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Standard Practice

**PREPARATION OF
WEB SERVICE DESCRIPTION DOCUMENTS**

FOREWORD

This standard is approved for use by all Departments of the Federal Aviation Administration (FAA).

This standard specifies the minimum acceptable content for documenting [Web services](#) within the FAA.

This standard is one of several related standards that together define FAA's requirements for developing, describing, and registering services. A Handbook entitled *Using FAA Standards to Describe and Register Web Services* (FAA-HDBK-008) [\[3\]](#) provides additional guidance for using these standards.

This standard has been prepared in accordance with FAA-STD-068, Department of Transportation Federal Aviation Administration, *Preparation of Standards* [\[9\]](#).

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1 SCOPE

This standard provides a set of requirements for developing a Web Service Description Document (WSDD). The WSDD provides the details needed to sufficiently describe a [Web service](#) as a part of the FAA's implementation of a [Service Oriented Architecture](#) (SOA).

This standard does not prescribe or suggest any technological solutions for implementing a Web service. Rather, it seeks to provide a [semantic](#) basis for a [service description](#) that is flexible enough to accommodate different Web service implementations for use across multiple business domains.

This standard does not specify any configuration management (CM) or quality assurance (QA) policies, rules or assertions to which the developed WSDD may be subjected.

1.1 Introduction

One of the challenges of moving the FAA's information systems into a net-centric environment involves migrating from systems that interact in a point-to-point fashion to systems that are based upon the concepts of [Service-Oriented Architecture](#) (SOA). SOA is an architectural paradigm that supports service orientation as a way of thinking in terms of services, service-based development, and the outcomes provided by services. The special case of services that leverage Web and Internet-based technologies, known as [Web services](#), are commonly used in the FAA as a major means of realizing SOA. (For more information about SOA and Web services, see FAA-STD-070 section 1.3 Basic Concepts [\[10\]](#).)

The notion of [service description](#) is central to the Web service deployment process. Because the Web service paradigm suggests that a Web service can be discovered and employed at runtime, the Web service description is realized as an [XML](#) artifact(s) in order to support interaction between software components and is thus referred to as a "machine-processable service description". Web Services Description Language (WSDL) [\[32\]](#) and Open Geospatial Consortium (OGC) Web Services Common Standard [\[23\]](#) are the two industry standards ordinarily used to create machine-processable Web service descriptions. But while the machine-processable service description documents based on these industry standards are an integral and indispensable part of Web service deployment, they present two fundamental drawbacks: 1) they provide *syntactic* information about the Web service (e.g., data types, Web service invocation syntax), but they lack information on the service's *semantics* (e.g., service properties, [business functionalities](#), [qualities of service](#)); and 2) they are encoded in XML, which makes it difficult for SOA stakeholders not trained in XML technology to read and understand them.

To enrich a service description with the necessary semantics, the notion of [ontology](#) comes into play. Ontology enables the development of a semantically empowered model and a shared vocabulary in the domain of service-oriented implementations. There are several initiatives for developing such ontologies, including the World Wide Web Consortium's Ontology Web Language-based Web Service Ontology (OWL-S) [\[24\]](#), Web Service Modeling Ontology (WSMO) by Earth and Space Science Informatics (see <http://www.wsmo.org/index.html>), and the Department of Defense's Service Definition Framework [\[28\]](#). The FAA has also started to develop a Web Service Description Ontological Model (WSDOM) of its own. (In fact, WSDOM was inspired by OWL-S, but it incorporates certain design decisions aimed at increasing the ease of adaptation of semantic models into the existing FAA engineering culture.) Again, however, although these

ontological models support sufficient description of a service, they are developed using XML-based languages that are hard for someone to understand who does not have expertise in semantic technologies. Moreover, these ontology-based descriptions are not consistent with current FAA system engineering practices.

The aim of this standard is to address the deficiencies of both machine-processable service descriptions and ontologies. It does this by specifying requirements for creating a Web service description as it is defined and understood in SOA, and which is rendered as a human-readable document in a way consistent with FAA system engineering standards and practices.

1.2 Intended Audience

The intended audience for this standard includes architects and developers designing, identifying, developing, or deploying a system based on the [Web service](#) paradigm; decision makers seeking a better understanding of the application of [SOA](#) principles; and [users](#) of current and future Web services.

1.3 Basic Concepts

The goal of this section is to establish a clear and unambiguous understanding of several important concepts used in this standard. The concepts are based on and fully consistent with corresponding concepts described in FAA-STD-070, Preparation of Web Service Requirements Documents [\[10\]](#).

1.3.1 Web Service Description

In a [SOA](#)-based environment, components are integrated through a set of [service interfaces](#) and communicate via [messages](#). For successful interactions between a [Web service](#) and consumer components, the Web service itself should provide the consumer with information about “how to interact with the service in order to achieve the required objectives, including the [format](#) and content of information exchanged between the service and the consumer and the sequences of information exchange that may be expected.” [\[21\]](#) This information may also describe a certain function or set of functions performed by the service, say whether the service operates under a specified set of constraints and policies, and specify one or more network locations at which the service can be invoked.

In essence, the [service description](#) is “the information needed in order to use, or consider using, a service.” [\[21\]](#) A document or set of documents that presents this information to a service consumer is collectively referred to as a Web service description.

1.3.2 Usage of a Web Service Description

A [Web service description](#) can be used in various settings and artifacts. It can be used by decision makers, including services architects and business managers, to identify a Web service to be used in a [SOA](#)-based environment. It can be used by [service consumers](#) to develop a [consumer agent](#) to make use of the Web service. And, it can be also used by service consumers to construct request [messages](#) for, correctly interpret and decode information received from, and enable connection to the Web service.

Figure 1 presents use cases that depict the usage of a Web service description in the context of service implementation.

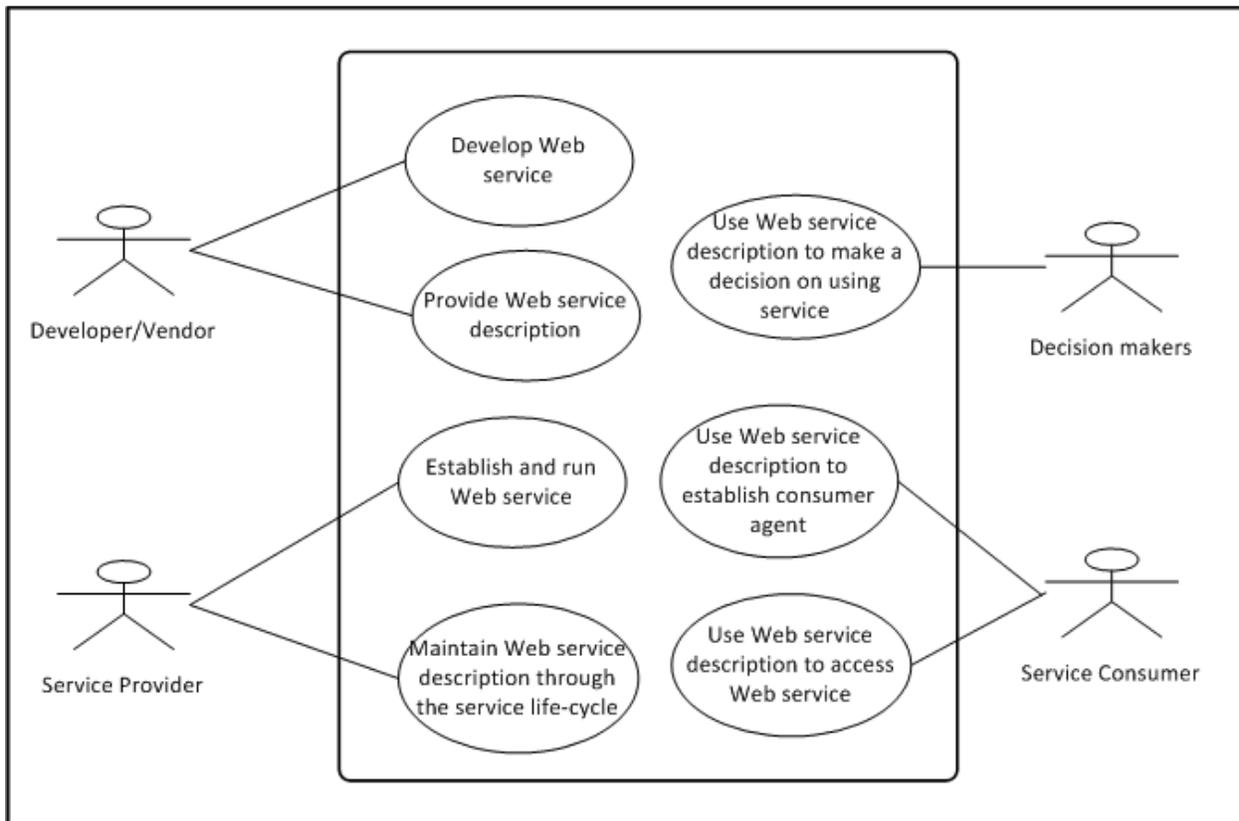


FIGURE 1. Web service description use cases

1.3.3 Structure of a Web Service Description Document (WSDD)

A Web Service Description Document, or WSDD, is a [Web service description](#) that is rendered as a human-readable document in a way consistent with FAA acquisition process standards and practices. This standard asserts the following structure for a WSDD.

