.

6.4.1 Commercial vehicle pre-clearance

The commercial vehicle pre-clearance service group provides services that enable commercial vehicles, including trucks and buses to have credentials and other documents, safety status and weights checked automatically at normal road speeds. A principal objective of this service is to effect pre-clearances with minimal disruption to the vehicle journey and the traffic flow.

Examples of services include:

— Weigh-in-motion;

— Non-stop pre-clearance; and

— Vehicle safety records monitoring.

6.4.2 Commercial vehicle administrative processes

This service group is complementary to the above service group (see 6.4.1). It enables haulers and shippers to purchase annual and ad hoc credentials, using communications and computer technologies.

Examples of services include:

— Automated credential filing;

— Automated commercial vehicle administration; and

— Automated border crossings.

6.4.3 Automated roadside safety inspection

The automated roadside safety inspection service group covers the use of ITS functionality to enable roadside access to safety performance records of haulers, vehicles and drivers. This will enhance existing systems of spot checks by providing inspectors with easy access to current data relevant to the inspection.

Examples of services include:

— Remote access to commercial vehicle safety data.

6.4.4 Commercial vehicle onboard safety monitoring

This service group covers the use of onboard monitoring systems to oversee the safety status of commercial vehicles, commercial vehicle drivers and cargo during the entire course of the trip. This may include sensing and collecting data on the following:

— Brakes;

— Driver alertness;

— Driving time;

— Lights;

— Shifted cargo; and

— Tyres.

Warning may be provided to both the driver and/or remote monitoring facilities.

Examples of services include:

— Commercial vehicle internal systems monitoring; and

— Commercial vehicle driver alertness monitoring.

6.4.5 Freight transport fleet management

At a multi-modal level, commercial fleet management includes logistics and freight management systems. It also covers the use of automatic vehicle location (AVL) to achieve automatic freight carrier location/container location, and vehicle-to-control centre communications to provide vehicle location and other status information to the fleet operators dispatched. This facilitates the use of dynamic dispatching systems to improve the efficiency of the fleet management process. These services are implemented in conjunction with the traffic management and control service group services as documented in 6.2.1. This service group includes:

— Pre-trip information; and

— Intermodal terminal conditions.

Examples of services include:

— Commercial vehicle fleet tracking;

— Commercial vehicle fleet dispatching; and

— Freight container tracking.

6.4.6 Intermodal information management

The ITS reference model architecture for transport information and control systems (ISO/TR 14813-2:2000, *Core TICS reference architecture*) identifies a commercial vehicle functional domain including:

> *"…transactions to maintain the TICS information about a shipment from the time of the order by the consignor to the reception of goods by the consignee. The key TICS transactions are to provide registers of service providers and to enable the goods to be tracked throughout intermodal journeys."*

This service group covers the exchange of information about transport of goods across modes. This includes knowledge of where the units transporting the goods are located, plus their condition and status, as well as similar information about the vehicle transporting the unit. It is also possible to locate sub-units, provide customers with information about the progress with the movement of the goods.

Examples of services include:

— Vehicle and container arrival information exchange (users are fleet and intermodal carriers and nodes); and

— Customer freight information access (users are customers and shippers).

6.4.7 Management and control of intermodal centres

This service group includes services that manage the operation of the intermodal centre, including those concerned with parking, operation and maintenance of buildings and equipment, the operation of the internal infrastructure, and the interfaces to the various modes in the external infrastructure. This differs from the previous service group (intermodal information management) in that it provides management and control capabilities based on the information collected and received. This includes managing the operation of the modal interchanges, and managing the personnel concerned with the transportation of the goods.

Examples of services include:

— Intermodal centre facility management; and

— Intermodal vehicle and container control.

NOTE This service group includes services which cross modal boundaries. These services are therefore being/will be developed in conjunction with other standardization committees or by other standardization committees in conjunction with ISO TC 204.

