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Intelligent transport systems — Using web services (machine-machine delivery) for ITS service delivery —

Part 1: Realization of interoperable web services

Utilisation des services du Web (livraison de machine à machine) pour la livraison de services ITS —

Partie 1: Réalisation des services du Web interopérables

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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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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

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

This second edition cancels and replaces the first edition (ISO 24097-1:2009), which has been technically revised.

A list of all the parts in the ISO 24097- series, can be found on the ISO website.

Introduction

ITS services have been evolving from single functional and limited area specific services, to a broad range of services in which many systems co-operate to provide effective and efficient service provision across a wide area. Today, ITS services are required to communicate not just with other parts of the same ITS service, but between different ITS services, and even with non-ITS services or a user's system directly, e.g. traffic management systems, route guidance systems, homeland security systems, environment protection systems, private freight management systems, etc.

These systems (even those limited to ITS services) are usually deployed in a heterogeneous environment that may use different hardware, operating systems (OS), middleware, and/or development languages. This creates a challenge to realize system coordination across the organizations in a way that is flexible and quick, at a reasonable cost. Web services (WS) are a recent methodology that overcomes these difficulties. Using web service technology for ITS services can significantly simplify and reduce the cost of internet based service provision, which may well affect the speed at which ITS services are deployed.

The World Wide Web Consortium (W3C) defines web services as follows:

"A web service is a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format (specifically WSDL (Web Services Description Language)). Other systems interact with the web service in a manner prescribed by its description using SOAP-messages, typically conveyed using HTTP with an XML serialization in conjunction with other web-related standards."

Web services require significant functionality, and as a result, an architecture is indispensable. Web service standardization organizations construct standards by SOA. SOA is the evolutional form of distributed computing and object orientation.

By applying SOA-based standards to the ITS services, the following benefits are expected.

From a business viewpoint:

— Increased service value;

— Internationalization; and

— Expansion towards business automation.

From a system development viewpoint:

— Easy and quick development of ITS service coordination and service area expansion;

— More efficient service development (web services enable system developers to focus on the "what" rather than the "how." "How" is covered by a set of standard base tools. This enables quick and easy system software development;

— More reusable software because web service standards have a composable structure, and

— Easier connections to legacy systems.

In the ITS sector, a significant number of messages have been or are being developed (and in some cases standardized). Message standardization is intended to improve system coordination, interoperability and re-use, so the conditions for web services are already considered mature. In addition, the use of web services will increase the flexibility of ITS services to interoperate and communicate beyond the ITS sector and in areas where the delineation between ITS services and general commercial services converge.

From the perspective of web services standards evolution, 2007 was an epoch-making year. WSDL 2.0 became the W3C recommendation. Correspondingly, relevant web service specifications were standardized by open standards bodies (W3C and OASIS). These standards cover all functional layers. By using these standards, the ITS sector has a rigid base for interoperable web services.

ITS service collaboration with other sectors is expected to increase mutual effectiveness. Economic globalization also requires communication across the country, often across the world. All of these collaborations rely on interoperability of services. Interoperability is only achieved based on open international standards.

Web services were developed to use distributed network resources in an interoperable way. However, to realize interoperable web services various capabilities are required.

Using web services (machine-machine delivery) for ITS service delivery has been developed considering these circumstances. ISO 24097 consists of two parts: ISO 24097-1 and ISO/TR 24097-2.

This document focuses on a way to realize interoperable ITS web services. ISO/TR 24097-2 will be an example-based document which will show how to realize interoperable web services.

Intelligent transport systems — Using web services (machine-machine delivery) for ITS service delivery —

Part 1: Realization of interoperable web services

1 Scope

This document establishes a Service Oriented Architecture (SOA) for the realization of interoperable web services for Intelligent Transport Systems (ITS).

Web service behaviour is described at the metadata level, i.e. a higher level of abstraction, to enable auto-generation of both a 'service requester' program as well as a 'service provider' program. Figure 1 presents the principal entities involved in a web service scenario. They are service provider, service requester, and 'registry'. The registry includes business information and technical information such as interface and policy. Figure 1 also depicts the actions of the service provider and the service requester. A service provider interacts with the registry to enable it to "publish" the provided service. The service is characterized in the form of a web service interface describer in the form of a standardized web service description language (WSDL) and policy (WS-Policy). A service requester interacts with the registry to "discover" a provider for the service he is seeking. That interaction takes place through "Universal Description Discovery and Integration" (UDDI) dialogue and endpoint reference (EPR). Once the service requester identifies a service provider, he "binds" to the service provider via an SOA protocol.

This document is applicable to inter-ITS sector web services as well as ITS web services for non-ITS users.

