INTERNATIONAL STANDARD

ISO
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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

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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 documents 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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 204, *Intelligent transport systems*.

This second edition cancels and replaces the first edition (ISO 14813-1:2007), 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 fundamental services*

— *Part 5: Requirements for architecture description in ITS standards*

— *Part 6: Data presentation in ASN.1*

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 road transport domain, but ITS is beginning to appear in the maritime and rail transport domains. 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 is now also expected to address services in the following areas of the road transport 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 road transport domain;

— Variable road pricing strategies for freight and personal travel;

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

— National security needs related to transportation infrastructure;

— Cooperative-ITS – sometimes referred to as 'connected vehicles' or 'connected vehicle/highway systems'.

Services in some of the areas identified above also interface with more generalized activities and environments outside the road transport domain. For example, it is possible for road pricing and revenue systems activities to interface with electronic commerce, or 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 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 must all be mapped to one or more of the ITS domains, service groups and services described in this part of ISO 14813. Additionally, the development of a standard international data dictionary and registry for ITS requires the ability to address both current and emerging services that ITS can provide.

To this end, the ITS service domains, groups and services presented in this part of ISO 14813 serve as a framework for developing ITS architectures and ITS-related concepts of operation, which in turn lead to the definition of the appropriate requirements, functionality and standards necessary to deploy specific ITS services. As the range 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 how they might be used as the input to ITS architectures. The Service Domains that apply to ITS are listed in 6.1 with each defining the nature of the activities provided. Each of these Domains is then covered by separate annexes in this part of ISO 14813, each of which includes the descriptions of its own Service Groups and Services. The Service Groups describe more specific activities that are part of the Domain and the Services provide the more detailed description of what is provided within each Service Group.

The way in which the descriptions of the services are used in ITS architectures depends on the methodology that has been adopted for their creation. Thus the service descriptions can be used to generate 'use cases' which are the input to an ITS architecture created using object orientated methodology (see other parts of the ISO 14813 series), or 'user needs', which are the input to an ITS architecture created using the process orientated methodology (see ISO/TR 26999).
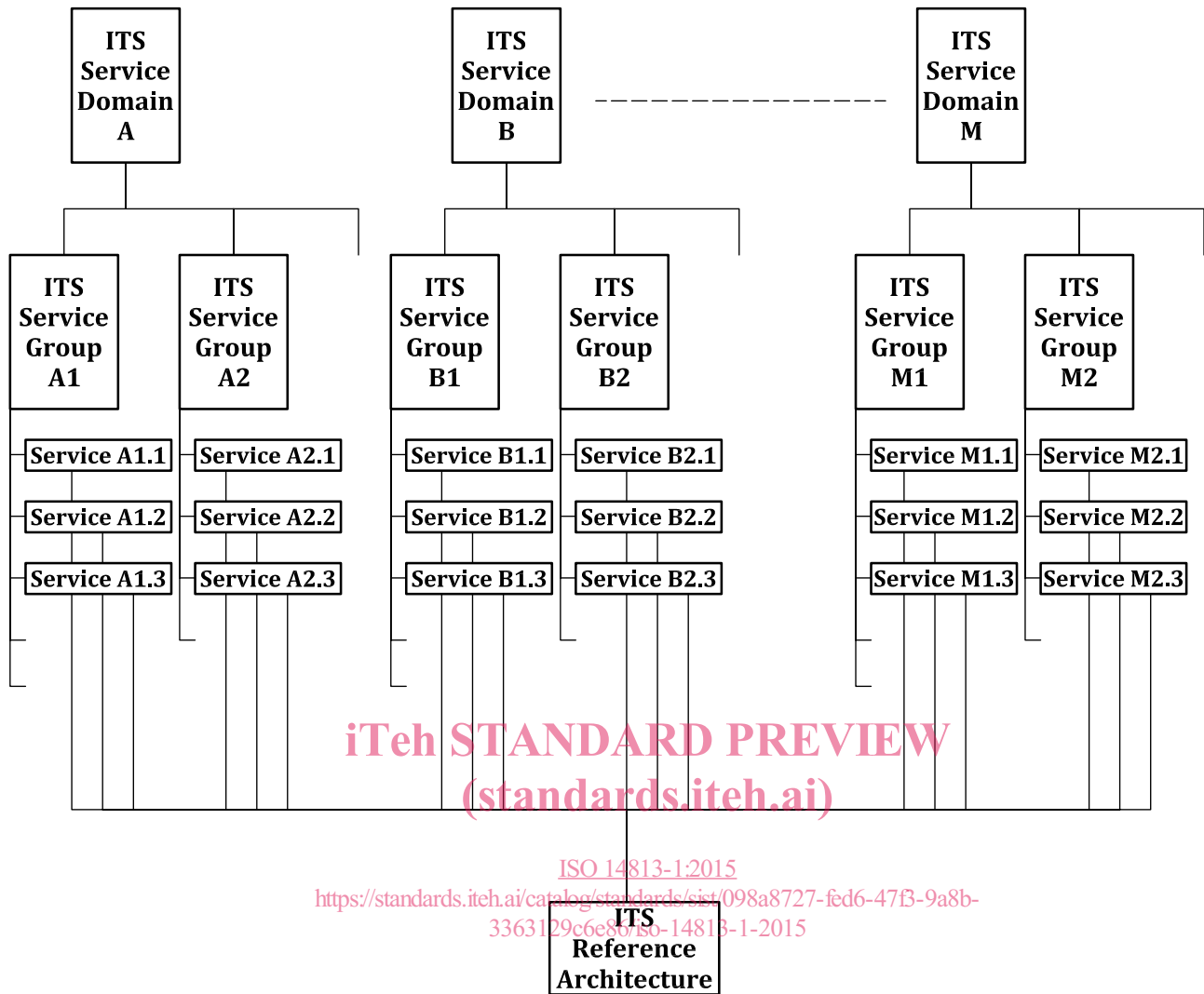
Figure 1 — ITS services — Hierarchy of definitions for 'ITS reference architecture'

