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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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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

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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 24097-1 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

ISO 24097 consists of the following parts, under the general title *Intelligent transport systems — Using web services (machine-machine delivery) for ITS service delivery*:

— *Part 1: Realization of interoperable web services*

An example-based document on the elaboration of interoperable ITS web services will form the subject of part 2.

Introduction

Intelligent Transport Systems (ITS) services have been evolving from single functional and limited area specific services, to a broad range of services in which many systems cooperate to provide effective and efficient service provision across a wide area. In today's world, ITS services are required to communicate not just with other parts of the same ITS service provision, but between different ITS services and even with non-ITS services or a user's system directly. Some examples of these systems are communications between traffic management, route guidance systems, homeland security systems, environment protection systems and private freight management systems.

These systems (even those limited to ITS services) are usually deployed in a heterogeneous circumstance, use different hardware, different operating system (OS), middleware, or development languages. This therefore creates a challenge in order to realize system coordination across the organizations in a way that is flexible, quick and at 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 can affect the level and speed of take up of use of ITS services.

The World Wide Web Consortium (W3C) defines WS as follows: "A web service is a software system designed to support interoperable machine-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."

WS require quite a lot of functionalities and as a result, an architecture is indispensable. Web service standardization organizations construct standards by Service-Oriented Architecture (SOA). SOA is an evolutional form of distributed computing and object orientation.

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

From a business viewpoint:

— increased service value;

— internationalization;

— expansion towards business automation.

From a system development perspective:

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

— WS enable system developers to focus on the "what" not the "how." "HOW" is covered by standard base tools. This enables quick and easy system software development;

— composable structure of web service standards promote reusability of software;

— easy connection to a legacy system.

In the ITS sector, message standardization of many applications has already been completed, are well advanced, or are determined regionally. Message standardization is intended to improve system coordination, interoperability and re-use and so the conditions for WS are considered already mature. In addition, the use of WS 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 the evolution of standards in WS, 2007 was an epoch-making year. WSDL 2.0 became the W3C recommendation. Correspondingly, relevant web service specifications were standardized by open standardization bodies (W3C and OASIS). These standards cover all functional layers. In using these standards, the ITS sector has a rigid base for interoperable WS.

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.

WS were developed to use distributed network resources in an interoperable way. However, to realize interoperable WS, various functionalities are required. ISO 24097 (all parts) has been developed based on these circumstances.

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

Part 1: Realization of interoperable web services

1 Scope

This part of ISO 24097 establishes a Service-Oriented Architecture (SOA) for the realization of interoperable Intelligent Transport Systems (ITS) web services (WS). Web service behaviour is described at the metadata level (i.e. a higher level of abstraction) to enable auto-generation of both a “Service requestor” program, as well as a “Service provider” program.

The principal entities involved in a web service scenario are “Service provider“, “Service requestor” and “Registry” (see Figure 1). The registry includes business information and technical information such as interface and policy. A service provider interacts with the registry to enable it to “publish” the service he/she is able to provide. The service is characterized by a web service interface describer in the form of a standardized web service description language (WSDL) and policy (WS-Policy). A service requestor interacts with the registry to “discover” a provider for the service he/she is seeking. That interaction takes place through Universal Description Discovery and Integration (UDDI) dialogue and endpoint reference (EPR). Once the service requestor identifies a service provider, he “binds” to the service provider via an SOA protocol.

NOTE Figure 1 depicts the actions of the service provider and the service requestor.

This part of ISO 24097 is applicable to inter-ITS sector WS, as well as ITS WS for non-ITS users.