The core of the WSDD consists of three parts: Service Profile, Service Interface, and Service Implementation, which correspond to sections 4, 5, and 6 of the document. (This layout is consistent with the structures used in [WSDOM](#).) Each part represents important aspects of describing a Web service, and each can be characterized as answering a particular question:

- The Service Profile part answers the question "what does the service do?" It represents a general description of a Web service from the perspective of a potential [service consumer](#). The Service Profile includes functional capabilities of the service, related [provider](#) information and constraints on the functionality of the service (e.g. [security](#), availability, contextual limitations).
- The Service Interface part answers the question "how does the service work?" It describes the [operations](#) performed by the service, [messages](#) and data that the Web service exchanges, and the [format](#) of those messages.

- The Service Implementation part answers the question "how does one access the service?" It specifies the [protocols](#) that the service supports and the location on the network (or endpoint) of the provider's Web service.

Each part can be associated with activities which are performed by or may be of interest to different [SOA](#) stakeholders: the Service Profile part can be used by business managers to make a decision about using a Web service, the Service Interface part is needed by developers of [consumer agents](#) for constructing requests for the service and being able to interpret responses, and the Service Implementation part allows a service consumer to access the service. It certainly should be understood that these [user](#) roles and uses can overlap each other in many different ways.

Figure 2 presents use cases that describe some of the ways that different stakeholders use the parts of a WSDD.

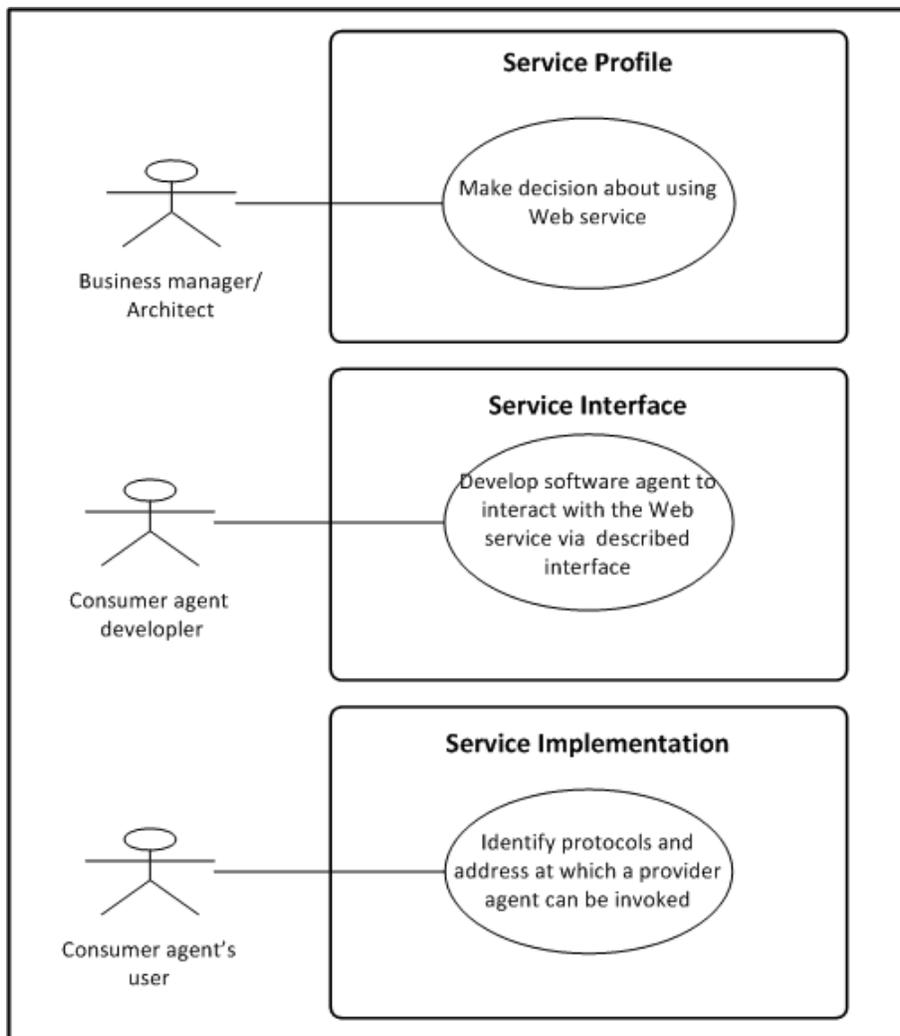


FIGURE 2. Use cases of the parts of a Web service description document

Note: the purpose of Figure 2 is not to provide an exhaustive list of possible scenarios, but rather to provide a few examples.

1.3.4 Relationship to Other Documents

As explained in [section 1.1](#), three different types of documentation coalesce to create a [WSDD](#): standards and specifications for describing services and interfaces in the canonical [SOA](#), [semantic](#) ontologies and ontological models, and FAA system engineering standards and guidance.

The first type ordinarily consists of [WSDL](#) [32] and [OGC](#) Web Services Common Standard [23] specifications, which define WSDL and OGC Capabilities documents, respectively. The description of a [service interface](#) as presented in [section 5](#) of this standard follows the model defined by [W3C](#) in the WSDL specification. (See section 1.3.3.1 of FAA-STD-070 [10] for more details.)

The second type follows a number of initiatives in the area of semantic modeling in the service-oriented domain. The aforementioned [WSDOM](#), which is a semantic model being developed by FAA and used by this standard, follows the model defined in [OWL-S](#). In addition, this standard was inspired by the Department of Defense's Service Definition Framework [28] that aims at defining a [service description](#) that can be both machine-processable and human-readable.

The third type is represented by FAA documents, including (but not limited to) FAA Order 1000.36 [1], FAA-STD-060 [5], and FAA-STD-070 [10], which this standard follows to establish a format and structure for the WSDD consistent with FAA system engineering documentation practices.

Figure 3 is a Venn diagram that represents the coalescing nature of the WSDD.

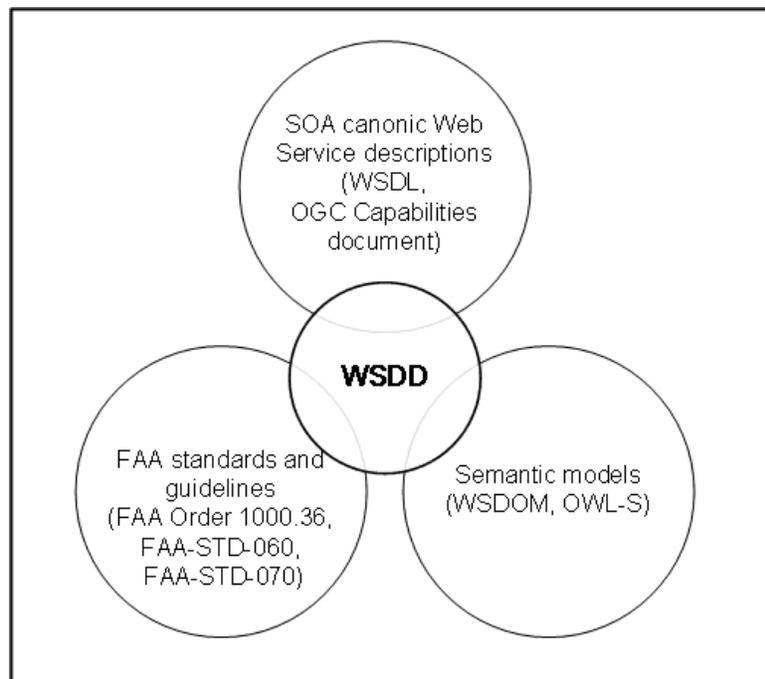


FIGURE 3. WSDD relationship to other types of documents

2 APPLICABLE DOCUMENTS

2.1 Government Documents

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- [2] FAA Order 1700.6C, FAA Branding Policy, Use of the FAA Logo, FAA Signature, and DOT Seal, 11 September 2006.
http://www.faa.gov/documentLibrary/media/order/branding_writing/Branding_Order_17006.pdf
- [3] FAA-HDBK-008, Using FAA Standards to Describe and Register Web Services, 4 February 2011.
<http://www.tc.faa.gov/its/worldpac/standards/faa-hdbk-008.pdf>
- [4] FAA-STD-025f, Preparation of Interface Documentation, 30 November 2007.
<http://www.tc.faa.gov/its/worldpac/standards/faa-std-025f.pdf>
- [5] FAA-STD-060b, Data Standard for the National Airspace System, 8 March 2004.
<http://www.tc.faa.gov/its/worldpac/standards/faa-std-060b.pdf>
- [6] FAA-STD-063, XML Namespaces, 1 May 2009.
<http://www.tc.faa.gov/its/worldpac/standards/faa-std-063.pdf>
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<http://www.tc.faa.gov/its/worldpac/standards/faa-std-068.pdf>
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- [12] NAS System Engineering Manual, Version 3.1, 6 June 2006.
<http://fast.faa.gov/SystemEngineering.cfm>

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2.2 Non-Government Documents

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<http://metadata-standards.org/11179/>
- [17] ISO/IEC 11404, Information technology — General-Purpose Datatypes (GPD), Second Edition, 15 December 2007.
[http://standards.iso.org/ittf/PubliclyAvailableStandards/c039479_ISO_IEC_11404_2007\(E\).zip](http://standards.iso.org/ittf/PubliclyAvailableStandards/c039479_ISO_IEC_11404_2007(E).zip)
- [18] ISO/IEC 12207, Information Technology – Software Life Cycle Processes, 2008.
http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=43447
- [19] ISO/IEC 6523-1, Structure for the Identification of Organizations and Organization Parts, 1998.
http://www.iso.org/iso/catalogue_detail?csnumber=25773
- [20] ISO/IEC CD 20944-002, Information Technology – Metadata Interoperability and Bindings (MDIB) – Part 002, Common Vocabulary, 12 April 2004.
<http://jtc1sc32.org/doc/N1101-1150/32N1105T-CD20944-002.pdf>
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<http://www.w3.org/Submission/OWL-S>
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<http://www.rfc-editor.org/rfc/rfc2119.txt>
- [26] RFC 2828, Internet Security Glossary, Network Working Group, May 2000.
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- [27] RFC 3986, Uniform Resource Identifier (URI): Generic Syntax, Network Working Group, January 2005.
<http://www.rfc-editor.org/rfc/rfc3986.txt>
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<http://test.zapthink.com/wp-content/uploads/2007/12/s300-ncidv20final21dec05.pdf>
- [29] Web Services Architecture, W3C Working Group Note, 11 February 2004.
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- [35] Web Services Policy 1.5 – Framework, W3C Recommendation, 04 September 2007.
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- [36] XML Schema Part 1: Structures Second Edition, W3C Recommendation, 28 October 2004.
<http://www.w3.org/TR/xmlschema-1/>

- [37] XML Schema Part 2: Datatypes Second Edition, W3C Recommendation, 28 October 2004.
<http://www.w3.org/TR/xmlschema-2/>

2.3 Order of Precedence

In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3 DEFINITIONS

3.1 Key Words

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this standard are to be interpreted as described in [RFC 2119 \[25\]](#). These key words are capitalized when used to unambiguously specify requirements. When these words are not capitalized, they are meant in their natural-language sense.

