TECHNICAL SPECIFICATION

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Intelligent transport systems — Data interfaces between centres for transport information and control systems — Platform independent model specifications for data exchange protocols for transport information and control systems

Systèmes de transport intelligents — Interface de données entre centres pour les systèmes de commande et d'information des transports — Spécification du modèle indépendant de plateforme pour les protocoles d'échange de données pour les systèmes de commande et d'information des transports

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Contents

Page

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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This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 278, *Intelligent transport systems (ITS)*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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

Introduction

This document defines a common set of data exchange specifications to support the vision of a seamless interoperable exchange of traffic and travel information across boundaries, including national, urban, interurban, road administrations, infrastructure providers and service providers. Standardisation in this context is a vital constituent to ensure interoperability, reduction of risk, reduction of the cost base, promotion of open marketplaces and many social, economic and community benefits to be gained from more informed travellers, network managers and transport operators.

Especially in Europe, delivering transport policy in line with the White Paper issued by the European Commission requires co-ordination of traffic management and development of seamless pan European services. With the aim to support sustainable mobility in Europe, the European Commission has been supporting the development of information exchange mainly between the actors of the road traffic management domain for a number of years.

This document supports a methodology that is extensible.

To be able to successfully connect systems and start exchanging data, in an interoperable and easy way, there is a need to describe and agree on how the exchange should be done. This is set out in a data exchange specification. Data exchange in different scenarios can have different needs and requirements. Therefore, several data exchange specifications can be needed.

Data exchange specifications need to address two main issues. First, they model the stakeholders and actors involved in data exchange, each potentially in different roles, as well as abstract exchange patterns for their interactions. Second, they select a suitable implementation platform and clearly specify how the abstract scenarios and patterns are effectively implemented on this platform.

The following diagram in Figure 1 shows such an abstract communication scenario from the perspective of a road operator who requires data exchange interfaces between the different components of its own operational systems, either between centre side components or between centre and field devices, but also to exchange information with other road operators or service providers.

