System Wide Information Management (SWIM)

Instructional Example of
How to Write a
Service Description Document (JMSDD)
for a Java Messaging Service

July 7, 2014

Foreword

This document was developed to aid in understanding the process of documenting JMS-based services and to provide a potential model to follow when writing Java Message Service Description Documents (JMSDDs) for services that have been developed in the context of the System Wide Information Management (SWIM) program and deployed using the NAS Enterprise Message Service (NEMS) as a provider of messaging capabilities.

The adoption of service-oriented architecture (SOA) design principles in the FAA has led many NAS programs to Web-enable their business applications and to adopt Web-related standards in their middleware solutions. Remote Procedure Call (RPC) style Web Services was the first popular paradigm for realizing SOA in the National Airspace System (NAS); however, in response to increased demand for event-driven, reliable asynchronous message handling and a higher degree of decoupling, many NAS SOA-driven implementations adopted the JMS Application Programming Interface (API) created by Sun Microsystems as a technological solution for service-oriented development.[3]

The component essential for successful realization of SOA is some form of a *service description*. The SWIM Controlled Vocabulary defines a service description as "information needed in order to use, or consider using, a service." To facilate documenting (describing) all relevant aspects of SOA services in a unified manner, FAA utilized a standards-based approach by developing a number of regulating documents (standard practices) for preparation of service descriptions for SOA services. These were augmented by a set of instructional examples, such as an example of a Web Service Description Document (WSDD) for canonical Web Services, and an example of a WSDD for RESTful services. This document provides an example of a JMSDD developed in accordance with FAA Standard Practice FAA-STD-073, “Preparation of Java Messaging Service Description Documents”.

As readers who are already familiar with the previous examples will see, this document uses the same set of premises that the WSDD examples used. It is also important to bear in mind that this document does not attempt to model or provide instructions for *developing* a JMS-based service, but rather solely focuses on how to *document* a JMS-based service in the context of a JMSDD. Therefore, while an effort was made to present a realistic picture of an air traffic control (ATC) service that could be developed to support flight planning, a number of logical and technical components that a “real” service may require were purposely omitted to make it easier for a reader to perceive or understand the major notions presented in FAA-STD-073.

To make the example complete, this document also includes a fictitious “Flight Plan Exchange Model” (FPXM) for distribution of flight plan data in digital format. FPXM, a very downscaled emulation of a real information exchange model such as the Flight Information Exchange model (FIXM) or Aeronautical Information Exchange Model (AIXM), was expressly created for this example; it does not represent any actual models or artifacts developed or being developed by FAA and should not be used for any purpose except as an instructional aide.

Questions about the example JMSDD may be directed to:

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Typographical Conventions used in the Instructional Example

Page headers, page numbers, figure and table captions, etc. are in accordance with FAA-STD-073 Section 4, General Requirements [3].

Instances of shaded and bordered paragraphs (like this) that appear at various points in the example represent **explanatory notes** that would not appear in an actual JMSDD.

U.S. Department
of Transportation
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July 6, 2014

Java Messaging Service Description Document
Flight Plan Service (FPS)

Java Messaging Service Description Document

Flight Plan Service (FPS)

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1 Scope

This Java Messaging Service Description Document (JMSDD) provides a description of the Flight Plan Service (FPS). This service has the capability to publish flight plans operating under Instrument Flight Rules (IFR).

This JMSDD has been prepared in accordance with FAA-STD-073, Department of Transportation Federal Aviation Administration, Preparation of Java Messaging Service Description Documents [3].

1.1 Background

In today's NAS environment, a flight plan specifies information that describes a desired route of flight between a well-defined departure and destination point within which separation services are required. Additional information provided in the flight plan shows that the flight meets the legal requirements of Instrument Flight Rules (IFR).

The intended outcome of filing an IFR flight plan is to receive air traffic control (ATC) separation services between the departure and destination airports through a subsequent flight plan clearance. After the flight plan is filed it should be made accessible to other air traffic services to allow further processing of flight plan data in all stages of the flight.

As a part of transitioning toward the Next Generation Air Transportation System (NextGen), the En Route Services Modernization Group (ESMG) has implemented this flight plan publishing capability as a service designed in accordance with the principal of Enterprise Messaging and deployed in the NAS SWIM environment via the NAS Enterprise Messaging Service (NEMS). See the FPS Web Service Requirements Document [2] for more information.

Figure 1-1 depicts the architecture of the FPS deployment environment.