All examples in the document are labeled as "non-normative", which means they are not to provide a canonical implementation for use in a [registry](#) or artifact, but merely to illustrate technical features of a particular approach.

3.2 Terms and Definitions

<i>Asynchronous Operation</i>	A type of operation whose message exchange pattern allows messages to be sent without precise sequencing, e.g., a flow of sensor event messages which need not be individually acknowledged. [34]
<i>Audit</i>	A process that records information needed to establish accountability for system events and for the actions of system entities that cause them. [26]
<i>Authentication</i>	The process of verifying an identity claimed by or for a system entity. [26]
<i>Authorization</i>	The granting of rights or permission to a system entity (mainly but not always a user or a group of users) to access a Web service . [10]
<i>Binding</i>	An association between an interface , a concrete protocol , and a data format . A binding specifies the protocol and data format to be used in transmitting messages defined by the associated interface. [33]
<i>Business Function</i>	A characteristic action or activity that needs to be performed to achieve a desired objective, or in the context of this standard, to achieve a real world effect . (Adapted from [12])
<i>Confidentiality</i>	Protective measures that assure that information is not made available or disclosed to unauthorized individuals, entities, or processes (i.e., to any unauthorized system entity). [26]
<i>Consumer Agent</i>	A software agent that is designed to interact with a service in order to request that a task be performed on behalf of its owner – the service consumer .
<i>Data Element</i>	A unit of data for which the definition, identification, representation, and permissible values are specified by means of a set of attributes. [16]
<i>Datatype</i>	A set of distinct values, characterized by properties of those values, and by operations on those values. [17]

Effect	A state or condition that results from interaction with a service . Multiple states may result depending on the extent to which the interaction completes successfully or generates a fault .
End Point	An association between a fully-specified binding and a physical point (i.e., a network address) at which a service may be accessed.
FAA Data Registry (FDR)	A metadata registry (http://fdr.gov) that provides ready access to the FAA's data standards and is compliant with the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) Standard 11179. [16]
Fault	A message that is returned as a result of an error that prevents a service from implementing a required function. A fault usually contains information about the cause of the error. [10]
Format	The arrangement of bits or characters within a group, such as a data element , message , or language. [10]
Idempotent	A term used to describe an operation in which a given message will have the same effect whether it is received once or multiple times; i.e., receiving duplicates of a given message will not cause any undesirable effect. [10]
Input	Data entered into, or the process of entering data into, an information processing system or any of its parts for storage or processing . (Adapted from [20])
Integrity	Protective measures that assure that data has not been changed, destroyed, or lost in an unauthorized or accidental manner. [26]
Message	An identifiable collection of units of information (data elements), presented in a manner suitable for communication, interpretation, or processing within a context of interacting SOA components. [10]
Message Exchange Pattern (MEP)	A template, devoid of application semantics , that describes a generic pattern for the exchange of messages between agents . It describes the relationships (e.g., temporal, causal, sequential, etc.) of multiple messages exchanged in conformance with the pattern, as well as the normal and abnormal termination of any message exchange conforming to the pattern. [34]
Metadata	Data that defines or describes other data. [16]
Namespace	A collection of names, identified by a URI reference, that are used in XML documents as element types and attribute names. The use of XML namespaces to uniquely identify metadata terms allows those terms to be unambiguously used across applications, promoting the possibility of shared semantics . [14]
Non-Repudiation	Protective measures against false denial of involvement in a communication. [26]

Normative Document	A document that provides rules, guidelines, or characteristics for activities or their results. Note: The term "normative document" is a generic term that covers such documents as standards, technical specifications, codes of practice, and regulations. [20] In the context of this standard, a normative document is a set of rules that (1) determines the behavior of interacting entities and (2) has been developed by a recognized body in industry or academia and established by consensus in the FAA. [10]
Ontology	An explicit and formal specification of a shared conceptualization.
Operation	A set of messages related to a single Web service action. [33]
Organization	A unique framework of authority within which a person or persons act, or are designated to act, towards some purpose. Any department, service , or other entity within an organization which needs to be identified for information exchange. [19]
Output	Data transferred out of, or the process by which an information processing system or any of its parts transfers data out of, that system or part. (Adapted from [20])
Permissible Values	The set of allowable instances of a data element . [10]
Precondition	A state or condition that is required to be true before an action can be successfully invoked.
Processing	A set of algorithms, calculations, or business rules that operate on input data in order to produce the required output or to produce a change of internal state. [10]
Protocol	A formal set of conventions governing the format and control of interaction among communicating functional units. [11]
Quality of Service (QoS)	A parameter that specifies and measures the value of a provided service .
Real World Effect	An ultimate purpose associated with the interaction with a particular service . It may be the response to a request for information or the change in the state of some entities shared between the participants in the interaction. (Adapted from [22])
Security	The protection of information and data so that unauthorized persons or systems cannot read or modify them and authorized persons or systems are not denied access to them. [18]
Security Mechanism	A process (or a device incorporating such a process) that can be used in a system to implement a security service that is provided by or within the system. [26]
Semantics	A conceptualization of the implied meaning of information that requires words and/or symbols within a usage context. [21]
Service Consumer	An organization that seeks to satisfy a particular need through the use of capabilities offered by means of a service . (Adapted from [21])

Service Description	The information needed in order to use, or consider using, a service . (Adapted from [21])
Service Provider	An organization that offers the use of capabilities by means of a service . (Adapted from [21])
Service Registry	An enabling infrastructure that uses a formal registration process to store, catalog, and manage metadata relevant to a service . A registry supports the search, identification, and understanding of resources, as well as query capabilities. [7]
Service-Oriented Architecture (SOA)	A paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains. A SOA provides a uniform means to offer, discover, interact with, and use capabilities to produce desired effects consistent with measurable preconditions and expectations. [21]
Software Agent	A running program that drives services , both to implement them and to access them. [29]
Structured Data	Data that is organized in well-defined semantic "chunks" or units that are variously called fields, elements, objects, or entities. Individual units are often combined to form larger, more complex units. (Adapted from [4])
Synchronous Operation	A type of operation whose message exchange pattern describes temporally coupled or "lock-step" interactions, e.g., remote procedure call (RPC)-style request-response interactions. [34]
Taxonomy	A system or controlled list of values by which to categorize or classify objects. [8]
Uniform Resource Identifier (URI)	A compact string of characters for identifying an abstract or physical resource. [27]
Uniform Resource Locator (URL)	A type of URI that identifies a resource via a representation of its primary access mechanism (e.g., its network "location"), rather than by some other attributes it may have. [27]
Unstructured Data	Data that does not follow any hierarchical sequence or any relational rules. Examples of unstructured data may include audio, video, and unstructured text such as the body of an e-mail or word processor document. (Adapted from [4])
User	A human, his/her agent , a surrogate, or an entity that interacts with information processing systems. [20] A person, organization entity, or automated process that accesses a system, whether authorized to do so or not. [15]

- Web Service** A platform-independent, loosely-coupled software component designed to support interoperable machine-to-machine interaction over a network. It has an [interface](#) described in a machine-processable format. Other systems interact with the Web service in a manner prescribed by its description by means of [XML](#)-based [messages](#) conveyed using Internet transport [protocols](#) in conjunction with other Web-related standards. (Adapted from [\[34\]](#))
- Web Service Interface** A logical grouping of [operations](#), where each operation represents a single interaction between [consumer agents](#) and a [Web service](#). Each operation specifies the types of [messages](#) that the service can send or receive as part of that operation without any commitment to transport or wire [protocol](#). (Adapted from [\[31\]](#))

3.3 Acronyms and Abbreviations

AIM	Aeronautical Information Management
AIXM	Aeronautical Information Exchange Model
DCMI	Dublin Core Metadata Initiative
DOT	Department of Transportation
EDD	External Data Document
FAA	Federal Aviation Administration
FDR	FAA Data Registry
FTP	File Transfer Protocol
GML	Geography Markup Language
HTTP(S)	Hypertext Transfer Protocol (Secure)
ISO/IEC	International Organization for Standardization/International Electrotechnical Commission
JMS	Java Message Service
MDR	Metadata Registry
MEP	Message Exchange Pattern
MTBCF	Mean Time Between Critical Failure
MTBF	Mean Time Between Failure
MTTR	Mean Time To Restore
NAS	National Airspace System
OASIS	Organization for the Advancement of Structured Information Standards

OGC	Open Geospatial Consortium
OWL-S	Ontology Web Language (OWL)-based Web Service Ontology
PNG	Portable Network Graphics
QoS	Quality of Service
RFC	Request For Comment
RPC	Remote Procedure Call
SOA	Service-Oriented Architecture
SOAP	Originally “Simple Object Access Protocol”; the full spelling is no longer used
SVG	Scalable Vector Graphics
TCP/IP	Transmission Control Protocol/Internet Protocol
UML	Unified Modeling Language
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
W3C	World Wide Web Consortium
WS	Web Service
WSDD	Web Service Description Document
WSDL	Web Service Description Language
WSDOM	Web Service Description Ontological Model
XML	eXtensible Markup Language

4 GENERAL REQUIREMENTS

This section describes requirements for the stylistic aspects of the [WSDD](#). Detailed requirements for the structure and content of the WSDD are provided in [section 5](#).

