

Common Support Services Information Management



Kajal Claypool

11 December 2012



Distribution Statement A. Approved for public release; distribution is unlimited.

This work is sponsored by the Federal Aviation Administration under Air Force Contract #FA8721-05-C-0002. Opinions, interpretations, recommendations and conclusions are those of the author and are not necessarily endorsed by the United States Government.



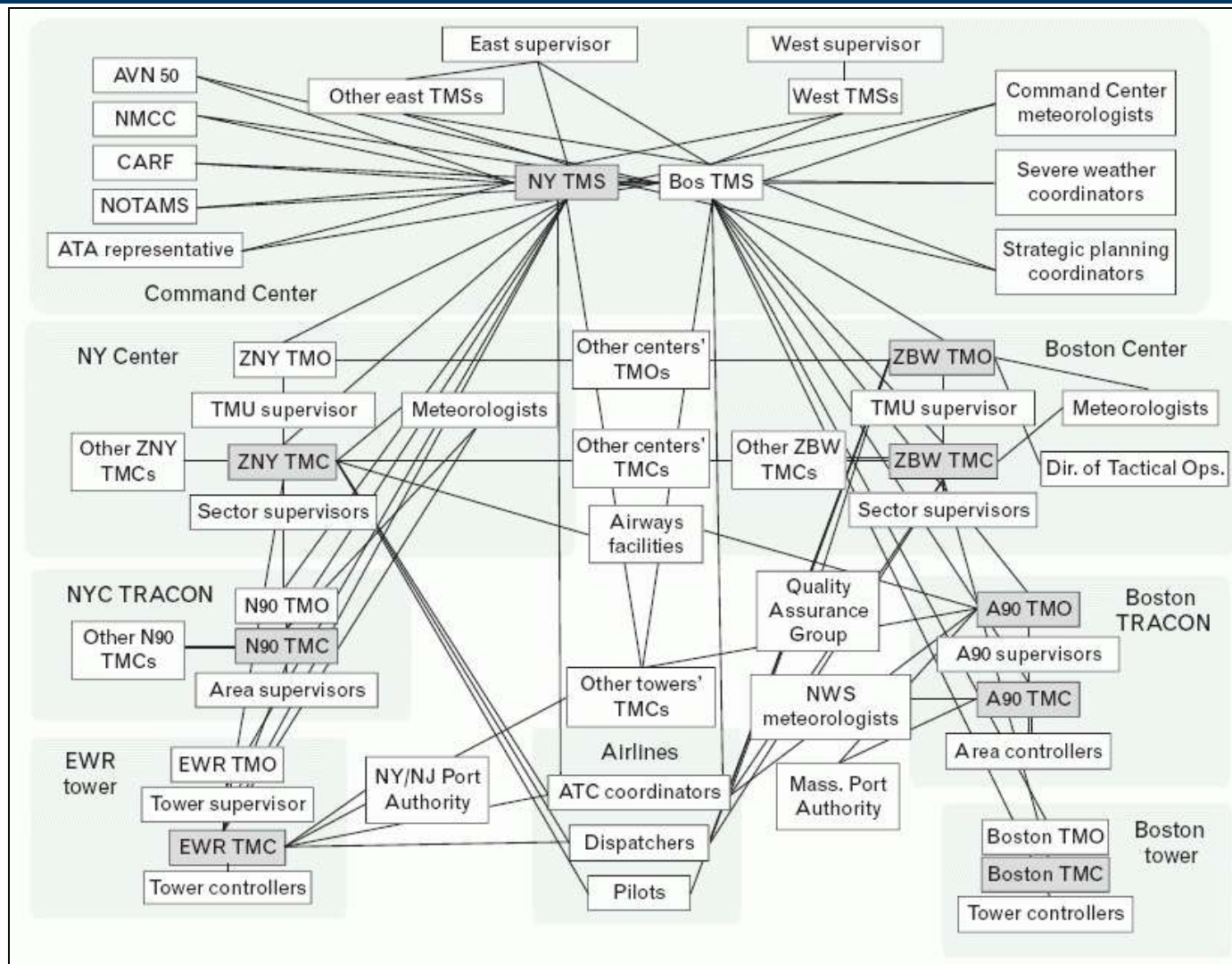
Outline