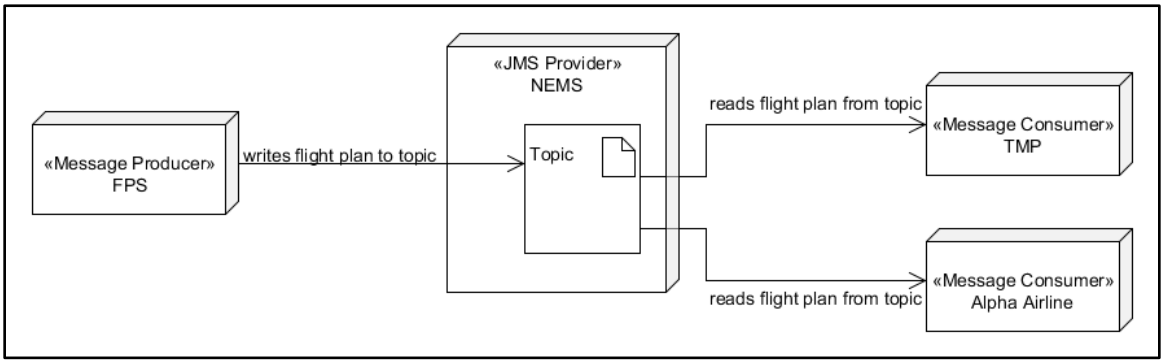

Figure 1-1 FPS Deployment Environment

2 Applicable Documents

NOTE: Document [5] does not actually exist.

2.1 Government Documents

[1] SWIM Controlled Vocabulary (CV), http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/atc_comms_services/swim/vocabulary/

[2] FAA-1-234, Flight Plan Service (FPS) Web Service Requirements Document (WSRD), FAA, 13 July 2012, http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/atc_comms_services/swim/governance/standards/

[3] FAA-STD-073, Preparation of Java Messaging Service Description Documents, FAA, 1 July 2013, http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/atc_comms_services/swim/governance/standards/media/FAA-STD-073%20FINAL%2001302014.pdf

[4] FAA-STD-070, Preparation of Web Service Requirements Documents, FAA, 12 July 2012, http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/atc_comms_services/swim/governance/standards/

[5] Flight Plan Exchange Model (FPXM) Version 1.0, FAA, 10 January 2006, http://faa.gov/fpxm/2006/

[7] NAS Enterprise Messaging Service (NEMS) Interface Control Document (ICD) Version 4, June 2014. Available upon request from SWIM Program Office.

[8] NIST Special Publication 800-95, Guide to Secure Web Services, National Institute of Standards and Technology, August 2007, http://csrc.nist.gov/publications/nistpubs/800-95/SP800-95.pdf

[9] Federal Aviation Administration Pilot/Controller Glossary (P/CG), Effective 3/7/12, http://www.faa.gov/air_traffic/publications/atpubs/pcg/index.htm

2.2 Non-Government Standards and Other Publications

[11] Extensible Markup Language (XML) 1.0 (Fifth Edition), W3C Recommendation 26 November 2008, http://www.w3.org/TR/2008/REC-xml-20081126/

[12] Java 2 Platform Enterprise Edition, v 5.0 API Specifications http://docs.oracle.com/javaee/5/api/javax/jms/Message.html

[13] RFC 5246, The Transport Layer Security (TLS) Protocol Version 1.2, Network Working Group, August 2008, http://tools.ietf.org/html/rfc5246

[15] Transport Transmission Control Protocol (TCP), RFC 675, Network Working Group, December 1974, http://tools.ietf.org/html/rfc675

[17] XML Signature Syntax and Processing (Second Edition), W3C Recommendation, 10 June 2008, http://www.w3.org/TR/xmldsig-core

3 Definitions

3.1 Terms and Definitions

Note: this section contains only the terms that are not included in the SWIM Controlled Vocabulary [1].

Asynchronous An interaction in which the associated messages are chronologically and procedurally decoupled. For example, in a request-response interaction, the client agent can process the response at some indeterminate point in the future when its existence is discovered. [3]

Audit A process that records information needed to establish accountability for system events and for the actions of system entities that cause them. [3]

Audit Trail A chronological record of system activities that is sufficient to enable the reconstruction and examination of the sequence of environments and activities. [4]

Authentication The process of verifying an identity claimed by or for a system entity. [3]

Authorization The granting of rights or permission to a system entity (mainly but not always a user or a group of users) to access a service. [3]

Binding 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. [3]

Business Function A characteristic action or activity that needs to be performed to achieve a desired objective, or in the context of this JMSDD, to achieve a real world effect. [3]

Credentials Data that is transferred to establish the claimed identity of an entity. [4]

Data Element A unit of data for which the definition, identification, representation, and permissible values are specified by means of a set of attributes. [3]

Datatype A set of distinct values, characterized by properties of those values, and by operations on those values. [3]

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. [3]

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. [3]