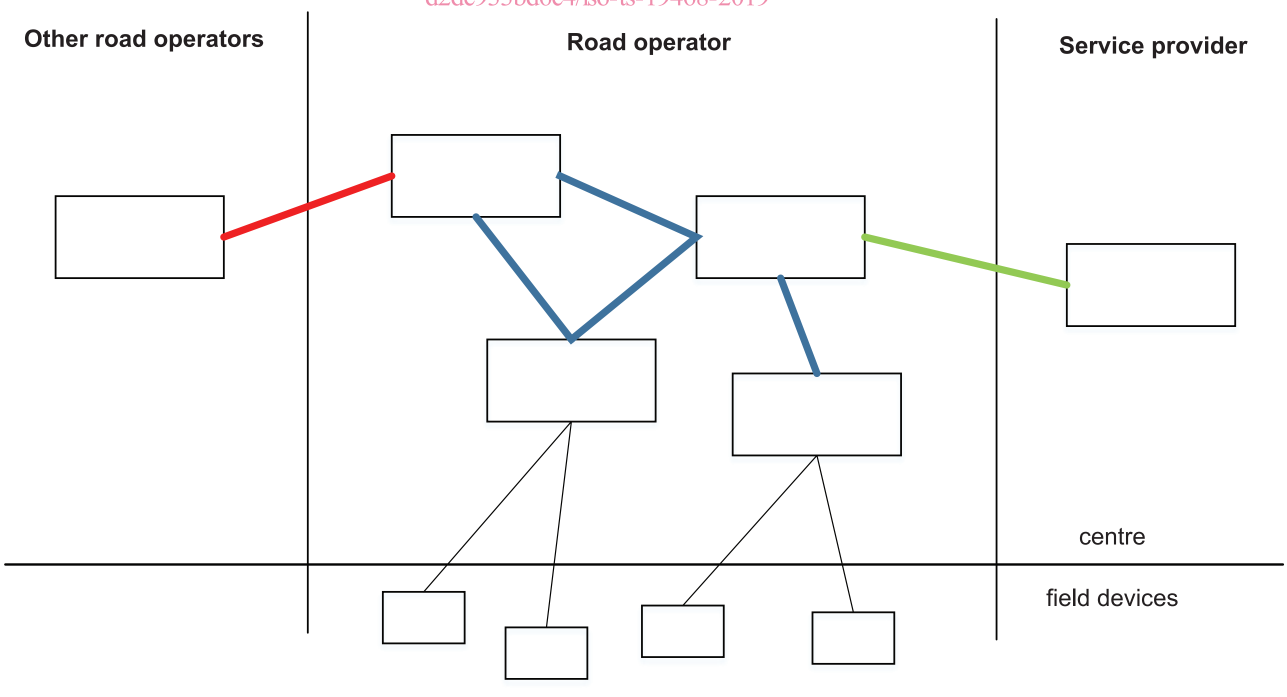

Figure 1 — Abstract communication scenario

While the black links between centre side components and field devices may use a variety of communication protocols, mostly depending on the physical link conditions, the vast majority of other coloured links between centre-side components, internal to one organisation or external to others, is based on an IP network and mostly use the TCP transport layer protocol (UDP is also possible in a few cases).

Nevertheless, as the different colours indicate, they can very well have significantly different requirements. Internal links (blue) can reside in one domain of trust, hence do not require protocols compatible with security gateways. This can already be different for links to other road operators (red) and will certainly not hold for links to other types of organisations, like service providers, via the Internet (green).

While different security requirements offer the most striking and obvious example, there are more criteria that can lead to different preferences on different types of links, e.g. scalability, robustness, integration complexity.

In broad terms, the colours blue – red – green form a hierarchy from more internal, closely-coupled, well-integrated systems towards external, loosely-coupled, and non-integrated systems. The world of *information and communication technology* (ICT) offers a broad range of solutions for these different scenarios, offering different advantages and disadvantages. It is obvious that the *one-size-fits-all* principle will not provide the most efficient way of working here. Even on the highest level of abstraction and inside the ICT domain itself, we already find a well-known battle of paradigms between *remote-procedure-call* (RPC) type service specifications and *RESTful* architectures. The same clusters of options are found in the domain of ITS standards, where for example the European standard for the real-time information interface relating to public transport operations (SIRI – EN 15531 series) introduces both concepts as complementary options: *Publish-Subscribe* and *Request-Response*.

As well, the ITS station architecture is not in contradiction with this document but is complementary of what is defined in this document. According to the principles and the taxonomy defined in ISO 21217, this document defines a conceptual notion of:

— How 2 *central ITS (sub) stations* could communicate to:
  — deliver (*application data units*) information,
  — negotiate functional service behaviour for collaborating traffic management functions (even if this use case could not directly be matched to ISO 21217 as it is not about information delivery).
— How a *Central ITS (sub) station* could communicate to deliver information (*application data units*) to another *ITS station* with the characteristics of a central ITS station.

This document specifies the process of defining the exchange characteristics by use case-driven feature selection of relevant parameters for the relevant OSI layers as defined in ISO 21217. Two exchange schemas are considered: *Information delivery* and *Functional service negotiation* between central ITS stations.

The drafting of this document was guided by the following principles:

— Interoperability, such that different implementations can successfully engage in a data exchange process;
— Support legacy implementations which are based on existing (exchange) specification, in order to maximize investments already made by stakeholders;
— Address other user profiles, not only road operators, and thus make this document available to a broader audience;
— Reuse of existing (communications) standards, in order to reduce implementation complexity and take benefit of proven and already existent solutions for common ICT problems;
— Clear separation between the payload content and the exchange model.

The informative Annex A details the adopted methodology for defining this exchange Platform Independent Model.

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1 Scope

This document defines and specifies component facets supporting the exchange and shared use of data and information in the field of traffic and travel.

The component facets include the framework and context for exchanges, the data content, structure and relationships necessary and the communications specification, in such a way that they are independent from any defined technical platform.

This document establishes specifications for data exchange between any two instances of the following actors:

— Traffic Information Centres (TIC);

— Traffic Control Centres/Traffic Management Centres (TCC/TMC);

— Service Providers (SP).

This document can be applied for use by other actors, e.g. car park operators.

This document includes the following types of information:

— the use cases and associated requirements, and features relative to different exchange situations;

— the different functional exchange profiles;

— the abstract elements for protocols;

— the data model for exchange (informational structures, relationships, roles, attributes and associated data types required).

In order to set up a new technical exchange framework, it is necessary to associate one functional exchange profile with a technical platform providing an interoperability domain where plug-and-play interoperability at technical level can be expected. The definition of such interoperability domains is not part of this document but can be found in other standards or technical specifications, e.g. ISO 14827-3. This document is restricted to data exchange. Definition of payload content models is beyond the scope of this document.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
business scenario
high level description of the interactions that can exist within a system being analysed or between the system and external entities (called actors) in terms of business functions

Note 1 to entry: See also *use case* (3.20).