6.4.8 Management of dangerous freight

This service group includes services that manage the operation of transport fleets concerned with the movement of dangerous goods, including the monitoring of its status and condition and its movement along the infrastructure of the transport modes that will be used. Also, the activities include exchange of information with organizations responsible for the actual transportation of the dangerous goods.

Examples of services include:

— Dangerous goods movement data sharing;

— Dangerous goods movement data registry;

— Dangerous goods movement fleet coordination; and

— Dangerous goods movement police/safety coordination.

6.5 Public transport service groups

The service groups within this domain describe activities that result in more timely and efficient operation of public transport services and provision of operational information to the operator and passenger.

6.5.1 Public transport management

This service group covers the application of ITS functionality to the operation, planning and management of public transport operations. It includes the provision of real-time information on vehicle location and status, enabling the identification of departures from schedules and dynamic rescheduling. This also includes the monitoring of public transport vehicle status such as passenger loadings, engine management system functions and tyre pressures. This service group also includes the application of public transport scheduling and planning systems for assuring reliable connections with minimum between different modes (e.g. bus and rail services). This is often called transfer connection protection, and can be addressed through one or more of the example services below. These services are implemented in conjunction with the traffic management service group services as documented in 6.2.1.

Examples of services include:

— Public transport vehicle internal systems monitoring;

— Public transport vehicle fleet tracking;

— Public transport scheduling services;

— Public transport service dispatch; and

— Public transport service planning.

6.5.2 Demand responsive and shared transport

This service group covers the provision of on-demand transport services to individual travellers. This will provide demand responsive transport services to the user, while enabling transport operators to dispatch and schedule vehicles.

Typically travellers may request service by specifying destination and any special needs such as pram conveyancing, wheelchair lifts or other special services for the disabled. Vehicles, covering a corridor or area, are then dispatched to the traveller by a dispatching system. The public transport fleet deployed on this service group may include buses, vans and taxis.

This service group addresses the needs of commuters by providing a viable shared transport alternative to the single occupancy private car and also addresses the needs of specific groups such as elderly and disabled.

Examples of services include:

— Paratransit fleet dispatch; and

— Dynamic ridesharing.

6.6 Emergency service groups

The service groups in this domain describe activities that permit emergency services to be more quickly initiated and expedited throughout the transportation network.

6.6.1 Transport-related emergency notification and personal security

This service group applies ITS functionality to provide both driver/personal security services and automatic incident notification for private car drivers and goods vehicle drivers. This may include:

- Automatic collision notification:
- User-initiated distress calls; and
- Third-party emergency notification.

NOTE The lead on standardization for the onboard issues will be agreed between TC 204 and TC 22.

Examples of services include:

- Automated emergency call and mayday dispatch; and
- Automated vehicle intrusion and stolen vehicle monitoring.

6.6.2 After-theft vehicle recovery

This service group applies ITS functionality to immobilize or recover stolen vehicles.

Examples of services include:

- User-initiated distress calls;
- Automated theft warning;
- Automated vehicle intrusion and stolen vehicle monitoring;
- Stolen vehicle tracking; and
- Remote vehicle immobilization.

6.6.3 Emergency vehicle management

This service group includes the application of fleet management, route guidance and traffic signal priority techniques to the management of emergency vehicles such as fire, police and ambulance. These services are implemented in conjunction with the traffic management service group services as documented in 6.2.1.

Examples of services include:

- Emergency vehicle fleet tracking; and
- Emergency vehicle traffic management coordination.

6.6.4 Hazardous materials and incident notification

This service group covers the use of ITS functionality to provide authorities with data on the nature, location and condition of hazardous goods cargoes. This facilitates the enforcement of routing instructions and the effective response to any incident involving the load. Data to be provided may include:

a) Routing data:

   1) Route guidance; and

   2) Route enforcement.

b) Incident data:

1) Issuing post-incident instructions to driver;

2) Location of vehicle;

3) Nature of incident; and

4) Nature of cargo.

Examples of services include:

— HAZMAT vehicle tracking;

— Automated HAZMAT emergency call/mayday notification; and

— HAZMAT pre-clearance services.