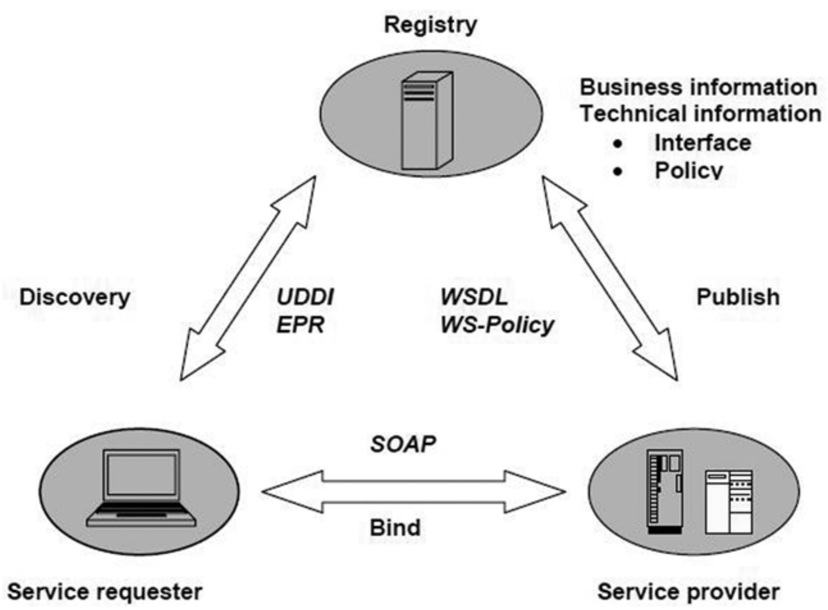

Figure 1 — Web service entities and their relationships

2 Conformance

There are no explicit conformance tests in this part of ISO 24097. Conformance is achieved by conforming to the requirements of ISO 24097-1. Specific conformance tests can be specified in another part of ISO 24097.

3 Normative references

The following referenced documents are indispensable for the application 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, *Transport information and control systems — Requirements for an ITS/TICS central Data Registry and ITS/TICS Data Dictionarie*s

4 Terms, definitions and abbreviated terms

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

NOTE 1 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.

NOTE 2 For general W3C references, see the Bibliography.

4.1 Terms and definitions

4.1.1
composability
facility enabling web services to add new features incrementally

4.1.2
domain
functional area in a policy assertion (e.g. security, reliability, transaction and messaging optimization)

4.1.3
ITS WS
web service that is designed specifically to support ITS services via the Internet

4.1.4
International Standard web service
web service conformant to this part of ISO 24097

4.1.5
platform
hardware, operating system, middleware and application development language, which provide a system environment

4.1.6
policy assertion
element of service metadata which identifies a domain (such as messaging, security, reliability and transaction) specific behaviour

4.1.7
skeleton
elements of service side code used for receiving remote method calls, invoking them and returning the result to the sender

4.1.8
stub
client code required to talk to a remote service

4.1.9
WS metadata
service metadata
metadata
high-level service description of a web service that controls provision of that service

4.2 Abbreviated terms

4.2.1
BNF
Backus Naur Form

4.2.2
BP
basic profile (of web services interoperability organization)

4.2.3
BPEL
business process execution language

4.2.4
DD
data dictionary

4.2.5
DR
data registry

4.2.6
EPR
endpoint reference

4.2.7
HTTP
hypertext transfer protocol

4.2.8
HTTPS
hypertext transfer protocol security

4.2.9
IRI
internationalized resource identifier

4.2.10
MIME
multipurpose Internet mail extension

4.2.11
MOF
meta object facility

4.2.12
MTOM
⟨SOAP⟩ message transmission optimization mechanism

4.2.13
OID
object identifier

4.2.14
OMG
object management group

4.2.15
OSI
open system interconnection

4.2.16
QoS
quality of service

4.2.17
REC
recommendation

4.2.18
RM
reliable messaging

4.2.19
RMI/IIOP
remote method invocation/Internet inter-ORB protocol

4.2.20
RPC
remote procedure call

4.2.21
SMTP
simple mail transfer protocol

4.2.22
SOA
service-oriented architecture

4.2.23
TCP/IP
transmission control protocol/internet protocol

4.2.24
tModel
technical model

4.2.25
UDDI
universal description, discovery and integration

4.2.26
URI
uniform resource identifier

4.2.27
UTF-8(/16)
8(/16)-bit universal character set transformation format

4.2.28
W3C
World Wide Web Consortium

4.2.29
WS
web service

4.2.30
WS-I
web services interoperability (organization)

4.2.31
WSDL
web services description language

4.2.32
XML
eXtensible markup language

4.2.33
XSD
XML schema definition

5 Notation

5.1 Prefixes and namespace URI used in core specification

This part of ISO 24097 uses predefined namespace prefixes throughout as given in Table 1. Other prefixes and namespaces (e.g. "Web Services Policy" and "Web Services Addressing") are given in this part of ISO 24097.