4.1 Text, Grammar and Style

- a. The text SHALL be written in clear and simple language, free of vague terms, or those subject to misinterpretation.
- b. All sentences SHALL be complete and grammatically correct. Refer to FAA Order 1000.36, FAA Writing Standards [\[1\]](#) for guidance.
- c. The United States Government Printing Office Style Manual [\[13\]](#) SHALL be used as a guide for capitalization, spelling, punctuation, syllabification, compounding words, tabular work, and other elements of grammar and style.

4.2 Page Numbering

- a. The front cover page SHALL omit the page number.
- b. All pages after the front cover page and before the page containing the first (“Scope”) section SHALL be numbered consecutively with lower-case Roman numerals, starting with ii (for example, ii, iii, and iv).
- c. The first page of the first (“Scope”) section SHALL be numbered with an Arabic numeral 1.
- d. All subsequent pages SHALL be numbered sequentially using Arabic numerals.
- e. The page numbers SHALL be placed at the bottom center of each page.

4.3 Page Headers

- a. Each page, including the front cover, SHALL contain a header in the upper right-hand corner right-justified.
- b. Each header SHALL contain the [WSDD](#) Identifier. Note: In most cases, the identifier is assigned by a governing or configuration management [organization](#) under whose authority the [service](#) is developed or functions.
- c. If the WSDD is a revision to a baselined WSDD, the word “Revision” followed by the revision letter SHALL be included immediately under the WSDD Identifier.
- d. If the WSDD has been approved by a governing or configuration management control organization, the header SHALL include the date of WSDD approval on the last line.
- e. If the WSDD is a draft, the header SHALL include the word “DRAFT” in capital letters under the WSDD identifier and the date of the draft on the next line.

4.4 Use of Hyperlinks

To improve the readability and understanding of the [WSDD](#), usage of hyperlinks is prescribed as follows:

- a. Every term that is used and defined within the WSDD SHOULD be linked via a hyperlink reference to the location of its definition in the WSDD's "Definitions" section.
- b. When the same term is used more than once within the same sentence or paragraph, only the first occurrence of the term SHOULD be referenced.
- c. Every document that is cited within the WSDD SHALL be linked via a hyperlink reference to the location of its bibliographic entry in the WSDD's "Applicable Documents" section.
- d. When a document is quoted within the WSDD, the quote SHALL include a hyperlink reference to the location of the document's bibliographic entry in the WSDD's "Applicable Documents" section.

4.5 Use of Diagrams

There are a number of sections in the [WSDD](#) where using diagrams is suggested to enhance the understanding of a described topic.

- a. Unified Modeling Language (UML) diagrams are RECOMMENDED since UML is able to concisely describe concepts without implying any specific technology. Information about UML diagrams is available at <http://www.uml.org/>.

4.6 Identifying Figures, Tables, and Appendixes

- a. Figures SHALL be identified by "Figure", the level one section number in which they appear followed by a dash and numbered sequentially using Arabic numerals within the level one section (e.g., 3-1, 3-2, 3-3, 4-1, 4-2), followed by the figure title.
- b. The figure identification SHALL be placed below the figure.
- c. Tables SHALL be identified by "Table", the level one section number in which they appear followed by a dash and numbered sequentially using Arabic numerals within the level one section (e.g., 3-1, 3-2, 3-3, 4-1, 4-2), followed by the table title.
- d. The table identification SHALL be placed above the table.
- e. Appendixes SHALL be identified by "Appendix", followed by sequential capital letters (e.g., Appendix A), and the appendix title.

5 DETAILED REQUIREMENTS

This section describes requirements for the structure and content of the [WSDD](#).

5.1 Cover Page

- a. The [WSDD](#) SHALL include a cover page as the first page.
- b. The upper left corner of the cover page SHALL include the FAA signature (the Department of Transportation triskelion figure with the words “U.S. Department of Transportation” and the words “Federal Aviation Administration” below it) in accordance with FAA Order 1700.6, FAA Branding Policy [\[2\]](#).
- c. The line “Web Service Description Document” SHALL be centered above the title.
- d. The title SHALL be the name by which the [service](#) will be known. Note: In most cases, the title will consist of the approved service’s name issued by the activity authorized to assign the name. That name will be referred to throughout the WSDD as the Web service name.

An example of a WSDD cover page is shown in [Appendix A](#).

5.2 Approval Page (Optional)

Signatures on this page ensure that the interested parties have approved the [WSDD](#) content. The approval page may not be required based on the configuration management policies established within a given [organization](#).

The following statements apply when signed approval is required.

- a. The approval page SHALL be the first interior page of the WSDD.
- b. The approval page SHALL contain the line “Web Service Description Document” centered above the title of the [Web service](#), and the line “Approval Signatures” centered below the title of the Web service.
- c. The approval page SHALL include information for every cosigner.
- d. The information SHALL include the cosigner's full name.
- e. The information SHALL include the full name of the cosigner's organization followed by the acronym by which the organization is commonly recognized within FAA.
- f. The information SHALL include the cosigner's signature.
- g. The information SHALL include the date of the signature.

An example of a WSDD Approval Page is shown in [Appendix B](#).

5.3 Revision Record Page

- a. The [WSDD](#) SHALL include a revision record page.

- b. The revision record page SHALL contain the centered line “Revision Record” above the revision record table.
- c. Only revisions SHALL be listed.
- d. The revision record page SHALL include information for every revision listed.
- e. The information SHALL include the revision letter.
- f. The information SHALL include a brief description of the revision.
- g. The information SHALL include the date of the revision.
- h. The information SHALL include the full name of the person who entered this revision record (“Entered by”).

An example of a WSDD Revision Record Page is shown in [Appendix C](#).

5.4 Table of Contents

- a. The [WSDD](#) SHALL include a table of contents.
- b. The WSDD SHALL conform to the basic outline shown in Table I below. Note: the sections shown in italics are optional.

TABLE I. WSDD table of contents

Cover Page
Approval Page
Revision Record Page
Table of Contents
<i>List of Figures</i>
<i>List of Tables</i>
1 Scope
1.1 <i>Background</i>
2 Applicable Documents
2.1 Government Documents
2.2 Non-Government Standards and Other Publications
3 Definitions
3.1 Terms and Definitions
3.2 Acronyms and Abbreviations
4 Service Profile
4.1 Service Provider
4.1.1 Point of Contact
4.2 Service Consumers
4.3 Service Functionality
4.4 Security
4.5 Qualities of Service
4.6 Service Policies

4.7 Environmental Constraints
5 Service Interface
5.1 Interfaces
5.2 Operations
5.2.1 Processing Considerations
5.3 Messages
5.4 Faults
5.5 Data Elements
5.6 Machine-Processable Service Description Document
6 Service Implementation
6.1 Bindings
6.1.1 Binding 1
6.1.1.1 Data Protocol
6.1.1.2 Message Protocol
6.1.1.3 Transport Protocol
6.1.1.4 Other Protocols
6.1.n Binding n
6.1.n.1 Data Protocol
6.1.n.2 Message Protocol
6.1.n.3 Transport Protocol
6.1.n.4 Other Protocols
6.2 End Points
6.2.1 End Point 1
6.2.n End Point n
<i>Appendixes</i>

5.5 Scope

- a. Section 1 of the [WSDD](#) SHALL provide a scope statement that is a clear, concise abstract of the coverage of the WSDD.
- b. Section 1 of the WSDD MAY include paragraphs on the WSDD's purpose, applicability, background, etc. as needed to give readers of the WSDD a context for understanding the body of the WSDD.

5.6 Applicable Documents

- a. Section 2 of the [WSDD](#) SHALL list all documents specifically cited in the WSDD.
- b. Only documents that are specifically cited in the WSDD SHALL be listed in section 2.
- c. Section 2 of the WSDD SHALL present bibliographic information about each document listed.
- d. The information SHALL include the full title of the document.
- e. The information SHOULD include the alternate title or abbreviated name by which the document is known or recognized.

- f. The information SHALL include the publisher of the document.
- g. The information SHALL include the publication date of the document.
- h. The information SHOULD include the appropriate version of the document (e.g., the latest version, the version needed for compatibility with other documents, the version of the document that is under contract by the project.)
- i. The information SHOULD include the creator of the document, if it is different from the publisher.
- j. The information SHALL include the address or location (preferably a persistent Web location, i.e., [URL](#)) where a copy of the document can be obtained.
- k. Section 2.1 of the WSDD SHALL list all types of Government standards and other publications cited in the WSDD.
- l. Section 2.2 of the WSDD SHALL list all types of non-Government standards and other publications cited in the WSDD.
- m. When a document is quoted within the WSDD, the quote SHOULD indicate where in the document the quote is to be found (e.g., using section number, paragraph number, page number, or other means of identification).