Flight Plan Specified information relating to the intended flight of an aircraft that is filed orally or in writing with an FSS or an ATC facility. [9]

Filed Used in conjunction with flight plans, meaning a flight plan has been submitted to ATC. [9]

Format The arrangement of bits or characters within a group, such as a data element, message, or language. [3]

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. [3]

Input Data entered into, or the process of entering data into, an information processing system or any of its parts for storage or processing. [3]

Integrity Protective measures that assure that data has not been changed, destroyed, or lost in an unauthorized or accidental manner. [3]

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. [3]

Non-Repudiation Protective measures against false denial of involvement in a communication. [3]

Operation A set of messages related to a single service action. [3]

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. [3]

Payload	The actual (business) data transferred by a message. See "message body".
Permissible Values	The set of allowable instances of a data element. [3]
Precondition	A state or condition that is required to be true before an action can be successfully invoked. [3]
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. [4]
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. [3]
User	A human, his/her agent, a surrogate, or an entity that interacts with information processing systems. A person, organization entity, or automated process that accesses a system, whether authorized to do so or not. [3]

3.2 Acronyms and Abbreviations

AIXM	Aeronautical Information Exchange Model
ATC	Air Traffic Control
ESMG	FAA En Route Services Modernization Group
FAA	Federal Aviation Administration
FIXM	Flight Information Exchange Model
FPS	Flight Plan Service
FPXM	Flight Plan Exchange Model
FSS	Flight Service Station
hPa	hectopascal
ICAO	International Civil Aviation Organization
ID	Identifier
IFR	Instrument Flight Rules
MEP	Message Exchange Pattern

MSL	Mean Sea Level
NAS	National Airspace System
NEMS	NAS Enterprise Messaging Service
NextGen	Next Generation Air Transportation System
NIST	National Institute of Standards and Technology
P/CG	Pilot/Controller Glossary
QoS	Quality of Service
RFC	Request For Comments
RPC	Remote Procedure Call
TLS	Transport Layer Security
TMP	Traffic Modernization Program
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
W3C	World Wide Web Consortium
JMSDD	Java Messaging Service Description Document
WSRD	Web Service Requirements Document
XML	eXtensible Mark-up Language

4 Service Profile

Name: Flight Plan Service (FPS)

URI: urn:us:gov:dot:faa:example:atm:enroute:fps

Description: Service for publishing an IFR flight plan to subscribed consumers for subsequent FAA flight data processing.

Revision: A

Service Category: Air Traffic Control Information Service

Lifecycle Stage: Development

Criticality Level: Essential

4.1 Service Provider

Name: FAA En Route Services Modernization Group (ESMG)

Description: A program within the FAA Air Traffic Organization responsible for developing SOA-based services

URI: urn:us:gov:dot:faa:example:atm

Web Page: http://www.faa.gov/air_traffic/flight_info/

4.1.1 Point of Contact

Name: John D. Doe

Title: ATO-X ESMG Manager

Telephone: (609) 444-5555

E-mail Address: Joe.doe@faa.gov

Postal Address: Bldg. 300 FAA William J. Hughes Technical Center
Atlantic City International Airport
Atlantic City, NJ

4.2 Service Consumers

4.2.1 Traffic Modernization Program (TMP)

Name: FAA Traffic Modernization Program (TMP)

Description: The FAA-maintained program responsible for regulating traffic during arrival, departure, or approach stages of flights with the goal to avoid exceeding airport or air traffic control capacity.

Web Page: http://www.faa.gov/air_traffic/TMP/ *

4.2.2 Alpha Airline

Name: Alpha Airline

Description: A United States commercial air carrier headquartered in Atlanta, Georgia. Alpha Airline provides air transport services for passengers and freight.

Web Page: http://www.example.alpha.com *

* The URLs in section 4.2 are provided as examples only and do not resolve to any resource.

4.3 Service Functionality

Table 4-1 describes the business functions of the FPS in terms of the real world effects that result from invoking these functions.

Table 4-1 FPS Business Functions

Business Function	Real World Effect
Publish a filed flight plan.	The flight plan has been made available to consumers who subscribe to the service.

4.4 Security

The FPS deploys Transport Layer Security (TLS) Protocol Version 1.2, RFC 5246, Network Working Group, August 2008, available at http://tools.ietf.org/html/rfc5246 [13].

The FPS is provisioned in “Trusted” regione.

4.4.1 Security Mechanisms

The FPS deploys the following security mechanisms: non-repudiation and audit. Each is described in a separate section below.

The FPS delegates the following security mechanisms to the NEMS: authentication, authorization, and integrity. For information on implementation of these security mechaninsms, see the NEMS ICD [7].