NOTE 1 The choice of any namespace prefix is arbitrary and not semantically significant (see [Namespaces in XML]). However, the prefix is 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 and 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" represent 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:

"?" (0 or 1);

"*" (0 or more);

"+" (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 SHALL 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 part of ISO 24097, the combination is represented by a (service provider and 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

Braces enclose a set: "{" "}".

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:address location="http://www.example.com/tentative/">
         </port>
      </service>
```


In this case, location is real service IRI and cannot determine the standardization point, however it shall be expressed in order 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 "[Rnnnn]".

6 Requirements

6.1 Basic concept of web services standardization

6.1.1 Web services architecture

Given that WS require a number of functionalities, an architectural context is therefore essential. Web service standardization organizations construct standards within the framework of an SOA. An SOA is an evolutionary form of distributed computing and object-orientation).

The fundamental SOA philosophy (architecture) is:

— systems shall be coupled loosely by message;

— systems shall be linked dynamically;

— systems shall be composable by functional stacks.

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

a) Service composition stack: the stack that describes coordination of business processes. This stack is used to automate real business.

b) Service description stack: the stack that describes service interface and related service policy. This stack is used for metadata description.

c) Quality of service (QoS) stack: the stack that ensures message quality, security and transaction quality.

d) Messaging stack: the stack that describes message behaviour.