5.7 Definitions

- a. Section 3.1 of the [WSDD](#) SHALL define all terms used in the WSDD to provide for clarity, unless the terminology is generally accepted and not subject to misinterpretation.
- b. Only terms that are specifically used in the WSDD SHALL be listed in section 3.1.
- c. Definitions MAY be included by reference to another document.
- d. Terms and their definitions SHALL be listed in alphabetical order.
- e. Section 3.2 of the WSDD SHALL include a list of acronyms and abbreviations used in the WSDD, together with their full spelling.
- f. Only acronyms and abbreviations that are specifically used in the WSDD SHALL be listed in section 3.2.
- g. Acronyms and abbreviations SHALL be listed in alphabetical order.

5.8 Service Profile

Section 4 of the [WSDD](#) identifies and describes the [Web service](#), its [provider](#), its [consumers](#), its functional and non-functional characteristics, and constraints over its capabilities.

- a. Section 4 of the WSDD SHALL present information about the service profile.
- b. The information SHALL include the name of the service.
- c. The name SHALL be identical with the name of the service provided on the cover page of the WSDD.

- d. The information SHALL include a service [namespace](#). See FAA-STD-063, [XML Namespaces \[6\]](#) for establishing a namespace.
- e. The information SHALL include a brief description of the service. Note: That description is similar to or the same as the description to be used to register this service in an FAA-affiliated [registry](#). For more details, see FAA-STD-064, Web Service Registration [\[7\]](#).
- f. The information SHALL include a service version or revision level.
- g. The information SHALL include a service category.
- h. One or more values representing the service category SHALL be selected from the FAA Service Category [Taxonomy](#) described in section 5.3.5 of FAA-STD-066, Web Services Taxonomies [\[8\]](#).
- i. The information SHALL include the lifecycle stage of the service.
- j. The single value representing the service's lifecycle stage SHALL be selected from the Lifecycle Stage Taxonomy described in section 5.3.7 of FAA-STD-066 [\[8\]](#).
- k. The information SHALL include the level of criticality for the service.
- l. The single value representing the service's criticality level SHALL be selected from the Service Criticality Taxonomy described in section 5.3.8 of FAA-STD-066 [\[8\]](#).
- m. The information MAY include additional service classifications using business domain-specific taxonomies.

5.8.1 Service Provider

This standard treats the [service provider](#) as an [organization](#) responsible for establishing and maintaining the [Web service](#).

- a. Section 4.1 of the [WSDD](#) SHALL present information about the provider organization.
- b. The information SHALL include the name of the organization.
- c. The provided name SHALL consist of the full name spelled out followed by the acronym by which it is commonly recognized within FAA.
- d. The information MAY include a brief description of the organization.
- e. The information MAY include an accessible reference (e.g., [URL](#)) for the Web page that supplies information about the Web service and/or organization.
- f. The information SHALL include a provider organization [namespace](#). See FAA-STD-063, [XML Namespaces \[6\]](#) for establishing a namespace.

5.8.1.1 Point of Contact

- a. Section 4.1.1 of the [WSDD](#) SHALL present information for a point of contact, i.e., a person or group within the [provider organization](#), suitable for making a human contact for any purpose.

- b. The information SHALL include the full name of the contact.
- c. The information SHALL include the contact's job title or a brief description of the contact's responsibilities.
- d. The information SHALL include at least one telephone number.
- e. The information SHALL include at least one e-mail address.
- f. The information MAY include a postal address.
- g. If the required point of contact information is maintained at a persistent Web location ([URL](#)), section 4.1.1 of the WSDD MAY include a hyperlink to this location in lieu of including the information itself.

5.8.2 Service Consumers

- a. Section 4.2 of the [WSDD](#) SHALL present information about each known [service consumer](#).
- b. The information SHALL include the consumer [organization's](#) full name and acronym.
- c. The information SHOULD include an accessible reference (e.g., [URL](#)) for the Web page that supplies information about the organization.

5.8.3 Service Functionality

This standard asserts that every [Web service](#) represents a set of one or more identifiable [business functions](#). The goal of section 4.3 of the [WSDD](#) is to describe the business function(s) and the [real world effects](#) that result from invoking these business functions from a business point of view, that is, from the point of view of [consumer organizations](#) that will use the service to conduct their business. Section 4.3 should not address the mechanics of invocation (this aspect is addressed in the Service Interface section), but rather it should focus on answering the question of what the service does and what is the ultimate result of using the service. The ultimate result of using a service is referred to as the "real world effect". The real world effect may include:

- "1. Information returned in response to a request for that information,
- 2. A change to the shared state of defined entities, or
- 3. Some combination of (1) and (2)." [\[21\]](#)

For example, a real world effect could be knowledge that "the flight has been rerouted" (change in the state) or a "weather forecast" (response to a request for information).

- a. Section 4.3 of the WSDD SHALL present information about the service functionality from the business perspective.
- b. The information SHALL describe the service's business function(s) and real world effect(s).
- c. The service's business function(s) SHALL be correlated with the real world effect(s).

5.8.4 Security

This standard defines [Web service security](#) as collective measures that enable the service to provide protection against security threats. These threats may include (but are not limited to): [unauthorized](#) access to service

information; unauthorized disclosure, modification and destruction of information; unknown status and repudiation in execution; and denial of service. To address the security threats, [security mechanisms](#) are utilized. Table II presents a list of the most typical security mechanisms commonly implemented by Web services, together with their intended purpose. Note: this list is neither exhaustive nor prescriptive.

TABLE II. Web service security mechanisms

<i>Mechanism</i>	<i>Purpose</i>
Authentication	To assure that system entities (individuals, entities, or processes) are who they claim to be.
Authorization	To assure that system entities have been granted the right or permission to access a Web service.
Integrity	To assure that data has not been changed, destroyed, or lost in an unauthorized or accidental manner.
Confidentiality	To assure that information is not made available or disclosed to unauthorized system entities.
Non-Repudiation	To assure that the sender or recipient of a message cannot legitimately claim that they did or did not participate in the message exchange.
Audit	To record information needed to establish accountability for system events and for the actions of system entities that cause them.

- a. Section 4.4 of the [WSDD](#) SHALL present information about the Web service security.
- b. Section 4.4 of the WSDD SHALL describe all security mechanisms implemented by the Web service.
- c. When a security mechanism is implemented by using a standard [protocol](#) or specification document, the information about this document SHALL be presented as prescribed in [section 5.6](#) of this standard.
- d. When the Web service delegates one or more security measures to an external security service, the document that specifies the external security service SHALL be presented as prescribed in [section 5.6](#) of this standard.

5.8.5 Qualities of Service

This standard defines [Qualities of Service](#) (QoS) as measurable characteristics that the [Web service](#) is expected to meet or possess. To be usable in practice, these QoS should be documented in a way that ensures clear and common understanding for the service stakeholders. Section 4.5 of the [WSDD](#) lists all QoS parameters associated with the Web service, including the parameter's name, its definition, its value or range of values, the method used to measure or calculate its values, and the unit of measure in which its values are expressed.

- a. Section 4.5 of the WSDD SHALL list all Quality of Service (QoS) parameters associated with the provided service.
- b. Section 4.5 of the WSDD SHALL present information about each QoS parameter listed.
- c. The information SHALL include the QoS parameter's name.
- d. The information SHALL include the QoS parameter's value or range of values.
- e. The information SHALL include the QoS parameter's definition. See section 6.2 of FAA-STD-064 [7] to help ensure that the definition is as informative and understandable as possible.
- f. The information SHALL include a description of how the values are measured or calculated.
- g. The information SHALL include the unit of measure (e.g., seconds, percentage).

[Appendix D](#) contains a comprehensive but not exhaustive list of QoS parameters that are relevant to Web services. WSDD developers may reuse these parameters or provide their own in accordance with the above requirements.

5.8.6 Service Policies

This standard defines policies as constraints on the allowable actions of a [service consumer](#) or [agent](#). [Web service](#) policies can be described as a part of the [WSDD](#) or, more frequently, in a separate document that contains common policies for a business or [organizational](#) domain. The policies can be written in both machine- and human-readable languages (an example of machine-readable policy language is "[WS-Policy](#)"; see [\[35\]](#)).

- a. Section 4.6 of the WSDD SHALL provide information about policies that apply to the Web service.
- b. When service policies are presented as a separate document, this policy document SHALL be referenced as prescribed in [section 5.6](#) of this standard.
- c. If a referenced policy does not have a persistent Web location ([URL](#)), the policy SHALL be included in an Appendix of the WSDD.

5.8.7 Environmental Constraints

Although [Web services](#) are defined as "platform and implementation independent" [\[10\]](#), a Web service is never a "standalone" product and requires integration with surrounding software components and underlying implementation platforms. This standard understands environmental constraints as being characteristics of the "super-system", that is, the larger system within which the Web service operates. Some examples of these constraints are: capacity of existing enterprise network, firewalls, physical computing resources, etc.

- a. Section 4.7 of the [WSDD](#) SHALL describe all environmental constraints under which the Web service is operated and maintained.

5.9 Service Interface

Section 5 of the [WSDD](#) describes how the functionality of the [Web service](#) is achieved in terms of interaction with the service, that is, it describes a [service interface](#). In so doing, this standard follows the abstract model of

interface description defined by the [W3C](#) in the Web Service Description Language (WSDL) specification [\[32\]](#). (See [Appendix E](#) for a correlation between WSDL and WSDD.) The WSDL specification provides a framework for describing a Web service and, more specifically, a service interface in terms of the W3C Abstract Component Model. This model “defines the abstract interface of a Web service as a set of abstract [operations](#), each operation representing a simple interaction between the [consumer](#) and the service. Each operation specifies the types of [messages](#) that the service can send or receive as part of that operation.” [\[31\]](#)

Figure 4 presents a conceptual depiction of this interface model.