6.7 Transport-related electronic payment service groups

This domain addresses activities that permit revenues for transportation services and facilities to be collected through non-cash and non-stop payment.

6.7.1 Transport-related electronic financial transactions

This service group includes the use of electronic, or cashless payment systems for transportation services, along with the implementation of automated systems to collect road user fees based on overall use of transportation services (e.g. distance-based), not just use of particular facilities. These services may also be coordinated with those in 6.2.3 which address dynamic pricing for demand management purposes.

Examples of services include:

— Electronic transit fare payment;

— Electronic toll collection;

— Electronic parking payment;

— Electronic services payment (e.g. traveller information, reservations); and

— Electronic distance-based road user fee payment services.

6.7.2 Integration of transport-related electronic payment services

This service group includes development of integrated payment systems and mechanisms between jurisdictions as well as between modes.

Examples of services include:

— Integration of multi-jurisdictional electronic payment systems; and

— Integration of regional multi-modal payment systems.

6.8 Road transport-related personal safety

The service groups in the road transport-related personal safety domain describe activities that protect the personal safety of pedestrians and individuals using road transportation facilities.

6.8.1 Public travel security

This service group includes the surveillance and monitoring systems for public transport facilities, car parks and onboard public transport vehicles. Systems may be automatic, sending a distress call when specified conditions are encountered or manually initiated. This also covers the use of security systems designed to protect public transport vehicle operators.

Examples of services include:

— Silent alarm;

— Emergency call/mayday alert for public transport;

— Intrusion detection; and

— Public transport surveillance.

6.8.2 Safety enhancements for vulnerable road users

This service group covers the application of ITS functionality to the enhancement of safety levels for vulnerable road user groups (particularly elderly or disabled and road maintenance workers). These groups include:

— Motorcyclists;

— Pedal cyclists; and

— Pedestrians.

Safety enhancement measures may include measures such as:

— Smart pedestrian crossings (e.g. automatic warning of pedestrians for drivers, prolonging crossing times for elderly users, and changing pedestrian prioritization);

— Vehicle speed warning systems;

— Vehicle presence detection; and

— Automatic advice to drivers by vulnerable road users (e.g. presence of road maintenance workers).

Examples of services include:

— Non-motorized vehicle and pedestrian monitoring systems; and

— Systems to monitor specialized vehicles.

6.8.3 Safety enhancements for disabled road users

This service group covers the application of ITS functionality to the enhancement of safety levels for road user groups (particularly pedestrians with physical impairment).

Safety enhancement measures may include measures such as:

— Smart pedestrian crossings (e.g. prolonging crossing times for elderly and disabled users);

— Vehicle presence detection (either to the vehicle or from the vehicle to the pedestrian); and

— Automatic advice to drivers by disabled road users (e.g. presence of wheel chair).

Examples of services include:

— Intersection monitoring of specialized conveyances (e.g. wheelchairs, carts); and

— Driver warnings for specialized conveyances.

6.8.4 Safety provisions for pedestrians using intelligent junctions and links

This service group covers the application of ITS technologies to the provision of monitoring and warning systems at junctions (including modal, multi-modal or intermodal), both signal controlled and priority, to enhance pedestrian safety. Warnings may include:

— Clarification of right-of-way rules;

— Onboard echo of warning signs;

— Presence of oncoming vehicles; and

— Warning of imminent signal phase change.

Examples of services include:

— Signal display advance warning;

— Oncoming vehicle advance warning (for non-signalized junction); and

— In-vehicle signage and warning systems.

6.9 Weather and environmental conditions monitoring service groups

The service groups in the weather and environmental conditions monitoring domain describe activities that monitor weather and environmental conditions that have an impact upon the transport network and its users.

NOTE Information obtained by these services will be provided to users by using traveller information services (6.1).

6.9.1 Weather monitoring

This service group contains activities that result in monitoring of weather conditions, including fog, ice, snow, wind, rain and heat, along with prediction of specific conditions as they impact the condition of the pavement and the overall travelled way, including icing and visibility.