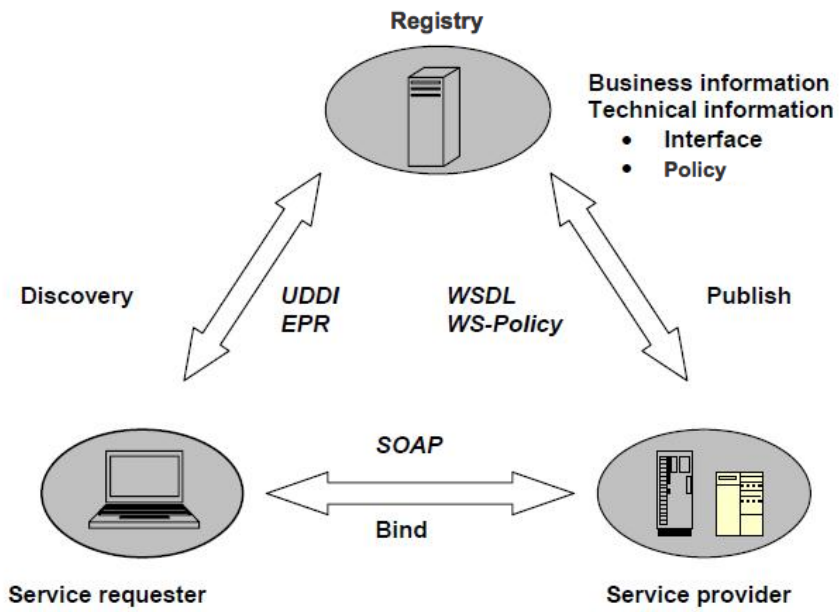

Figure 1 — Web service entities and their relationships

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14817 (all parts), *Intelligent transport systems — ITS central data dictionaries*

NOTE See Bibliography for general W3C references.

3 Terms, definitions and abbreviated terms

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:

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

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

General terms of W3C web service definitions can be obtained from the website www.w3.org/tr/ws-arch/ and terms defined in a specific web service standard are also referable.

3.1 Terms and definitions

3.1.1
composability
facility enabling web services to add new features incrementally

3.1.2
domain
functional area in a policy assertion

EXAMPLE Security, reliability, transaction, messaging optimization.

3.1.3
ITS WS
web service that is designed specifically to support ITS services via the internet

3.1.4
international standard web service
web service conformant to this document

3.1.5
platform
hardware, operating system, middleware, and application development language which provide a system environment

3.1.6
policy assertion
element of service metadata which identifies a domain (such as messaging, security, reliability and transaction) specific behaviour

3.1.7
skeleton
elements of service-side code used for receiving remote method calls, invoking them and returning the result to the sender

3.1.8
stub
client code required to talk to a remote service

3.1.9
WS metadata
service metadata
metadata
high-level service description of a web service that controls provision of that service

3.2 Abbreviated terms

BNF	Backus-Naur Form
BP	basic profile (of Web Services Interoperability Organization)
BPEL	business process execution language
DD	data dictionary
DR	data registry
EPR	endpoint reference
HTTP	hypertext transfer protocol
HTTPS	hypertext transfer protocol security
IRI	internationalized resource identifier
MIME	multipurpose internet mail extension
MOF	meta object facility
MTOM	(SOAP) Message Transmission Optimization Mechanism
OID	Object Identifier
OMG	object management group
OSI	open system interconnection
QoS	quality of service
REC	recommendation
RM	reliable messaging
RMI/IIOP	remote method invocation/internet inter-ORB protocol
RPC	remote procedure call
SMTP	simple mail transfer protocol
SOA	service-oriented architecture
TCP/IP	transmission control protocol/internet protocol
tModel	technical model
UDDI	universal description, discovery, and integration
URI	uniform resource identifier
UTF-8(/16)	8(/16)-bit universal character set transformation format
W3C	world wide web consortium
WS	web service
WS-I	web services interoperability (organization)
WSDL	web services description language
XML	eXtensible markup language
XSD	XML schema definition

4 Conformance

There are no explicit conformance tests within this document. Conformance is achieved by conforming to the provisions of the requirements clauses of ISO 24097-1. Specific conformance tests may be added at a subsequent date as an additional part to the ISO 24097- series.

5 Notation

5.1 Prefixes and namespace URI used in core specification

This document uses predefined namespace prefixes throughout; as provided in Table 1. Other prefixes and namespaces (e.g.' Web Services Policy' and 'Web Services Addressing' etc.) are shown in specific clauses of this document.

NOTE 1 The choice of any namespace prefix is arbitrary and not semantically significant (see [Namespaces in XML]). However, the prefix must be unique in any single document.

NOTE 2 For reasons of brevity, not all examples are shown as full schemas. In this case, it is assumed that the namespace has been declared in a parent element.