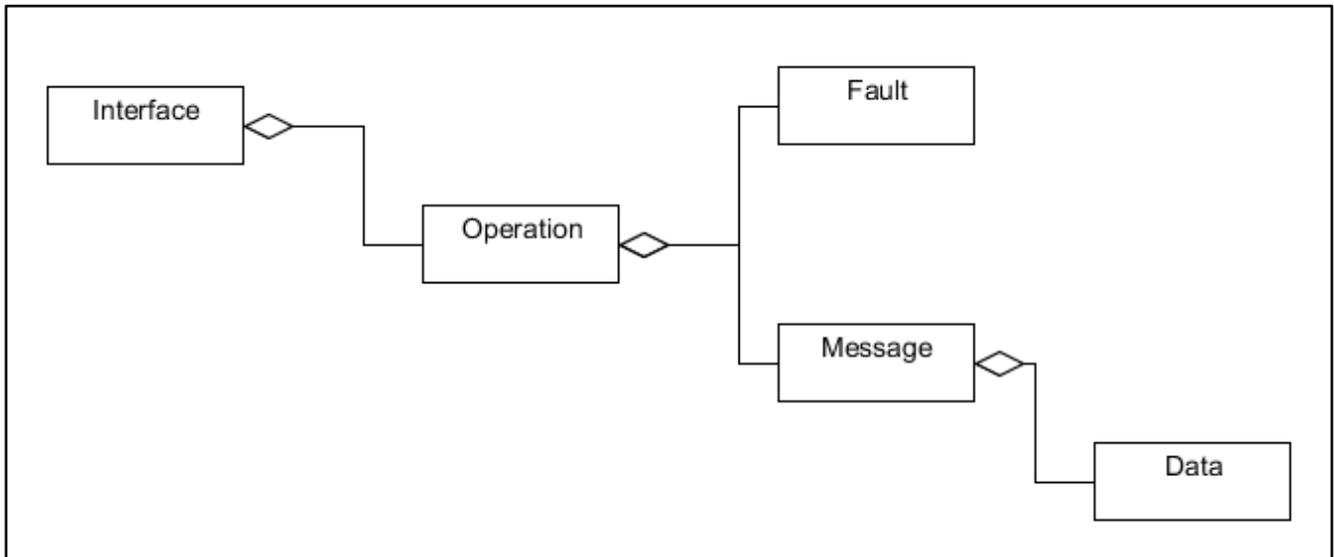


FIGURE 4. Interface model - conceptual diagram

- a. Section 5 of the WSDD SHALL describe the interface or interfaces with the Web service.

5.9.1 Interfaces

Section 5.1 of the [WSDD](#) describes the [interface\(s\)](#) exposed by the [Web service](#). An interface is a named set of [operations](#), each of which is also described in WSDD section 5.2 “Operations”. In the context of a WSDD, it may be said that an interface characterizes the behavior of the service or, alternatively, that an interface is an abstract representation of the service type.

- a. Section 5.1 of the WSDD SHALL present information about the interface being offered by the service.
- b. The information SHALL include a name that uniquely identifies the interface throughout the WSDD.
- c. The information SHALL include a brief plain language description of the interface.
- d. The information SHALL include a list of all names of all the operations that constitute the interface.
- e. All operations that constitute the interface SHALL be defined in section 5.2 of the WSDD as prescribed in [section 5.9.2](#) of this standard.

It is possible, although rarely recommended, that a service may expose more than one interface.

- f. When a service exposes multiple interfaces, each interface SHALL be described in section 5.1 of the WSDD in accordance with requirements (a) through (e) above.

5.9.2 Operations

Section 5.2 of the [WSDD](#) lists and describes all of the [operations](#) that are performed by the [Web service](#) through its [interface\(s\)](#). Every operation that is listed in WSDD section 5.2 "Operations" represents the patterns and content of interactions of [messages](#) described in WSDD section 5.3 "Messages".

- a. Section 5.2 of the WSDD SHALL list all operations offered by the Web service.
- b. Section 5.2 of the WSDD SHALL present information about each operation listed.
- c. The information SHALL include a name that uniquely identifies the operation throughout the WSDD.
- d. The information SHALL include a brief plain language summary of the pattern and goals of the actions that constitute the operation. For example, "allows client to retrieve current status of a specified flight".
- e. The information SHALL include a [Message Exchange Pattern](#) (MEP).
- f. The single value representing the MEP SHOULD be selected from the Message Exchange Pattern [Taxonomy](#) described in section 5.3.11 of FAA-STD-066 [8].
- g. If a value that represents the MEP is not available in the Message Exchange Pattern Taxonomy described in section 5.3.11 of FAA-STD-066 [8], the MEP SHALL be provided accompanied by a complete and coherent description of it.
- h. The information SHALL state if the operation is "[synchronous](#)" or "[asynchronous](#)".
- i. The information SHALL state if the operation is "[idempotent](#)" or "non-idempotent".
- j. The information SHALL describe the [precondition](#), i.e., the state or condition that should be true before the operation can proceed. A typical example is, "the [user](#) has logged in and been [authorized](#)".
- k. The information SHALL describe the [input](#), i.e., the data that initiates interaction, including the name of the relevant input message described in WSDD section 5.3 "Messages". NOTE: sometimes there is no input message (e.g., in notification scenarios).
- l. The information SHALL describe the [output](#), i.e., the data that is produced in response to a service request, including the name of the relevant output message described in WSDD section 5.3 "Messages". NOTE: sometimes there is no output generated (e.g., in solicitation scenarios).
- m. The information SHALL describe the [effect](#), i.e., the state or condition that exists after the operation is completed (assuming that no error has occurred). For example, "requested map was generated and returned to the [consumer](#)".

- n. The information SHALL describe the [fault\(s\)](#), i.e., the information that is produced in response to conditions that result in operation failure, including the name of the corresponding fault message described in section 5.4 of the WSDD.
- o. The information SHOULD include a diagram that shows how and in what order messages are exchanged within the context of the operation. Using Unified Modeling Language (UML) diagrams is a RECOMMENDED method for concisely describing concepts without implying a specific technology.

5.9.2.1 Processing Considerations

For the purpose of this standard, “[processing](#)” is defined as steps or actions which are required to be taken on data that is received as part of a [Web service](#) request ([input](#)) in order to produce the desired [output](#) or change of internal state. Actions on data that [consumers](#) should know about might be (but are not limited to): transformations, algorithms, unique logic, or business rules (e.g., after a certain period of time, data is not considered valid and should be removed).

- a. The information SHOULD include a description of the processing that takes place within the [operation](#).

5.9.3 Messages

Section 5.3 of the [WSDD](#) lists and describes all of the [messages](#) exchanged between the [Web service](#) and a [consumer agent](#). It is important to understand that every message that is listed in WSDD section 5.3 “Messages” is the aggregation of parts ([data elements](#)), each of which is described in WSDD section 5.5 “Data Elements”.

- a. Section 5.3 of the WSDD SHALL list all messages to be exchanged. (NOTE: [fault](#) messages are listed separately as described in section 5.9.4 below.)
- b. Section 5.3 of the WSDD SHALL present information about each message listed.
- c. The information SHALL include a name that uniquely identifies the message throughout the WSDD.
- d. The information SHALL include a plain language description of the message. See section 6.2 of FAA-STD-064 [\[7\]](#) to help ensure that the description is as informative and understandable as possible.
- e. The information SHALL indicate whether the message is [input](#) or [output](#).
- f. The information SHALL include a list of all data elements that constitute the message.
- g. All data elements that constitute the message SHALL be defined in section 5.5 of the WSDD as prescribed in section 5.9.5 of this standard.

5.9.4 Faults

Section 5.4 of the [WSDD](#) lists and describes all of the [faults](#) that are generated in response to conditions that result in failure of an [operation](#) or set of operations.

- a. Section 5.4 of the WSDD SHALL list all faults.
- b. Section 5.4 of the WSDD SHALL present information about each fault listed.

- c. The information SHALL include a name that uniquely identifies the fault throughout the WSDD.
- d. The information SHALL include a plain language description of the cause of the fault.
- e. The information SHALL include a list of all [data elements](#) (e.g., fault code, timestamp, etc.) that are contained in the fault [message](#).
- f. All data elements that are contained in the fault message SHALL be defined in section 5.5 of the WSDD as prescribed in section 5.9.5 of this standard.

5.9.5 Data Elements

Section 5.5 of the [WSDD](#) lists and describes all of the data transmitted between [service providers](#) and [consumers](#). For the purpose of this standard, two categories of data are considered: [structured](#) (e.g., [XML](#) documents) and [unstructured](#) (e.g., images, binary-encoded documents). Structured data is usually stored within a record or file in a database and formally described in a data model or a schema. In a [SOA](#) environment, the most popular approach for exchanging structured data is serializing the data as an XML document using XML Schema [W3C](#) Recommendations [\[36\]](#) and [\[37\]](#) as a formal structure and syntax specification. This standard focuses on structured data as most often used in today's FAA SOA-based implementation (requirements [\(a\)](#) through [\(u\)](#)), but it also addresses unstructured data (requirements [\(v\)](#) and [\(w\)](#)).