4.4.1.1 *Non-repudiation*

The FPS complies with XML Signature Syntax and Processing (Second Edition), W3C Recommendation, 10 June 2008, available at http://www.w3.org/TR/xmldsig-core [17] to ensure that each message is digitally signed.

4.4.1.2 *Auditing*

The FPS keeps an audit trail of all messages sent to NEMS. Each FPS message is timestamped with the date and time the message was sent. Each audit trail record includes user ID (using credentials received as part of the authentication process), date, time, and an error description if the interaction with the NEMS failed.

4.5 Qualities of Service

The qualities of service (QoS) that the FPS is expected to meet or possess are listed in Table 4-2.

Table 4-2 FPS Qualities of Service

QoS Parameter Name	*Value*	*Definition*	*Calculation Method*	*Unit of Measure*
Accuracy	98	Percentage of messages published by the service that are delivered to the service consumers.	Daily measurement of total consumable messages divided by the total messages produced.	Percentage.
Capacity	8000	Total number of unique messages produced by the service over a given period of time.	Average daily amount.	Whole positive number, per period of time.
Availability	≥99.975	A measure of the lowest probability that a system or constituent piece will be operational during any randomly selected period of time, or, alternatively, the fraction of the total available operating time that the system or constituent piece is operational.	100 * ((24 – Total Outage Time) / 24). Measurements are taken daily and apply to the preceding 24-hour period.	Percentage, accurate to 3 decimal places

QoS Parameter Name	*Value*	*Definition*	*Calculation Method*	*Unit of Measure*
Response Time	2 seconds per message	A measure of the longest average time it takes for a notification message to be published before it is available for receipt by a consumer agent.	Measurements are taken daily and apply to the preceding 24-hour period.	Seconds.

4.6 Service Policies

The FPS complies with NIST Special Publication 800-95, Guide to Secure Web Services, National Institute of Standards and Technology, August 2007, available at http://csrc.nist.gov/publications/nistpubs/800-95/SP800-95.pdf [8]

4.7 Environmental Constraints

The FPS is implemented in the SWIM/NEMS environment and is subject to the following environmental constraints:

JMS Provider: Apache ActiveMQ, Version 5.5.1

Service Provider Domain: NAS

Service Provider Location: Northeast Region

NEMS Environment: NAS-OPS

Security Zone: Internal

Record Type: Live

5 Service Interface

5.1 Interface

The interface that FPS extends has been desgned in accordance with the Java 2 Platform, Enterprise Edition, v 5.0 API Specification [12].

5.1.1 PublishFlightPlanInterface

Name: PublishFlightPlanInterface

Description:	FlightPlanInterface allows a topic subscriber to receive data associated with a single Flight Plan as a topic.
Messaging Model:	Publish-Subscribe
Operation:	PublishFlightPlanOperation

5.2 Operations

5.2.1 PublishFlightPlanOperation

Name:	PublishFlightPlanOperation
Description:	PublishFlightPlan operation writes a message containing a flight plan to a topic established by the NEMS.
Operation Type:	Asynchronous
Idempotency:	Non-Idempotent
Precondition:	The flight plan has been created and filed in the FPS.
Input:	NA.
Output:	Message FlightPlanTopicMessage containing the flight plan as an XML document.
Effect:	Flight plan has been distributed to the FPS topic subscribers.
Faults:	TopicNotWriteableFault

5.3 Messages

5.3.1 FlightPlanTopicMessage

Name:	FlightPlanTopicMessage
Description:	Contains an instance of FlightPlan as a payload along with all message headers.
Delivery Mode:	Persistent
Body Type:	Text
Priority:	4

5.3.1.1 *Application-Specific Message Properties*

The following application-specific properties are included in the FPS message header:

Table 5-1 FPS Application-Specific Properties

Property Name	*Description*	*Permissible Values*
FPS_FlightPlanID	Specifies ID of the flight plan presented in the body of the message.	Consistent with the FlightPlanId in the body of the message.
FPS_FlightPlanStatus	Indicates current status of the flight plan contained in the body of the message. Intended to be used for possible filtering by a recipient.	ACTIVE CANCELLED COMPLETED FILED
FPS_DestinationAerodrome	Indicates a Destination Aerodrome for the flight plan. Intended to be used for possible filtering by a recepient.	For permissible values see "ICAO 8643, Aircraft Type Designators", http://legacy.icao.int/anb/ais/8643/.

5.4 Exceptions Handling

Table 5-2 FPS Fault Messages

ID	*Name*	*Description*
ERROR:FPS:001	TopicNotWriteableFault	Unable to allocate or write to the topic required by a method.

For the list of errors generated by NEMS, see the NEMS ICD [7].