Table 1 — Namespace prefix and namespace URI

Category	Prefix	Namespace URI
WS-I namespace	`wsi`	http://ws-i.org/profiles/basic/1.1
WSDL 2.0 namespace for WSDL framework.	`wsdl`	http://schemas.xmlsoap.org/wsdl/
WSDL 1.1 namespace	`wsdl11`	http://schemas.xmlsoap.org/wsdl
WSDL namespace for WSDL SOAP binding.	`soapbind`	http://schemas.xmlsoap.org/wsdl/soap/
WSDL namespace for WSDL HTTP GET & POST binding.	`http`	http://schemas.xmlsoap.org/wsdl/http/
Encoding namespace as defined by SOAP 1.1	`soapenc`	http://schemas.xmlsoap.org/soap/encoding/
Envelope namespace as defined by SOAP 1.1	`soapenv`	http://schemas.xmlsoap.org/soap/envelope/
Instance namespace as defined by XSD	`xsi`	http://www.w3.org/2000/10/XMLSchema-instance/
Schema namespace as defined by XSD	`xsd`	http://www.w3.org/2000/10/XMLSchema/
The "this namespace" (tns) prefix as a convention to refer to the current document.	`tns`	`(various)`
All other namespace prefixes are samples only. In particular, IRIs starting with "http://example.com" represents application-dependent or context-dependent IRI.	`(other)`	`(various)`

5.2 Web service syntax notation: BNF pseudo-schemas

BNF pseudo-schemas are used to represent web service syntax.

— The syntax appears as an XML instance, but values in italics indicate data types instead of literal values.

— Characters are appended to elements and attributes to indicate cardinality:

  o "?" (0 or 1)

  o "*" (0 or more)

  o "+" (1 or more)

— The character "|" is used to indicate a choice between alternatives.

— The characters "(" and ")" are used to indicate that contained items are to be treated as a group with respect to cardinality or choice.

— The characters "[" and "]" are used to call out references and property names.

— Ellipses (i.e., "...") indicate points of extensibility. Additional children and/or attributes MAY be added at the indicated extension points but MUST NOT contradict the semantics of the parent and/or owner, respectively. By default, if a receiver does not recognize an extension, the receiver SHOULD ignore the extension; exceptions to this processing rule, if any, are clearly indicated below.

5.3 XPath 1.0 notation

XPath 1.0 notation is used to specify an XML element and/or attribute.

5.4 Notation of service provider, service consumer combination

There are four combinations of service provider and service consumer. In this document the combination is represented using the “service provider”, “service consumer” notation.

EXAMPLE Traffic service provider, freight industry.

5.5 SOA stack name notation

SOA stack name is represented by bold italics.

EXAMPLE ***messaging***

5.6 Set notation

Set is represented by being embraced in curly brackets (“{ “and”}”).

EXAMPLE Integer set of 1 to 9

```
{1, 2, 3, 4, 5, 6, 7, 8, 9}
```


5.7 Tentative IRI expression

Some constructs cannot determine their value when creating standards. In this case, a tentative value is expressed by ***/tentative*** in bold italics. The final value will be given using real IRI.

EXAMPLE WSDL `soapbind:address` (real web service address)

```
<definitions name=…
   xmlns="http://schemas.xmlsoap.org/wsdl"… >
   …
   <service name=…>
      <port name=…>
         <soapbind:addrss location="http://www.example.com/tentative/">
         </port>
      </service>
```

In this case, location is real service IRI and cannot determine the standardization point but it is necessary to be expressed to provide a valid WSDL document.

5.8 Rnnnn (nnnn: digits integer)

Rnnnn is used to display the WS-I Basic Profile requirement identifier number. The expression is shown as “[Rnnnn]”.

6 Requirements

6.1 Basic concept of web services standardization

6.1.1 Web services architecture

Given that web services require significant functionality, an architectural context is essential. Web service standardization organizations construct standards within the framework of an SOA.[4],[5] An SOA is an evolutionary form of distributed computing and object-orientation.

The fundamental SOA philosophy (architecture) is:

— Systems shall be coupled loosely with messages;

— Systems shall be linked dynamically; and

— Systems shall be composable by functional stacks.

In a web service SOA, functional stacks are as follows:

— ***Service composition*** stack: the stack that describes the coordination of business processes. This stack is used to automate real business;

— ***Service description*** stack: the stack that describes the service interface and its related service policy. This stack is used for metadata description;

— ***Quality of service (QoS)*** stack: the stack that ensures message quality, security, and transaction quality;

— ***Messaging*** stack: the stack that describes message behaviour;

— ***Transport*** stack: the stack that transports the message; and

— ***Service publication and discovery*** stack: the stack that publishes a web service and supports its discovery.