3.2
client
entity that receives the information

Note 1 to entry: It is represented in the information delivery *business scenario* (3.1).

3.3
Functional Exchange Profile
FEP
selection of data exchange features for a particular *business scenario* (3.1)

3.4
HTTP server
software application that provides content to client applications by using the HTTP protocol

3.5
interoperability domain
pair of *Functional Exchange Profile (FEP)* (3.3) and platform selected for implementing a data exchange subsystem

Note 1 to entry: Each Platform Specific Model (PSM) document defines an interoperability domain, which ensures that two implementations of this PSM are interoperable and can successfully exchange payload.

3.6
payload content model
content model
UML definition of the data structures that can be used to describe travel and traffic information to be exchanged in an exchange system

3.7
payload publication
payload
bundle of information that is exchanged between two exchange systems containing an instance of the *content model* (3.6)

3.8
Platform Independent Model
PIM
document describing the abstract model of the standardised data exchange process in a platform-independent way

Note 1 to entry: This definition is specific to this document.

3.9
Platform Specific Model
PSM
document providing the implementation details of a *Functional Exchange Profile (FEP)* (3.3) described in a *Platform Independent Model (PIM)* (3.8) for a concrete platform

Note 1 to entry: This definition is specific to this document.

3.10
profile-to-platform mapping
act of defining an *interoperability domain* (3.5)

3.11
pub/sub
publish-subscribe pattern

3.12
pull exchange
exchange pattern where the exchange of information is originated by the client

3.13
push exchange
exchange pattern where the exchange of information is originated by the *supplier* (3.19)

3.14
simple push
push-based exchange pattern where that does not require state to be maintained

3.15
snapshot
set of data providing all of the last known state as opposed to providing partial changes

Note 1 to entry: This definition is specific to this document.

3.16
snapshot pull
pull-based exchange pattern where only the last snapshot version is exchanged

3.17
snapshot push
push-based exchange pattern where only the last snapshot version is exchanged

3.18
stateful push
push-based exchange pattern where data describing a communication session is maintained across successive communication within that session

3.19
supplier
entity that provides the information

Note 1 to entry: It is represented in the information delivery *business scenario* (3.1).

3.20
use case
UC
set of operational interactions between entities (called actors) and a system to ease understanding the main functions behind such interactions

4 Symbols and abbreviated terms

ASN.1 Abstract Syntax Notation One

BUC Business use case

HTTP Hypertext Transfer Protocol

ICT Information and Communication Technology

IP Internet Protocol

ITS Intelligent Transport Systems

MDA Model Driven Architecture

REST Representational State Transfer

RPC Remote Procedure Call

SOAP Simple Object Access Protocol

TCP Transmission Control Protocol

TMP Traffic Management Plan

UDDI Universal Description Discovery and Integration

UDP User Datagram Protocol

UML Unified Modeling Language

NOTE Specified in ISO/IEC 19505.

VMS Variable Message Sign

W3C World Wide Web Consortium

WSDL Web Service Definition Language

WSIL Web Services Inspection Language

WSS Web Services Security

XML eXtensible Markup Language

5 Exchange modelling framework

5.1 Overview

The model driven approach is chosen to describe exchange: this leads to describe exchange systems by means of abstract models which are named Platform Independent Model (PIM), in which modelling of exchange features is done by describing interaction among systems and subsystems as exchange patterns. These interactions implement system capabilities as features which fulfil exchange requirements requested by specific business scenarios which are used to specify specific uses of exchange.

Since simple data exchange process is no longer sufficient for resolving all business needs, this document encompasses more business functions as stakeholders consolidate their systems and look at new ways to address the requests they encounter with the tools they already know and have in place.

5.2 Business scenarios and Functional Exchange Profile (FEP)

This document is based on business scenarios, i.e. a high-level description of the interactions that can exist within a system being analysed or between the system and external entities (called actors) in terms of business functions. It is derived from requirements a business scenario has on information as well as technical parameters. FEPs are identified to ensure interoperable services with the restriction of determining one FEP per business scenario for a specific technical platform. One FEP can support more than one business scenario (see Figure 2).