5.5 Data

NOTE: Section 5.9.5 requirement (t) of FAA-STD-073 [3] states that a conceptual data model of all data used by the service shall be included in this section of the JMSDD. A data model is usually the result of an architectural effort, and a reference to the model's location in the architecture can be made instead of reproducing the model in the JMSDD.

In this JMSDD example, we have simulated a scenario in which a data model has been developed as a separate effort. Because the example is unable to supply a real URL for the model, a conceptual model of the data elements that appear in the FlightPlan XML schema is provided in Figure 5-1, and the XML schema itself is provided in Appendix A . An example of an instantiation of this schema is provided in Appendix B.

All data provided by the FPS conforms to the FPXM 1.0, Flight Plan Exchange Model, 10 January 2006, available at http://faa.gov/fpxm/2006/ * [5]. A conceptual data model (Figure 5-1) is available at http://faa.gov/fpxm/2006/FPXM_Conceptual Model.pdf *.

All data elements provided by the FPS conform to definitions, syntax, and constraints as defined in the XML schema found at http://faa.gov/fpxm/2006/fpxm10.xsd *. (See Appendix A for a copy of the schema.)

Data elements are also described in Table 5-3 in accordance with FAA-STD-073 section 5.9.5 [3].

* The URLs in section 5.5 are provided as examples only and do not resolve to any resource.