In order to develop a cohesive reference architecture, and in order to establish the relationship and interdependencies of the various 'intelligent transport systems' (ITS) services, it is beneficial to firstly determine the underlying ITS services. Thus, the purpose of this part of ISO 14813 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 U.S., 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.

Currently there are many instantiations of ITS architecture in use around the world, with fragments of ITS architectures being used as the basis for several International Standards. This part of ISO 14813 embraces architecture concepts from the following sources:

— Other ITS architecture activities from several parts of the world, including the US National ITS Architecture and the European ITS Framework (FRAME) Architecture;

— Other ISO TC 204 and CEN TC278 working groups.

Most if not all ITS architectures 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. The following table provides a high-

level comparison between some key terms used in these two ITS architectures that are relevant to this part of ISO 14813.

ISO 14813-1	**US Architecture**	**FRAME Architecture**
Actor	Terminator	Terminator/Actor
ITS Service Domain	User Service Bundle	ITS Service Group
ITS Service Group	User Service	ITS Service Topic
ITS Service	User Service Requirement	ITS Service

Note that in the FRAME Architecture, many of the terminators are classed as "generic". This means that they have several forms (called "actors") for specific instances. An example of this is the terminator "Driver", which has specific instances that include actors such as drivers of private cars, plus drivers of other vehicle types, e.g. public transport, freight and emergency.

By combining the results of the work that has been done to develop these two architectures the working group has used the basic hypothesis that it is possible to define a set of 'ITS service domains, groups and services' that can be used in a variety of combinations and configurations, to provide an outline description of the different ITS architecture approaches.

Full documentation of all possible architectural approaches is 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 standardisation. A defined and consistent approach is however required to facilitate reuse and interoperability.

Users of this part of ISO 14813 should note that it is also possible to use a sub-set of the Services as the starting point for the creation of an ITS architecture for a particular ITS implementation. It is possible to add specific services that are peculiar to that implementation in order that the ITS architecture will support all that the stakeholders would like ITS to provide.

A further important point to note is that it is assumed that the scope of the ITS sector always has a definable boundary. Experience over the last 20 to 30 years has shown that this will change over time and that it will be necessary for this International Standard to be revised again after five years, if not before.

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

Part 1:
ITS service domains, service groups and services

1   Scope

This part of ISO 14813 provides a description of the primary services that an ITS implementation can provide to ITS users. Those services 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 part of ISO 14813 identifies thirteen service domains, within which numerous groups are then defined.

In this version of this part of ISO 14813 an indication has been provided to show the relationship of each service to Cooperative-ITS. Cooperative-ITS provides services that have previously been unavailable, notably those for ITS users who are on the move. For many other services, Cooperative-ITS can actually be seen as a "delivery mechanism" that can be used to enhance their use and availability. Thus for some services, Cooperative-ITS is essential, whilst for others it adds value. However for a small number of services it is not relevant.

This part of ISO 14813 is intended for use by at least two groups of people involved in the ITS sector. The first group is those looking for ideas about the services that ITS implementations can provide and the second is for those who are developing standards.