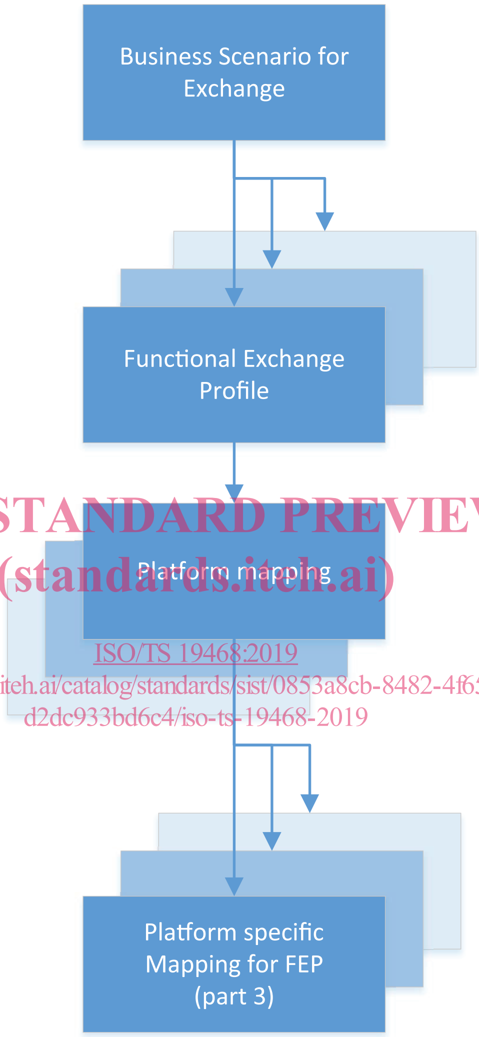

Figure 2 — Business scenario and Functional Exchange Profile (FEP)

This version of the document addresses the following business scenarios:

— Information delivery,

— Collaborative ITS services (partly).

Other business scenarios can be developed in future versions using the same methodology.

5.3 Requirements, feature and exchange patterns

Requirements can vary depending on data exchange applications, i.e. use cases to be fulfilled, so there are many reasons to consider or not any requirement based both on the gathering of data at supplier system and the usage of the delivered data in the client.

Requirements address the following items:

— Information provision,

— Communications,

— Security,

— Financial aspects.

Exchange is defined through **features** which implement the information exchange and fulfils data exchange requirements.

Depending on many possible exchange platforms considered for implementation, a subset of features and relative requirements is possible to be implemented. To fulfil a set of requirements many platforms are possible, but to be interoperable a client and a supplier shall implement the same platform with the same pattern. Allowing a wide variety of possible **exchange patterns**, the best suitable for an application is chosen, according to requirements the fulfilment of which is granted by the selected exchange pattern.

Based on the requirements of a specific business scenario, a set of appropriate exchange features shall be combined into a Functional Exchange Profile (FEP).

The following schema in Figure 3 represent the domains of PIM and PSM introducing exchange pattern (EP) and Functional Exchange Profile (FEP).