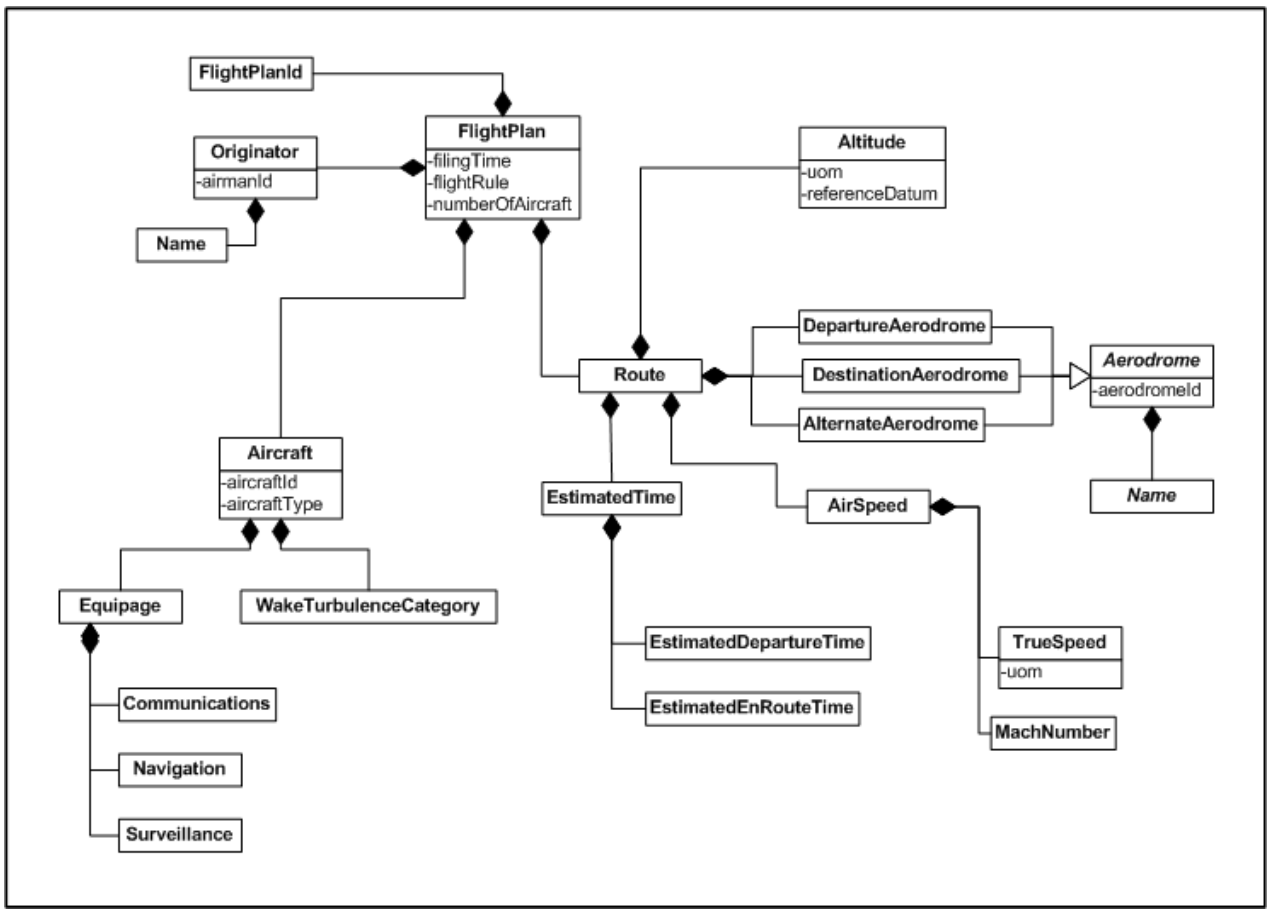

Figure 5-1 Flight Plan Exchange Conceptual Data Model

NOTE: Section 5.9.5 requirement (a) of FAA-STD-073 [3] states that section 5.5 of the JMSDD shall list and describe all data elements, that are part of the message payload. The following table does not contain an exhaustive list of all of the data elements but rather provides a subset of elements selected to exemplify how data elements should be presented in a JMSDD.

Note also that all metadata is required (Unit of Measure and Permissible Values are required if applicable) except for Maximum Length and Format which are optional.

All data elements in Table 5-3 are defined in the namespace **http://faa.gov/fpxm**

Table 5-3 Selected Flight Plan Data Elements

Name	Definition	Permissible Values	Unit of Measure	Datatype	Format	Obligation	Occurrence
FlightPlan	The outmost container (root) element for all data provided by the pilot or his/her designated representative to air traffic services units, relative to the intended flight or portion of the flight of the aircraft.	N/A	N/A	Complex		Required	1
FlightPlanId	An element that uniquely identifies the flight plan.	N/A	N/A	String	[A-Za-z0-9]*	Required	1
FlightPlan.flightRule	A code representing regulations (i.e., instrument or visual flight rules) under which the pilot is flying or intends to fly the aircraft.	"I" – IFR only "V" – VFR only "Y" – IFR first "Z" – VFR first	N/A	String		Required	1

Name	Definition	Permissible Values	Unit of Measure	Datatype	Format	Obligation	Occurrence
FlightPlan.filingTime	The point in time (UTC) at which the flight plan is filed.	N/A	N/A	dateTime	CCYY-MM-DDThh:mm:ssZ	Required	1
Altitude	An element that indicates the pressure altitude above mean sea level (MSL) at which the aircraft is flying or is intended to be flown.	N/A	N/A	Complex		Required	1
Altitude.uom	A code representing the units of measure of the aircraft's altitude.	"m", "meter" – altitude in meters "foot" – altitude in feet	N/A	String		Required	1
Altitude.referenceDatum	A code representing the atmospheric pressure reference used to adjust a pressure altimeter.	"Local" – local pressure extrapolated to zero MSL. "Standard" – pressure with respect to the pressure datum 1013.2 hectopascals (hPa).	N/A	String		Required	1
Aircraft	A container element for all data related to the aircraft.	N/A	N/A	Complex		Required	1

Name	Definition	Permissible Values	Unit of Measure	Datatype	Format	Obligation	Occurrence
Aircraft.aircraftType	An aircraft type designator that informs an air traffic controller of the performance characteristics of the aircraft.	Values are listed in ICAO 8643, Aircraft Type Designators, http://legacy.icao.int/anb/ais/8643/.	N/A	String		Required	1
WakeTurbulenceCategory	A code that classifies the aircraft for the purpose of wake turbulence separation minima, based on the maximum certified takeoff mass of the aircraft.	"H", "HEAVY" – aircraft having a maximum certificated take-off mass of 136,000 kg (300,000 lb) or more. "M", "MEDIUM" – aircraft having a maximum certificated take-off mass of less than 136,000 kg (300,000 lb) and more than 7,000 kg (15,500 lb). "L", "LIGHT" – aircraft having a maximum certificated take-off mass of 7,000 kg (15,500 lb) or less.	N/A	String		Required	1

Name	Definition	Permissible Values	Unit of Measure	Datatype	Format	Obligation	Occurrence
DestinationAerodrome	A container element for all data related to the primary aerodrome to which the flight is destined.	N/A	N/A	Complex		Required	1
DestinationAerodrome.aerodromeId	An element that uniquely identifies the destination aerodrome.	Values are listed in ICAO Document 7910, Location Indicators, http://store1.icao.int/mainpage.ch2.	N/A	String	[A-Z][A-Z][A-Z][A-Z]	Required	1
DestinationAerodrome.Name	An element that contains the name or location (nearest city) of the destination aerodrome.	N/A	N/A	String		Optional	1

6 Service Implementation

6.1 Bindings

6.1.1 Binding "JMSFlightPlanBinding"

The FPS deploys the protocols described in sections 6.1.1.1 through 6.1.1.3 for the binding to the interface "FlightPlanInterface".