For the first group, this part of ISO 14813 provides service descriptions that can act as the catalyst for more detailed descriptions. It is possible for the level of detail to differ from one ITS implementation to another, depending on whether or not a national ITS architecture is involved, and whether this architecture is based directly on services, or on groups of functions.

For standards developers, this part of ISO 14813 is applicable to the working groups of ISO TC 204 and other Technical Committees who are developing standards for the ITS sector and associated sectors whose boundaries cross into the ITS sector (such as some aspects of public transport (transit), plus inter-modal freight and fleet management). This part of ISO 14813 is designed to provide information and explanation of services that can form the basis and reason for developing standards.

This part of ISO 14813 is in itself, by its nature, advisory and informative. It is designed to assist the integration of services into a cohesive reference architecture, plus interoperability and the use of common data definitions. Specifically, services defined within the service groups shall be the basis for definition of 'use cases', 'user needs' or "user service requirements' depending on the methodology being used to develop the resultant ITS architecture functionality, along with definition of applicable data within data dictionaries, as well as applicable communications and data exchange standards.

2   Normative references

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

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

ISO/TR 17465-1:2014, *Intelligent transport systems — Cooperative-ITS — Part 1: Terms and definitions*

ISO 21217:2014, *Intelligent transport systems — Communications access for land mobiles (CALM) — Architecture*

3 Terms and definitions

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

3.1
actor
entity that fulfils a role

3.2
application
mechanism of delivering some or all parts of a service

3.3
cooperative-ITS
subset of overall ITS that communicates and shares information between ITS stations to give advice or facilitate actions with the objective of improving safety, sustainability, efficiency and comfort beyond the scope of stand-alone systems

Note 1 to entry: This definition also appears in ISO 21217:2014. It is sometimes referred to as 'connected vehicles' or 'connected vehicle/highway systems'.

3.4
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

Note 1 to entry: This definition is taken from ISO/TR 15638-18.

3.5
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

3.6
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.

3.7
ITS service
functionality provided to users of intelligent transport systems designed to increase safety, sustainability, efficiency, and/or comfort

Note 1 to entry: This definition also appears in ISO 21217:2014.

3.8
ITS service group
one or more similar or complementary ITS services provided to ITS users

3.9
ITS service domain
specific application area which comprises one or more ITS service groups

3.10
ITS stakeholders
individual or organisation 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: Their involvement can be through use, manufacture of products, provision of Services, or regulation.

3.11
ITS user
one who directly receives and can act on ITS data or control products

Note 1 to entry: An ITS user is one who receives, directly or indirectly, or provides to, the transaction of an ITS service; these users of ITS services must be human, external systems, or another source of data, e.g. detection equipment.

3.12
navigation
ITS service which provides directional information to an individual during a trip

3.13
mass
mass of a given heavy vehicle as measured by equipment affixed to the regulated vehicle

Note 1 to entry: This definition is taken from ISO/TS 15638-12.

3.14
paratransit
non-scheduled, non-fixed route public transport services for customers requiring special assistance and access to specific destinations at a user-requested time

EXAMPLE   Disabled or elderly persons.

3.15
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

3.16
probe vehicle system /vehicle probe
system that comprises (1) vehicles which collect and transmit probe data and (2) land-based centres which do probe processing

Note 1 to entry: Probe processing builds an accurate understanding of the overall roadway and driving environment by fusing and analysing probe data sent from multiple vehicles and data from other data sources.

Note 2 to entry: 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.

3.17
route guidance
service which utilizes directional information, destination or real-time data to select an appropriate route, either prior to or during a trip

3.18
transit
alternative term for public transport that is used in some countries and in some instances and is expanded to "public transit"

3.19
telematics applications for regulated vehicles
provision of telematics services for regulated vehicles by an application service provider communicating with a regulated (usually commercial) vehicle using ITS-station to ITS-station communications

4 Symbols and abbreviated terms

C-ITS	Cooperative-ITS
EETS	European Electronic Toll Service
EFC	Electronic Fee Collection
HAZMAT	Hazardous materials
IFMS	Interoperable Fare Management Systems
ITS	Intelligent transport systems
OBE	On-board Equipment
PT	public transport
RSE	Roadside Equipment
TARV	Telematics applications for regulated vehicles
TICS	Transport information and control systems (old term for ITS)
UML	Unified modelling language

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. These application areas 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), those who move freight. They 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 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 organisational structures used in different geographical areas.

There is no proscribed relationship between ITS service domains and the areas of common functionality that are included in different ITS architectures. Sometimes a relationship may 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 part of ISO 14813.