- a. Section 5.5 of the WSDD SHALL list all [data elements](#), complex or primitive, that appear in [messages](#) (or [faults](#)) to be sent or received via the [Web service](#).
- b. Section 5.5 of the WSDD SHALL decompose all complex data elements to the primitive level, i.e., into their identifiable indivisible constituent elements.
- c. Section 5.5 of the WSDD SHALL present information about each element listed.
- d. The information SHALL include a [namespace](#) for the element. Note: if all elements in the list are defined in the same namespace, the namespace can be indicated once for the whole list. See FAA-STD-063 [\[6\]](#) for establishing a namespace.
- e. The information SHALL include a name that uniquely identifies the element within its namespace.
- f. For elements that are registered in the [FAA Data Registry](#) (FDR), the information SHALL include the FDR registration identifier. Note: See FAA-STD-060 [\[5\]](#) for information about registering data elements in the FDR.
- g. For elements that are registered in the FAA Data Registry (FDR), the information MAY omit items called for in requirements [\(h\)](#) through [\(r\)](#).
- h. The information SHALL include a plain language definition of the element. See section 6.2 of FAA-STD-064 [\[7\]](#) to help ensure that the definition is as informative and understandable as possible.
- i. The information SHALL include a description of the element's [permissible values](#) in one of the following forms: a range of numbers, a list of individual values, a reference to a source that lists the values (e.g., "FAA Order 7350.7 Location Identifiers"), or a textual description (e.g., "Not Applicable").

- j. For elements whose values represent codes, the information SHALL include the meanings of the codes (e.g., “BR = Mist, VA = Volcanic Ash, DU = Widespread Dust, etc.”).
- k. For elements whose values represent quantitative measures, the information SHALL include the unit of measure (e.g., feet, kilograms, degrees Fahrenheit, dollars).
- l. The information SHALL include the element’s [datatype](#).
- m. For primitive elements, i.e., elements that are not composed of other elements, datatype SHOULD be denoted using the typing system defined in section 3.2 of the W3C XML Schema Part 2: Datatypes specification [\[37\]](#).
- n. If another typing system is used, the information SHALL include an explanation of the system or a reference to a source that describes the system. NOTE: if all datatypes are denoted using this system, the explanation or reference may be made once for the whole element list.
- o. The information MAY include the element’s maximum length together with units of length (e.g., characters, bytes, etc.), if applicable.
- p. If an element is to be rendered in a special format, the information SHOULD include a [format](#) string.
- q. Regular expressions as defined in Appendix F of the W3C XML Schema Datatypes specification [\[37\]](#) are RECOMMENDED for use in describing format strings.
- r. If another method is used to express format strings, the information SHALL include an explanation of the method or a reference to a source that describes the method. NOTE: if the method is used to express all format strings, the explanation or reference may be made once for the whole element list.
- s. The information SHALL include the obligation (“Required” or “Optional”) of the element, i.e., whether the element is required or optional in the context of its underlying information model.
- t. The information SHALL include the multiplicity (occurrence) of the element in the context of its underlying information model (e.g., 0, 1, ..., unbounded).
- u. Section 5.5 of the WSDD SHALL include a diagram, or a persistent Web location ([URL](#)) of a document or artifact containing such a diagram, that depicts a conceptual or logical model of the data elements listed.
- v. If the data that appears in messages is unstructured, section 5.5 of the WSDD SHALL provide the type, format, and plain language description of the data.
- w. If the data that appears in messages is unstructured, section 5.5 of the WSDD SHALL refer to section 6.1.1.1 (or 6.1.n.1, as appropriate) of the WSDD that describes how the data should be encoded (see also [section 5.10.1.1](#) of this standard).

5.9.5.1 Referencing External Data Documents

Sometimes a document that describes the data exchanged by a [Web service](#) is produced separately, often by an [organization](#) other than the organization responsible for developing the [WSDD](#). For the purpose of this

standard, such a document will be referred to as an External Data Document (EDD). Usually an EDD is developed for use by multiple services and not just for the service described in the WSDD. If such an EDD exists, it would seem logical and efficient to provide a reference to the EDD instead of copying its content into section 5.5 of the WSDD. If an EDD is to be used as a substitute for the content prescribed above for section 5.5 of the WSDD, the EDD must comply with following requirements:

- a. The EDD SHALL conform to the requirements (a) through (v) specified in [section 5.9.5](#) of this standard.
- b. The EDD SHALL maintain a versioning policy.
- c. The EDD SHALL have a persistent Web location ([URL](#)).
- d. The EDD specified in section 5.5 of the WSDD SHALL be documented as prescribed in the Applicable Documents [section 5.6](#) of this standard.

5.9.6 Machine-Processable Service Description Document

According to general [SOA](#) principles, a [Web service](#) should be presented with an externalized and accessible [service description](#) that defines and describes its [interface](#) and invocation [bindings](#). To support direct interaction with [consumer agents](#), this description is realized as a document rendered in a machine-processable [format](#) via a common [XML](#) grammar.

While the Web Service Description Language (WSDL) specification set forth by [W3C \[30\], \[32\]](#) provides the most popular format for developing machine-processable descriptions of Web services (because of this popularity, a machine-processable service description is commonly referred to as a “WSDL file”), there are other formats that are used in industry and in the FAA (e.g., the XML Capabilities document defined by the [OGC](#)).

- a. Section 5.6 of the [WSDD](#) SHALL reference the machine-processable service description document developed for the described service.
- b. Section 5.6 of the WSDD SHALL identify the title, version, and location of the open standard with which the machine-processable service description document complies.
- c. When the machine-processable service description document is available online, a persistent Web location ([URL](#)) of the document SHALL be provided.
- d. When the machine-processable service description document is not available online, the document itself SHALL be reproduced in the WSDD, either as part of section 5.6 or in an Appendix.

5.10 Service Implementation

Section 6 of the [WSDD](#) provides details for the means of invoking the [Web service](#). The means include the underlying technology [protocols](#) and network location(s) of the service.

5.10.1 Bindings

For the purpose of this standard, a [binding](#) is understood to be a named collection of [protocols](#) which are used in the course of an execution of the [Web service](#); i.e., a “binding specifies the protocol and data [format](#) to be used in transmitting [messages](#) defined by the associated [interface](#)” [33].

The binding concept is depicted in Figure 5.

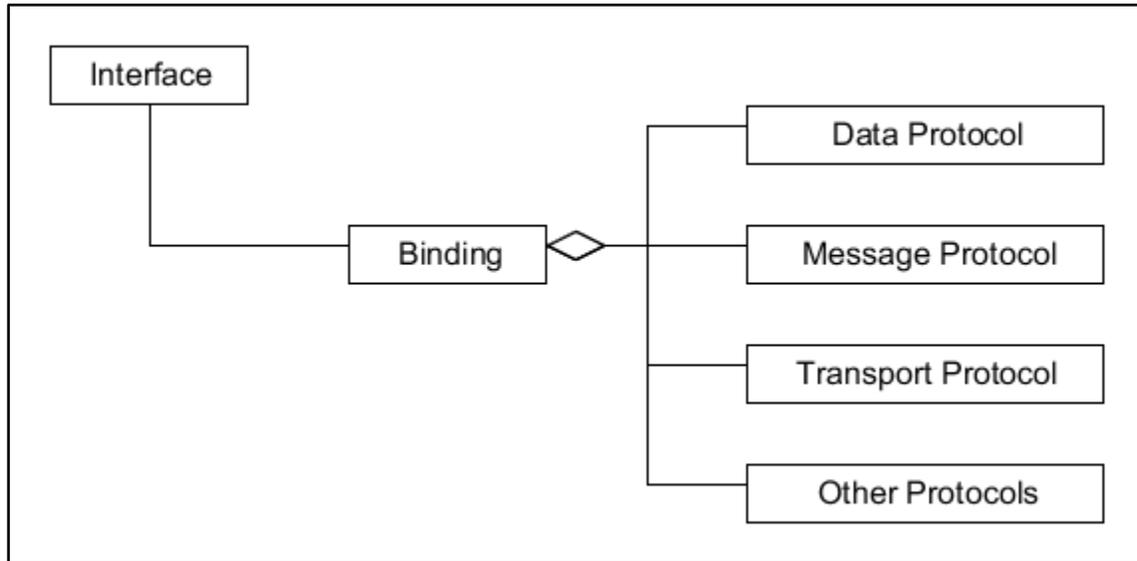


FIGURE 5. Binding - conceptual diagram

- a. Section 6.1 of the [WSDD](#) SHALL list all bindings implemented by the Web service.
- b. Section 6.1.1 of the WSDD SHALL describe the first binding.
- c. If there are multiple bindings, they SHALL be described in consecutive additional WSDD sections with headings numbered 6.1.2 (or 6.1.n, as appropriate).
- d. The heading of the WSDD section describing each binding SHALL include the name that is used throughout the WSDD to refer to that binding.
- e. Each binding description SHALL include the name of the [operation](#), and the name of an interface associated with this operation, that deploys this binding. Note: when all operations within the interface deploy the same binding, only the interface name is required.
- f. The name of the operation and/or associated interface SHALL be consistent with the operation and/or interface name established in section 5.2 and/or 5.1 respectively of the WSDD.
- g. Each binding description SHALL include information about each data protocol that the service uses for this binding, as described in [section 5.10.1.1](#) of this standard.
- h. Each binding description SHALL include information about the message protocol that the service uses for this binding, as described in [section 5.10.1.2](#) of this standard.

- i. Each binding description SHALL include information about the transport protocol that the service uses for this binding, as described in [section 5.10.1.3](#) of this standard.
- j. Each binding description SHALL include information about other protocols that the service uses for this binding, as described in [section 5.10.1.4](#) of this standard.

5.10.1.1 Data Protocol

In order to exchange data between [SOA](#) components, an agreed-upon [format](#) must be used. A data [protocol](#) is a formal set of rules governing data encoding and coordination for data exchange among SOA components.