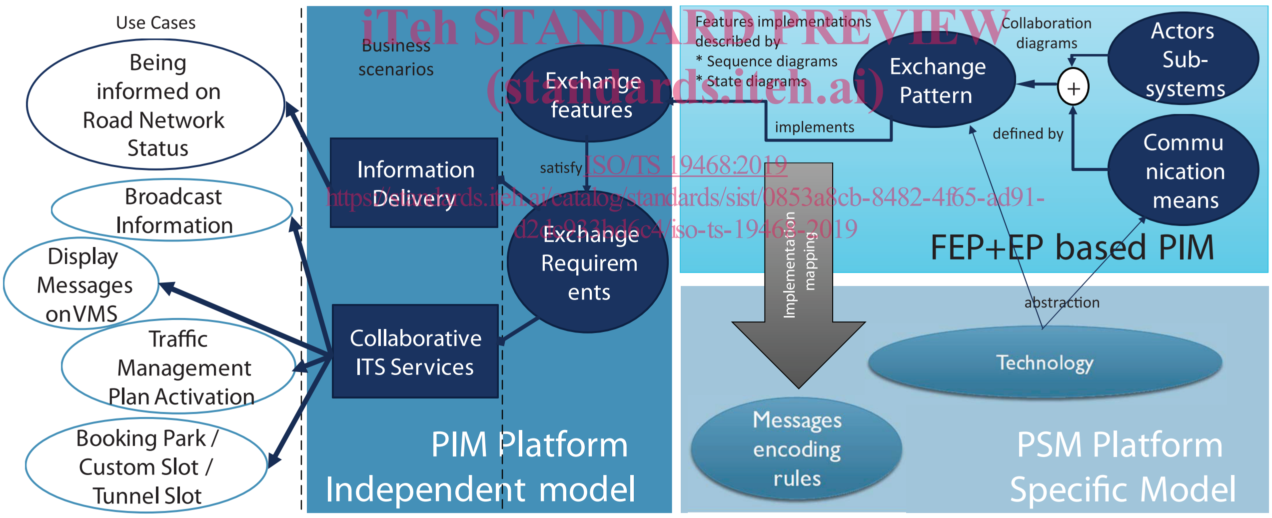

Figure 3 — Business scenario and Functional Exchange Profile (FEP)

5.4 Business scenario: Information delivery

5.4.1 Overview

One of the most common applications of a data exchange system is the exchange of traffic and travel information between two nodes. In such a scenario, one node acts as the supplier of the information while the other acts as the intended receiver of that information, i.e. the client.

EXAMPLE It is done by using the form of publications, e.g. in the European DATEX II.

The data delivery business scenario considers the actors as defined in the following Figure 4:

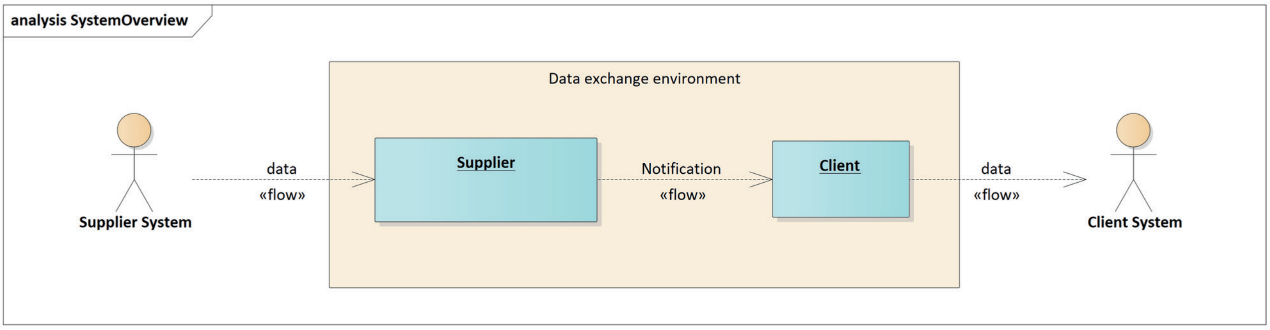

Figure 4 — General data delivery business scenario actors

The following table provides the basic definitions for exchange:

Table 1 — Main definitions in exchange

Name	Definition
Supplier system	A system which gathers information (road information) which needs to be conveyed to another system named client system. Examples of supplier systems are traffic control centres or traffic information centres or service provider systems, gathering road data from any available source they have.
Client system	A system which needs to update its internal information based on information which is available from another system named supplier. Examples of client systems are traffic control centres or traffic information centres or service provider systems.
Exchange environment	The set of components which enables information exchange among client systems and supplier systems via a data exchange protocol.
Supplier	The component of exchange environment which is devoted to providing data to client, retrieving them from supplier system.
Client	The component of exchange environment which is devoted to collecting data from supplier, delivering them to the client system.

Road and traffic information is gathered in a system which is named “Supplier System” in case the information it stores is needed to be transferred to another system, named “Client System”, for any purpose.

The data delivery business scenario describes the exchange pattern and messages which are needed to be exchanged among supplier and client systems besides the underneath technology and exchange pattern. The purpose for which information is exchanged is not considered in this use case description.

As explained in the information delivery background in Annex F, any update of information status at the supplier system shall be replicated to the client system via information delivery. The main objective of information delivery is that information on the client system is updated exactly in the same way as it is in the supplier system without any difference in information values and semantics.

“Exchange message” is defined as the data structure in which the information is coded to transfer information in the exchange system from the supplier to the client.

Assuming Sc = Client status, Ss = Supplier status, exchange is a mean to have Sc equivalent to Ss,

Formally:

Ss → Information → Supplier → Exchange Message → Client → Information → Sc

i.e. client system status is updated in equivalent mode as supplier system status by means of data delivery exchange messages between supplier and client.