Examples of services include:

— Road weather information monitoring; and

— Road weather prediction.

6.9.2 Environmental conditions monitoring

This service group contains activities that result in monitoring of conditions such as flooding (due to high tides), land movement (earthquakes, mud slides, etc.) and pollution levels. Also, the service group may include services that can predict specific conditions that are likely to occur based on current and historical trends.

Examples of services include:

— Water level/tidal monitoring and prediction;

— Seismic monitoring;

— Pollution monitoring; and

— Avalanche, mud slide and fallen rock monitoring.

6.10 Disaster response management and coordination service groups

The service groups in this domain describe ITS activities that manage resources from multiple jurisdictions in their response to natural disasters, civil disturbances or terrorism.

6.10.1 Disaster data management

This service group includes services that collect data about the disaster from the appropriate agencies.

Examples of services include:

— Disaster and emergency data collection; and

— Disaster and emergency data sharing.

6.10.2 Disaster response management

This service group includes services that manage the use of the road network to minimize the impact of the disaster on its use.

Examples of services include:

— Disaster response planning for the transport network; and

— Disaster response implementation.

6.10.3 Coordination with emergency agencies

This service group includes services that coordinate the use of the road network by vehicles belonging to emergency agencies. This may coordinate with the traffic control services activities reflected in 6.2.1 and 6.2.2.

Examples of services include:

— Disaster response coordination.

6.11 National security service groups

The service groups in the national security domain describe activities that directly protect or mitigate physical or operational harm to persons and facilities due to natural disasters, civil disturbances or terror attacks.

Bibliography

[1] ISO/TR 14813-2:2000, *Transport information and control systems — Reference model architecture(s) for the TICS sector — Part 2: Core TICS reference architecture*

[2] ISO/TR 14813-3, *Transport information and control systems — Reference model architecture(s) for the TICS sector — Part 3: Example elaboration*

[3] ISO/TR 14813-4, *Transport information and control systems — Reference model architecture(s) for the TICS sector — Part 4: Reference model tutorial*

[4] ISO/TR 14813-5, *Transport information and control systems — Reference model architecture(s) for the TICS sector — Part 5: Requirements for architecture description in TICS standards*

[5] ISO 17452, *Transport information and control systems — Using UML for defining and documenting ITS/TICS interfaces*

6.11.1 Monitoring and control of suspicious vehicles

This service group includes remote monitoring of vehicles for explosives or HAZMAT detection, and operational control of such vehicles (permitting shutdown of a vehicle's operations if it is occupied by terrorists or known to be equipped, e.g. rigged with explosives, to cause destruction).

Examples of services include:

— Vehicle HAZMAT and explosives monitoring;

— Vehicle disablement;

— Road traffic management; and

— Identification of suspicious vehicles.

6.11.2 Utility or pipeline monitoring

This service group includes systems designed to address stoppage of flow or detection of foreign or hazardous matter within the utility or pipeline facility and emergency notification to relevant agencies.

NOTE Although utilities and pipelines are not directly related to ITS, the common practice of siting on or near roadways means that an incident against such utilities or pipelines is likely to disrupt the transport system and ITS may be used.

Examples of services include:

— Pipeline and utility HAZMAT/explosives monitoring; and

— Emergency notification to key agencies.

6.12 ITS Data Management

The collation, management and supply of ITS data to legitimate interested parties.

Examples of services include:

— Data registries;

— Data dictionaries;

— Emergency messages;

— Control centre data;

— Enforcement; and

— Traffic management data.

7 Summary of ITS reference architecture service hierarchy

The purpose of this clause is to summarize the hierarchy of ITS service domains, groups and example services as presented in Clause 6, which serve as the basis for the TICS reference architecture and resultant use cases and functionality. This summary consists of Table 1.