For the purpose of this standard, two categories of data are considered: 1) text-based data (e.g., an [XML](#) document) and binary-encoded data (e.g., a [PNG](#) image, a Microsoft Excel spreadsheet). The XML format is presently the protocol most often employed for exchanging textual data via [Web services](#). Besides transmitting textual data, an important use for XML is serializing data structures according to domain-specific conceptual models; e.g., the Geography Markup Language (GML) used to serialize information about geographical features or the Aeronautical Information Exchange Model (AIXM) used for transmitting aeronautical information.

Binary-encoded data is data that is converted using a code, frequently consisting of binary numbers or two-dimensional arrays of pixels (a graphical-based encoding). Both XML-based and graphical-based formats are used in today's FAA SOA implementation and, in some scenarios, within the same service implementation; e.g., a Web Map service uses XML to request a map rendered as an [SVG](#) image.

- a. Section 6.1.1.1 (or 6.1.n.1, as appropriate) of the [WSDD](#) SHALL describe the data protocol for this [binding](#).
- b. Section 6.1.1.1 (or 6.1.n.1, as appropriate) of the WSDD SHALL include the [normative document](#) that regulates the data protocol.
- c. The normative document SHALL be described as prescribed in [section 5.6](#) of this standard.
- d. If an accessible reference (e.g., [URL](#)) to the normative document is not available, the document itself SHALL be included in an Appendix of the WSDD.
- e. The data protocol described in section 6.1.1.1 (or 6.1.n.1, as appropriate) of the WSDD SHALL be compatible with the data defined in section 5.5 ("Data Elements") of the WSDD.

5.10.1.2 Message Protocol

In a [SOA](#) environment, the communication and interaction between components is performed by exchanging [messages](#) of predefined content. A message [protocol](#) is a formal set of rules and conventions governing procedure calls and responses among communicating SOA components. The most widely used message protocol for [Web services](#) is [SOAP](#), a specification that defines an [XML](#)-based common message format.

Generally, a message consists of a header part and a message-specific payload. The message header may include directives or contextual information related to the message delivery (e.g. [security](#) or addressing information). The message payload consists of instances of service-defined [data elements](#) (see [section 5.9.5](#) of this standard for requirements for describing payload data).

- a. Section 6.1.1.2 (or 6.1.n.2, as appropriate) of the [WSDD](#) SHALL describe the message protocol for this [binding](#).
- b. Section 6.1.1.2 (or 6.1.n.2, as appropriate) of the WSDD SHALL include the [normative document](#) that establishes the message protocol.
- c. The normative document SHALL be described as prescribed in [section 5.6](#) of this standard.
- d. If an accessible reference (e.g., [URL](#)) to the normative document is not available, the document itself SHALL be included in an Appendix of the WSDD.
- e. The message protocol described in section 6.1.1.2 (or 6.1.n.2, as appropriate) of the WSDD SHALL be compatible with the data protocol described in section 6.1.1.1 (or 6.1.n.1, as appropriate) of the WSDD.

5.10.1.3 Transport Protocol

A transport [protocol](#) is a formal set of rules governing [message](#) transmission and port handling among communicating [SOA](#) components. Various approaches can be used in SOA for transporting messages, and consequently various transport protocols are deployed; e.g., [HTTP/HTTPS](#) (traditional approach), [JMS](#) (message-based [asynchronous](#) approach), and [FTP](#) (file-based approach).

Note: because [Web services](#) operate using Internet-based standards, it is assumed that all transport protocols defined in the context of a [WSDD](#) use [TCP/IP](#) as an underlying protocol.

- a. Section 6.1.1.3 (or 6.1.n.3, as appropriate) of the WSDD SHALL describe the transport protocol for this [binding](#).
- b. Section 6.1.1.3 (or 6.1.n.3, as appropriate) of the WSDD SHALL include the [normative document](#) that establishes the transport protocol.
- c. The normative document SHALL be described as prescribed in [section 5.6](#) of this standard.
- d. If an accessible reference (e.g., [URL](#)) to the normative document is not available, the document itself SHALL be included in an Appendix of the WSDD.
- e. The transport protocol described in section 6.1.1.3 (or 6.1.n.3, as appropriate) of the WSDD SHALL be compatible with the message protocol described in section 6.1.1.2 (or 6.1.n.2, as appropriate) of the WSDD.

5.10.1.4 Other Protocols

Some modern [protocols](#) may combine data definitions with messaging conventions or messaging and transport governing conventions and cannot be unambiguously classified as strictly a data, [message](#) or transport protocol to be described in section 6.1.1.1, 6.1.1.2 or 6.1.1.3 of the [WSDD](#). This section of the standard describes requirements for such protocols.

- a. Section 6.1.1.4 (or 6.1.n.4, as appropriate) of the WSDD SHALL describe any other protocols that the [service](#) uses for this [binding](#) and that cannot be clearly identified as a data protocol, a transport protocol, or a message protocol.

- b. Section 6.1.1.4 (or 6.1.n.4, as appropriate) of the WSDD SHALL include the [normative document](#) that establishes each described protocol.
- c. The normative document SHALL be described as prescribed in [section 5.6](#) of this standard.
- d. If an accessible reference (e.g., [URL](#)) to the normative document is not available, the document itself SHALL be included in an Appendix of the WSDD.

5.10.2 End Points

In the context of this standard, an [end point](#) is understood to be an association between a fully-specified [binding](#), as described in [section 5.10.1](#) of this standard, and “a physical point at which a [service](#) may be accessed” [\[11\]](#), i.e., a network address.

NOTE: the term “end point” used in this standard should not be confused with the term “endpoint” defined in the [WSDL](#) specification [\[32\]](#) or the term “EndPoint” defined in the Web Service Description Requirements [\[33\]](#) (both of which documents were produced by [W3C](#)).

The end point concept is depicted in Figure 6.

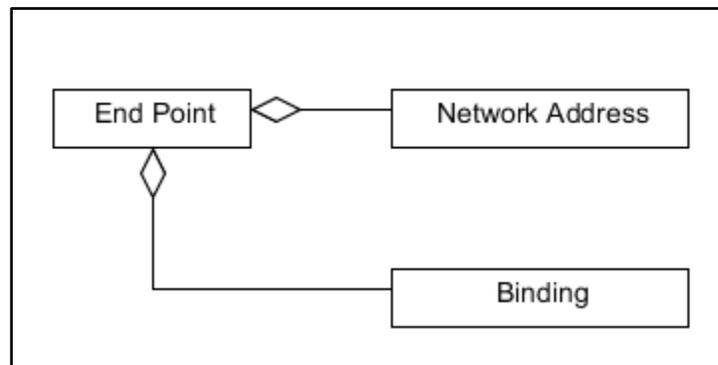


FIGURE 6. End point - conceptual diagram

- a. Section 6.2 of the [WSDD](#) SHALL list all end points implemented by the Web service.
- b. Section 6.2.1 of the WSDD SHALL describe the first end point.
- c. If there are multiple end points, they SHALL be described in consecutive additional WSDD sections with headings numbered 6.2.2 (or 6.2.n, as appropriate).
- d. The heading of the WSDD section describing each end point SHALL include the name that will be used throughout the WSDD to refer to that end point.
- e. Each end point description SHALL include the name of the binding, and the network address.
- f. The name of the binding SHALL be consistent with the binding name established in section 6.1 of the WSDD.

APPENDIXES

Appendix A. Example of a [WSDD](#) Cover Page



U.S. Department of
Transportation
**Federal Aviation
Administration**

FAA-X-XXX
Revision A
September 4, 2012

**Web Service Description Document
Special Activity Airspace Management Web Service,
Aeronautical Information Management (AIM)**

Appendix B. Example of a WSDD Approval Signature Page

FAA-X-XXX
Revision A
September 4, 2012

**Web Service Description Document
Special Activity Airspace Management Web Service,
Aeronautical Information Management (AIM)**

Approval Signatures

Name	Organi- zation	Signature	Date Signed

Appendix C. Example of a WSDD Revision Record Page

FAA-X-XXX
Revision A
September 4, 2012

Revision Record

Revision Letter	Description	Revision Date	Entered By

Appendix D. Examples of Quality of Service (QoS) Parameters

The table below provides examples of QoS parameters that are relevant to [Web services](#). [WSDD](#) developers may reuse these parameters or provide their own, as well as their own values or range of values.

QoS Parameter Name	Definition	Method	Unit of Measure	Value or Range of Values
Accuracy	Number of errors produced by the service over a period of time.	Simple count. Measurements are taken daily and apply to the preceding 24-hour period.	Whole positive number	250
Availability	Probability that the service is present or ready for immediate use.	$100 * ((24 - \text{Total Outage Time in Hours}) / 24)$. Measurements are taken daily and apply to the preceding 24-hour period.	Percentage, accurate to 3 decimal places.	Greater than or equal to 99.900%
Capacity	Number of service requests that the service can accommodate within a given time period.	Simple count.	Whole positive number, per period of time.	25 per minute
Mean Time Between Critical Failure (MTBCF)	The average time between hardware or software component failures that result in the loss of the service.	The sum of the individual times between critical failures divided by the number of critical failures.	Hours.	Greater than or equal to 3,000
Mean Time Between Failure (MTBF)	Average time between hardware or software component failures that do not result in the loss of the service.	The sum of the individual times between noncritical failures divided by the number of noncritical failures.	Hours.	Greater than or equal to 5,000
Mean Time To Restore (MTTR)	Average time required to localize a component failure, remove and replace the failed component, and to perform tests to confirm operational readiness of the component.	The sum of the individual times to repair divided by the number of repairs.	Hours.	Less than or equal to 0.5

QoS Parameter Name	Definition	Method	Unit of Measure	Value or Range of Values
Response Time	Maximum time required to complete a service request.	Measured from the time the provider agent receives the request to the time the service provider transmits the response.	Seconds.	10

Appendix E. Correlation between WSDL and WSDD