6.1.1.1 *Data Protocol*

For data serialization, the FPS uses Extensible Markup Language (XML) 1.0 (Fifth Edition), W3C, November 2008, http://www.w3.org/TR/2008/REC-xml-20081126/ [11].

6.1.1.2 *Message Protocol*

The FPS uses Java 2 Platform Enterprise Edition, v 5.0, http://docs.oracle.com/javaee/5/api/javax/jms [12] as a message-level protocol.

6.1.1.3 *Transport Protocol*

The FPS uses Transport Transmission Control Protocol (TCP), RFC 675, Network Working Group, December 1974, http://tools.ietf.org/html/rfc675 [15] as a transport-level protocol.

6.1.1.4 *Other Protocols*

See the NEMS ICD [7] for details about other protocols, e.g., application network and datalink protocol.

6.2 End Points

6.2.1 End Point "JMSFlightPlanEndPoint"

Associated Binding:	JMSFlightPlanBinding
Network Address:	Established by NEMS and provided to service consumer during on-ramping of a consumer agent.

7 Appendixes

Appendix A. Schema of XML message payload content

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
        xmlns="http://faa.gov/fpxm"
        targetNamespace="http://faa.gov/fpxm"
        elementFormDefault="qualified" attributeFormDefault="unqualified">
  <xs:annotation>
    <xs:documentation xml:lang="en">
      Title: FlightPlan schema for JMSDD Example.
      Description: This schema declares XML elements for defining
      a Flight Plan transmitted by FlightPlanService
      Creator: Mark Kaplun (mark.kaplun@faa.gov)
      Date:  2010-01-21
    </xs:documentation>
  </xs:annotation>
  <!-- /////////////   Global types  ////////////////// -->
  <xs:element name="FlightPlan">
    <xs:complexType>
      <xs:sequence>
        <!-- "FlightPlanId" is always required.
          When flight plan is filed and the "FlightPlanId" element has no content
          - the content is nil. -->
        <xs:element name="FlightPlanId" type="FlightPlanIdType" nillable="true"/>
        <xs:element name="Originator" type="OriginatorType"/>
        <xs:element ref="Aircraft"/>
        <xs:element ref="Route"/>
      </xs:sequence>
      <xs:attribute name="filingTime" type="xs:dateTime" use="required"/>
      <xs:attribute name="flightRule" type="FlightRuleType" use="required"/>
      <xs:attribute name="numberOfAircraft" type="xs:positiveInteger" default="1"/>
    </xs:complexType>
  </xs:element>
  <xs:element name="Aircraft" type="AircraftType"/>
  <xs:element name="Route" type="RouteType"/>
  <!-- ///////////////  Types definitions ////////////////// -->
  <xs:simpleType name="FlightPlanIdType">
    <xs:restriction base="xs:string">
      <xs:pattern value="[A-Za-z0-9]*"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:complexType name="AircraftType">
```

```
    <xs:sequence>
      <xs:element name="Equipage">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="Communication" type="xs:string"/>
            <xs:element name="Navigation" type="xs:string"/>
            <xs:element name="Surveillance" type="xs:string"/>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
      <xs:element name="WakeTurbulenceCategory" type="WakeTurbulenceCategoryType"/>
    </xs:sequence>
    <xs:attribute name="aircraftId" type="xs:string"/>
    <xs:attribute name="aircraftType" type="xs:string"/>
    <!-- Values are listed in ICAO 8643, Aircraft Type Designators,
      http://www.icao.int/anb/ais/8643/index.cfm.-->
  </xs:complexType>
  <xs:complexType name="OriginatorType">
    <xs:sequence>
      <xs:element name="Name" type="xs:string"/>
    </xs:sequence>
    <xs:attribute name="airmanId" type="xs:string" use="required"/>
  </xs:complexType>
  <xs:complexType name="RouteType">
    <xs:sequence>
      <xs:element name="Altitude" type="AltitudeType"/>
      <xs:element name="EstimatedTime ">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="EstimatedDepartureTime" type="xs:time"/>
            <xs:element name="EstimatedEnRouteTime" type="xs:duration"/>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
      <xs:element name="AirSpeed" type="AirSpeedType"/>
      <xs:element name="DepartureAerodrome" type="AerodromeType"/>
      <xs:element name="DestinationAerodrome" type="AerodromeType"/>
      <xs:element name="AlternateAerodrome" type="AerodromeType"/>
      <xs:any minOccurs="0" maxOccurs="unbounded">
        <!--This element is declared as "any" to indicate that Route element
          can be extended with elements such as: fixes (significant points),
          route names, route segments and etc. -->
      </xs:any>
    </xs:sequence>
  </xs:complexType>
  <xs:complexType name="AerodromeType">
```