Table 1 — Summary of hierarchy of Fundamental Services for ITS reference architecture

Service domain	Service group	Example services
1. Traveller information	1.1 Pre-trip information	*Pre-trip information – Traffic and roadway*
		Pre-trip information – Public transport (bus and rail)
		Pre-trip information – Commercial vehicle
		Pre-trip information – Personal interactive
		Pre-trip information – Modal changes and multi-modal information
	1.2 On-trip information	*On-trip information – Roadside*
		On-trip information – In-vehicle signing
		On-trip information – Public transport vehicle
		On-trip Information – Parking information
		On-trip information – Mobile devices
	1.3 Route guidance and navigation – Pre-trip	*Dynamic in-vehicle route guidance and navigation programming/setup*
		Integrated multi-modal trip guidance
		Pedestrian and bicycle route guidance
	1.4 Route guidance and navigation – On-trip	*Autonomous in-vehicle navigation*
		Dynamic in-vehicle route guidance and navigation (based on real-time network information)
		Integrated multi-modal trip guidance
		Pedestrian and bicycle route guidance
	1.5 Trip planning support	*Individual trip planning*
		Centralized trip planning
		Data archiving
		Data warehouse
	1.6 Travel services information	*Travel services information – In-vehicle*
		Travel services information – Personal interactive
		Travel services information – Dedicated location

Table 1 (*continued*)

Service domain	Service group	Example services
2. Traffic management and operations	2.1 Traffic management and control	*Traffic monitoring*
		Surface street control
		Freeway traffic control
		Preferential treatment for specific vehicle types (signal priority and pre-emption)
		Reversible lane management
		Coordination of surface street and freeway control
		Intermodal highway junction management
		Parking management
		Work zone traffic management
		Traffic information dissemination
	2.2 Transport-related incident management	*Incident monitoring and confirmation*
		Incident on-site motorist assistance
		Incident on-site traveller assistance
		Incident coordination and clearance
		Hazardous materials monitoring and management
	2.3 Demand management	*Variable road pricing*
		Access management
		High-occupancy lane management
		Air quality-based transport management
	2.4 Transport infrastructure maintenance management	*Roadway construction and maintenance management*
		Winter maintenance
		Pavement management
		Automated road management
		Work zone safety management
	2.5 Policing/ enforcing traffic regulations	*Access control*
		High-occupancy vehicle facility usage
		Parking regulation enforcement
		Speed limit enforcement
		Signal enforcement (e.g. red light violation)
		Emissions monitoring

Table 1 (*continued*)

Service domain	Service group	Example services
3. Vehicle	3.1 Transport-related vision enhancement	*In-vehicle driver vision management*
	3.2 Automated vehicle operation	*Automated highway operation*
		Automated low-speed manoeuvring
		Precision docking for public transport vehicles
		Automated cruise control
	3.3 Collision avoidance	*Longitudinal collision avoidance*
		Lateral collision avoidance
		Intersection collision avoidance
	3.4 Safety readiness	*Vehicle internal systems monitoring*
		Vehicle external conditions monitoring
	3.5 Pre-crash restraint deployment	*Pre-crash restraint deployment*
4. Freight transport	4.1 Commercial vehicle pre-clearance	*Weigh-in-motion*
		Non-stop pre-clearance
		Vehicle safety records monitoring
	4.2 Commercial vehicle administrative processes	*Automated credential filing*
		Automated commercial vehicle administration
		Automated border crossings
	4.3 Automated roadside safety inspection	*Remote access to commercial vehicle safety data*
	4.4 Commercial vehicle onboard safety monitoring	*Commercial vehicle internal systems monitoring*
		Commercial vehicle driver alertness monitoring
	4.5 Freight transport fleet management	*Commercial vehicle fleet tracking*
		Commercial vehicle fleet dispatching
		Freight container tracking
	4.6 Intermodal information management	*Vehicle and container arrival information exchange*
		Customer freight information access

Table 1 (*continued*)