Web services are constructed upon an SOA-based open body of standards (see Figure 2 below). Each standard is constructed in a platform independent manner. As a result, a web service (service and client) can communicate with each other independent of their platform. In this case, interoperability is realized when both sides conform to the same standard.

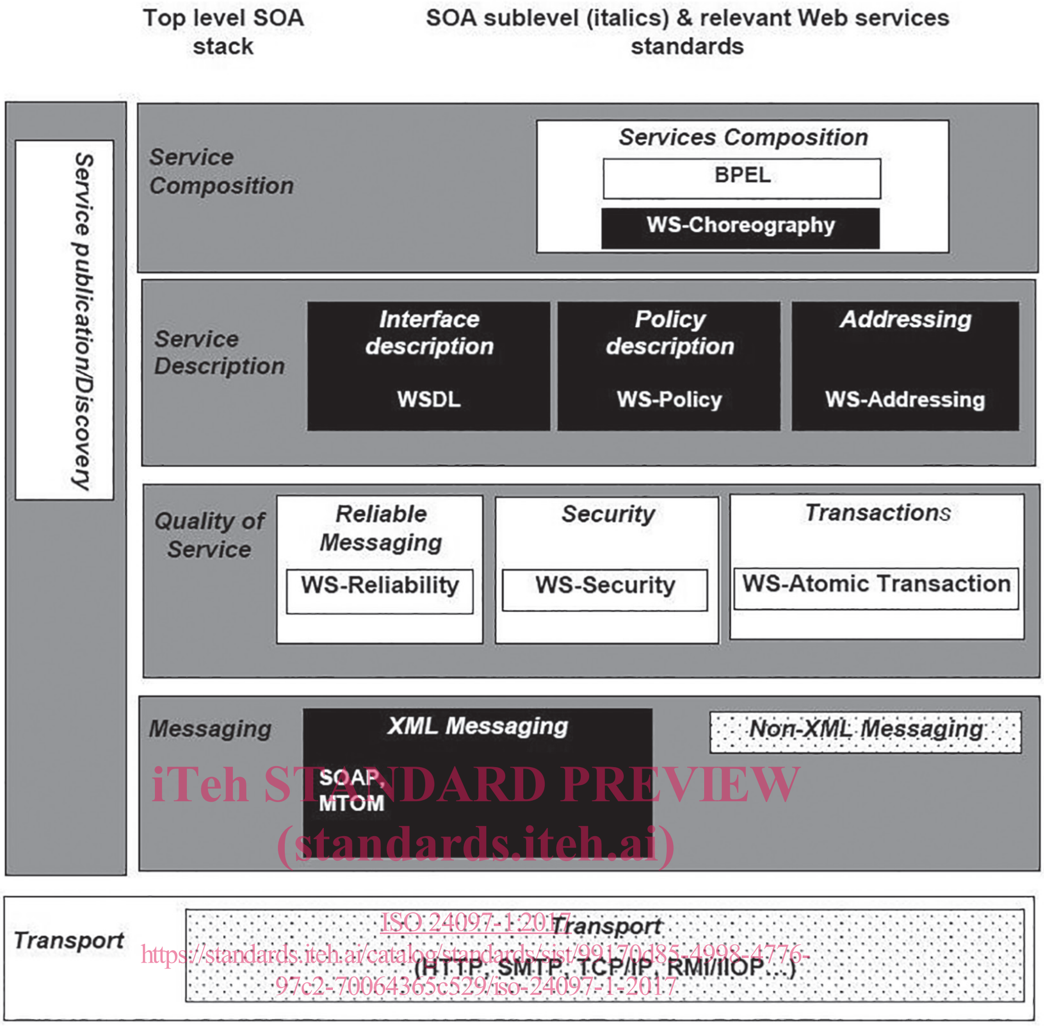

Figure 2 — SOA and its construct standards

NOTE 1 Currently, many software vendors provide a variety of development tools from integrated web service development tools to component level tools. Using these tools enables the developer to make rapid and comparatively easy enhancements.

NOTE 2 Some architects depict ***QoS layer*** as being higher than the upper layer of ***Service description layer***. Other architects depict the reverse. This document describes the ***Service description layer*** as the higher of the two layers. The reason for this is that ***Service description layer*** uses the ***QoS layer*** and it controls the behaviour of the ***QoS*** layer.

6.1.2 International standard web service standardization

Figure 3 depicts an MOF-like view of web services. The dashed arrow shows reference relationships.

M3 Layer (XML + XML Schema and Namespace) provides the syntax of the web service standards. ISO 24531 is the standard schema used within the ITS sector.

M2 Layer (Web service standards, WS-I BP, and this document) provide the rules and guidance for web service development.

M1 Layer (ITS Web service standards) provides rules and guidance for web service development that is particular to ITS. If M1 Layer instances of specific web service (ITS web service) follow this document, basic interoperability should be achieved.