```
  <xs:annotation>
    <xs:documentation>
      Values for aerodrome Ids are listed in ICAO Document 7910,
      Location  Indicators, http://www.icao.int/eshop/index.html.
    </xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="Name" type="xs:string"/>
  </xs:sequence>
  <xs:attribute name="aerodromeId" type="AerodromeIdType" use="required"/>
</xs:complexType>
<xs:simpleType name="SpeedBase">
  <xs:restriction base="xs:decimal"/>
</xs:simpleType>
<xs:complexType name="TrueSpeedType">
  <xs:simpleContent>
    <xs:extension base="SpeedBase">
      <xs:attribute name="uom" type="UnitOfSpeedType" default="knots"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>
<xs:complexType name="AirSpeedType">
  <xs:sequence>
    <xs:element name="TrueSpeed" type="TrueSpeedType"/>
    <xs:element name="MachNumber" type="xs:decimal"/>
  </xs:sequence>
</xs:complexType>
<xs:simpleType name="AltitudeBase">
  <xs:restriction base="xs:nonNegativeInteger"/>
</xs:simpleType>
<xs:complexType name="AltitudeType">
  <xs:simpleContent>
    <xs:extension base="AltitudeBase">
      <xs:attribute name="uom" type="UnitOfAltitudeType" default="foot"/>
      <xs:attribute name="referenceDatum" type="ReferenceDatumType" use="required"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>
<!-- //////////  Code types  //////////////////////// -->
<xs:simpleType name="AerodromeIdType">
  <xs:restriction base="xs:string">
    <xs:maxLength value="4"/>
    <xs:pattern value="[A-Z][A-Z][A-Z][A-Z]"/>
  </xs:restriction>
</xs:simpleType>
<!-- /////////  Enumerations types  //////////////////////// -->
```

```
  <xs:simpleType name="FlightRuleType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="I"/>
      <xs:enumeration value="V"/>
      <xs:enumeration value="Y"/>
      <xs:enumeration value="Z"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="WakeTurbulenceCategoryType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="H"/>
      <xs:enumeration value="HEAVY"/>
      <xs:enumeration value="M"/>
      <xs:enumeration value="MEDIUM"/>
      <xs:enumeration value="L"/>
      <xs:enumeration value="LIGHT"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="ReferenceDatumType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="local"/>
      <xs:enumeration value="standard"/>
    </xs:restriction>
  </xs:simpleType>
  <!-- /////////// Units of Measurement  enumerations   ////////// -->
  <xs:simpleType name="UnitOfSpeedType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="km/h"/>
      <xs:enumeration value="knots"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="UnitOfAltitudeType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="m"/>
      <xs:enumeration value="meter"/>
      <xs:enumeration value="foot"/>
    </xs:restriction>
  </xs:simpleType>
</xs:schema>
```

Appendix B. Example of FPS message payload


```xml
<?xml version="1.0" encoding="UTF-8"?>
<FlightPlan xmlns="http://faa.gov/fpxm"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://faa.gov/fpxm fpxm.xsd"
  flightRule="I"
  numberOfAircraft="1"
  filingTime="2001-12-17T09:30:47Z" >
  <FlightPlanId xsi:nil="true" />
  <Originator airmanId="215336745">
    <Name>John Doe</Name>
  </Originator>
  <Aircraft aircraftType="PA-32R" aircraftId="JHB426E">
    <Equipage>
      <Communication>V</Communication>
      <Navigation>C</Navigation>
      <Surveillance>OL</Surveillance>
    </Equipage>
    <WakeTurbulenceCategory>LIGHT</WakeTurbulenceCategory>
  </Aircraft>
  <Route>
    <Altitude referenceDatum="local" uom="foot">7000</Altitude>
    <EstimatedTime>
      <EstimatedDepartureTime>14:20:00.0Z</EstimatedDepartureTime>
      <EstimatedEnRouteTime>PT3H30M</EstimatedEnRouteTime>
    </EstimatedTime>
    <AirSpeed>
      <TrueSpeed uom="knots">170</TrueSpeed>
      <MachNumber>0.12</MachNumber>
    </AirSpeed>
    <DepartureAerodrome aerodromeId="KBWI">
      <Name>Baltimore-Washington International, MD</Name>
    </DepartureAerodrome>
    <DestinationAerodrome aerodromeId="KBOS">
      <Name>Logan International Airport,Boston, MA</Name>
    </DestinationAerodrome>
    <AlternateAerodrome aerodromeId="KJFK">
      <Name>John F. Kennedy International Airport,NY,NY</Name>
    </AlternateAerodrome>
  </Route>
</FlightPlan>
```