Service domain	Service group	Example services
	4.7 Management and control of intermodal centres	*Intermodal centre facility management*
		Intermodal vehicle and container control
	4.8 Management of dangerous freight	*Dangerous goods movement data sharing*
		Dangerous goods movement data registry
		Dangerous goods movement fleet coordination
		Dangerous goods movement police/safety coordination
5. Public transport	5.1 Public transport management	*Public transport vehicle internal systems monitoring*
		Public transport vehicle fleet tracking
		Public transport scheduling services
		Public transport service dispatch
		Public transport service planning
	5.2 Demand responsive and shared transport	*Paratransit fleet dispatch*
		Dynamic ridesharing
6. Emergency	6.1 Transport-related emergency notification and personal security	*Automated emergency call and mayday dispatch*
		Automated vehicle intrusion and stolen vehicle monitoring
	6.2 After-theft vehicle recovery	*User-initiated distress calls*
		Automated theft warning
		Automated vehicle intrusion and stolen vehicle monitoring
		Stolen vehicle tracking
		Remote vehicle immobilization
	6.3 Emergency vehicle management	*Emergency vehicle fleet tracking*
		Emergency vehicle traffic management coordination
	6.4 Hazardous materials and incident notification	*HAZMAT vehicle tracking*
		Automated HAZMAT emergency call/mayday notification
		HAZMAT pre-clearance services

Table 1 (*continued*)

Service domain	Service group	Example services
7. Transport-related electronic payment	7.1 Transport-related electronic financial transactions	*Electronic transit fare payment*
		Electronic toll collection
		Electronic parking payment
		Electronic services payment (e.g. traveller information, reservations)
		Electronic distance-based road user fee payment services
	7.2 Integration of transport-related electronic payment services	*Integration of multi-jurisdictional electronic payment systems*
		Integration of regional multi-modal payment systems
8. Road transport-related personal safety	8.1 Public travel security	*Silent alarm*
		Emergency call/mayday alert for public transport
		Intrusion detection
		Public transport surveillance
	8.2 Safety enhancements for vulnerable road users	*Non-motorized vehicle and pedestrian monitoring systems*
		Systems to monitor specialized vehicles
	8.3 Safety enhancements for disabled road users	*Intersection monitoring of specialized conveyances (e.g. wheelchairs, carts)*
		Driver warnings for specialized conveyances
	8.4 Safety provisions for pedestrians using intelligent junctions and links	*Signal display advance warning*
		Oncoming vehicle advance warning (for non-signalized junction)
		In-vehicle signage and warning systems
9. Weather and environmental conditions monitoring	9.1 Weather monitoring	*Road weather information monitoring*
		Road weather prediction
	9.2 Environmental conditions monitoring	*Water level/tidal monitoring and prediction*
		Seismic monitoring
		Pollution monitoring
		Avalanche, mud slide and fallen rock monitoring

Table 1 (*continued*)

Service domain	Service group	Example services
10. Disaster response management and coordination	10.1 Disaster data management	*Disaster and emergency data collection*
		Disaster and emergency data sharing
	10.2 Disaster response management	*Disaster response planning for the transport network*
		Disaster response implementation
	10.3 Coordination with emergency agencies	*Disaster response coordination*
11. National security	11.1 Monitoring and control of suspicious vehicles	*Vehicle HAZMAT and explosives monitoring*
		Vehicle disablement
		Road traffic management
		Identification of suspicious vehicles
	11.2 Utility or pipeline monitoring	*Pipeline and utility HAZMAT/explosives monitoring*
		Emergency notification to key agencies
12. ITS Data Management	12.1 Data registries	*Registration of ITS data concepts and subroutines for re-use and interoperability*
	12.2 Data dictionaries	*Local registration of ITS data concepts and subroutines for re-use and interoperability*
	12.3 Emergency messages	*Registration of emergency related messages, both originated from vehicles and from transport system users via portable or other devices, to provide interpretable data to assistance providers that is relevant to the emergency*
	12.4 Control centre data	*Registration of data concepts that may be exchanged between control centres*
	12.5 Enforcement	*Data storage and exchange for law enforcement*
	12.6 Traffic management data	*Data storage and exchange for use within and between traffic management centres, road operators, government agencies, law enforcement and emergency services*

ICS 03.220.01; 35.240.60

Price based on 28 pages