e) Transport stack: the stack that transports message.

f) Service publication and discovery stack: the stack that publishes a web service and its discovery.

WS are constructed on SOA-based open body standards (see Figure 2). 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.

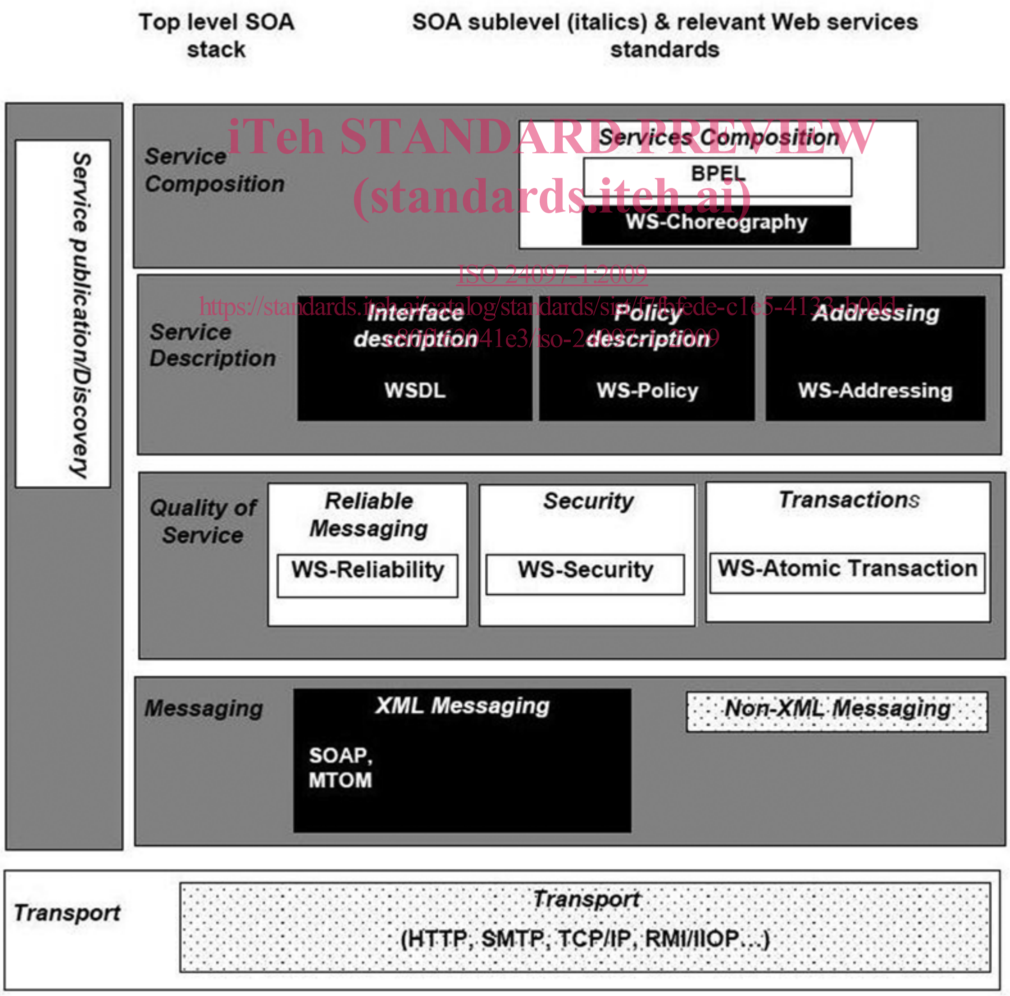

Figure 2 — SOA and its construct standards

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

NOTE 2 Some architects depict QoS layer as an upper layer of Service description layer. Other architects depict the reverse. This part of ISO 24097 describes the Service description layer as upper layer of the QoS layer. The reason for this is that the Service description layer uses QoS layer and it controls behaviour of QoS.

6.1.2 International standard web service standardization

Figure 3 depicts a MOF-like view of WS. 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 schema usage standard for the ITS sector.

M2 Layer (Web service standards, WS-I BP and this part of ISO 24097) provide rules and guidance for web service development.

M1 Layer (ITS Web service standards) provided rules and guidance for web service development particular to ITS. As long as M1 Layer instances of specific web service (ITS web service) follow this part of ISO 24097, basic interoperability is achieved.

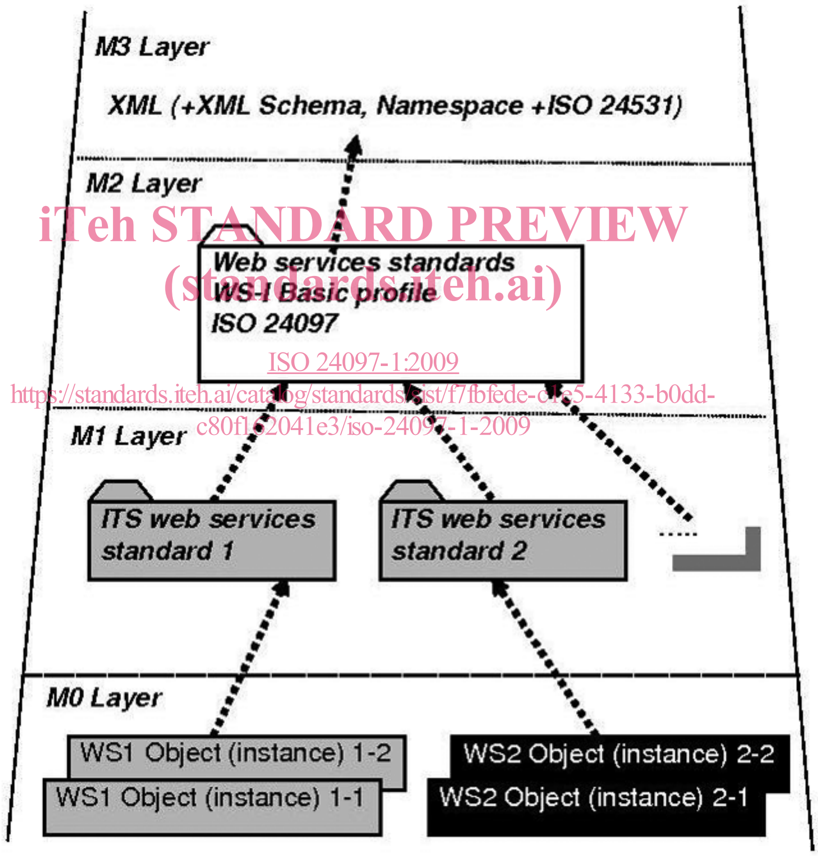

Figure 3 — ITS web service standard structure

6.2 Web service metadata

Web service standards are based on an SOA. This means that WS are constructed by the collection of layered functions. The fundamental layers are depicted in Figure 2. The topmost layer is the Service composition layer. This layer covers, as the name indicates, the composition of multiple services. As this part of ISO 24097 covers only single web service application, this layer description is not included in this part of ISO 24097.

The second upper-most layer is the Service description layer. This layer is a metadata layer in general terms. The Service description layer consists of three sub-components, namely interface description, policy