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." Therefore, 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 services contained within:

a) Each 'ITS service group' is oriented to a specific activity related to management or information of 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

5.1.3 Characteristics of ITS services

An ITS service consists of a product or activity that can be provided to a specific ITS user. Thus ITS services shall be considered as the elemental building blocks of any ITS architecture/implementation.

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. Despite this, users are still able to add to or replace some of the specific services described in this document in order to reflect particular location and/or jurisdictionally and/or societal requirements. Whenever this is done the names of these new or replacement services must not conflict or replicate the names of services used in this document.

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

ISO ITS architecture standards do not require the use of a specific methodology and it is possible to use either Unified Modelling Language (UML – see ISO/TR 24529) or process orientated techniques (see ISO 26999). The choice of methodology must be driven by factors such as the point in the ITS implementation process at which the architecture is being developed and hence who is the target audience for the architecture.

ISO 14813-5 provides guidance as to the requirements for architecture description in ITS standards and ISO 17452 provides guidance and assistance for the use of UML in defining ITS interfaces.

5.2 ITS users

The general definition of the ITS user is that it represents a "partner", *i.e.* one who receives an ITS service through interaction with applications in the ITS implementation. ITS users have elsewhere been described as one of the sets of "stakeholders" who are involved in ITS implementations. . By definition, all human interaction with ITS implementations involves external actors 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

Categorisation 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 13 'ITS service domains'. These are:

— <u>Traveller Information</u> – this domain addresses the provision of both static and dynamic information about the road transport network to users prior to and during their trips, including inter-modal options and transfers and the status of other transport modes.

— <u>Traffic Management and Operations</u> –this domain specifically addresses the management of the movement of all types of vehicles, travellers and pedestrians throughout the road transport network, and includes 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.

— <u>Vehicle Services</u> –this 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 external information from on-board sensing devices, and/or from wireless communications with other sources.

   NOTE   The lead on standardization for the on-board issues will be agreed between TC204 and TC22.

— <u>Freight Transport</u> – 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.

— <u>Public Transport</u> – this service domain addresses the management of public transport (transit) to enable them to provide services that operate more timely and efficiently and the provision of operational information to the operator and user, including multimodal aspects.

— <u>Emergency Service</u> – the services in this domain are delivered in response to incidents that are categorized as emergencies and permit emergency services to be more quickly initiated and expedited throughout the transportation network.

— <u>Transport-related Payment</u> – this domain addresses activities that permit revenues for transportation services and facilities to be collected either electronically through non-cash and non-stop payment, or using mechanisms that require vehicles to stop.

— <u>Road transport related Personal Safety</u> – the services in this domain are responsible for the protection of the personal safety of transport users including pedestrians and individuals using road transportation facilities.

— <u>Weather and Environmental Conditions Monitoring</u> – the services in this domain are 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 road transport network and its users.

— <u>Disaster Response Management and Coordination</u> - the services in this domain are concerned with road transport based activities that manage resources from multiple jurisdictions in their responses to natural disasters, civil disturbances, or terror attacks.

— <u>National Security</u> - the services in this domain are concerned with the remote monitoring of vehicles for explosives or HAZMAT detection, and operational control of such vehicles (permitting shut down of vehicle operations if it is currently occupied by terrorists or known to be equipped (e.g., rigged with explosives) to cause destruction.

— <u>ITS Data Management</u> – the services in this domain are responsible for the definition and management of data that is capable of being used by some or all of the other services described in this part of ISO 14813.

— <u>Performance Management</u> – the services in this domain are responsible for the on-line and off-line simulation of road transport network operation using archived and/or live data that has been obtained from monitoring of the road transport network.

The categorization of the services into 13 groups does also not imply that all ITS architectures and the implementations deployed from them 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 ITS architecture elaborations based on these services it is important that the proposed classification schema identify WHO is responsible for the provision of the service.

6.2 Cooperative-ITS

The advent of Cooperative-ITS is seen by many as a completely new service or group of services. However closer study reveals that much of what Cooperative-ITS "provides" can in fact be categorised under one of the existing service groups. 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 Cooperative-ITS does provide are improved ways of communication both to collect road transport data from which information can be derived and to provide 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. The agreed definition of Cooperative-ITS is provided in TR17465-1:2014.

NOTE   In some countries, the use of the term "Cooperative-ITS" has been replaced by the term "Connected Vehicles".

6.3 Service Domain Structure

Table 1 shows the structure of each of the 13 service domains identified in 5.1. Within each domain are a number of groups, each of which can have one or more constituent services.