- ➔ • **Motivation**
- **CSS-Wx Deep Dive**
- **Summary & Future Steps**



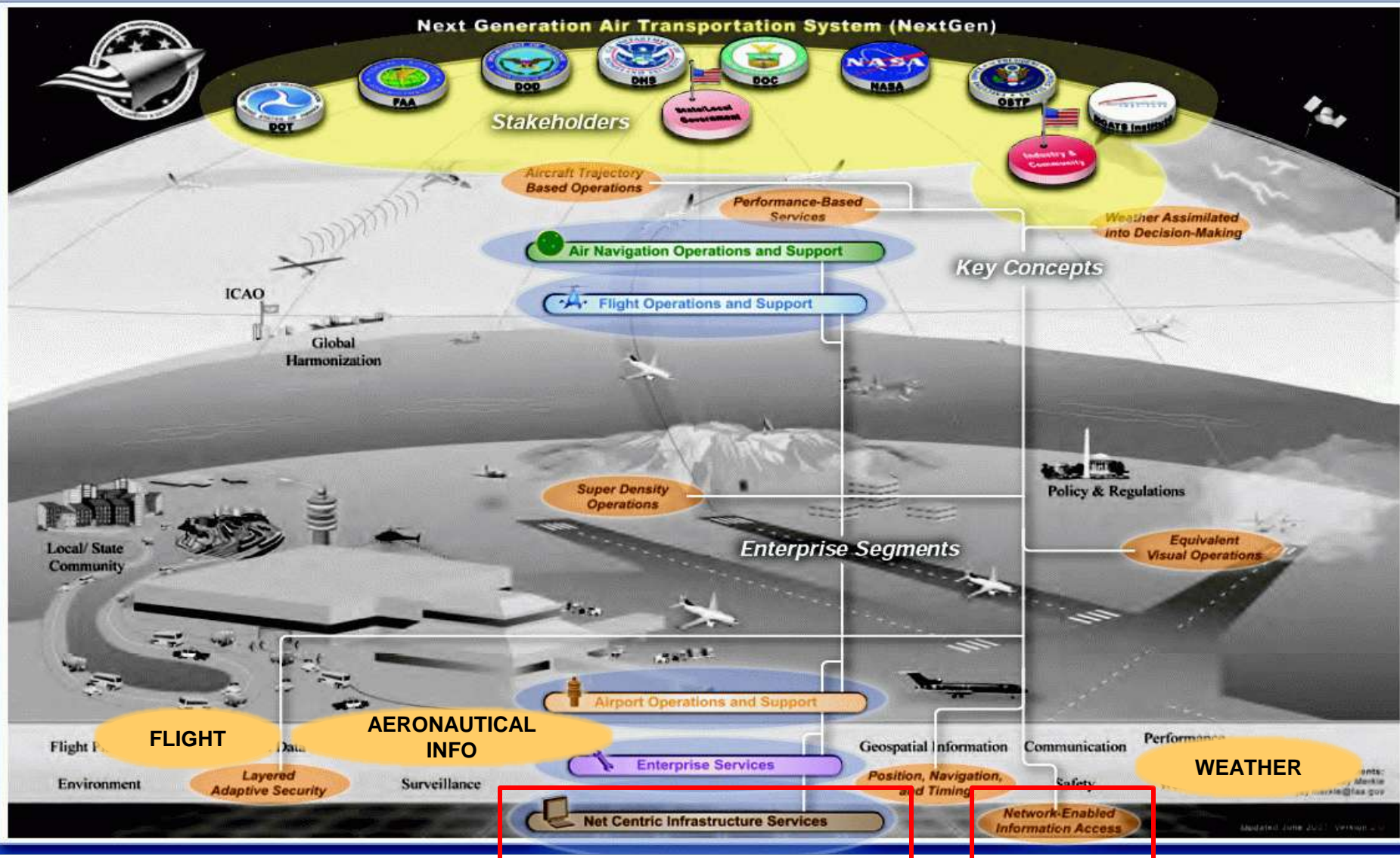
Interactions between FAA Facilities and Airlines for Newark Congestion Problems



Evans, J. Ducot, E., "Corridor Integrated Weather System, Lincoln Laboratory Journal, Volume 16, Number 1, 2006



Next Generation Air Transportation System Operational Concept





Information Management Session



- **Common Support Services – Weather**
 - Kajal Claypool, MIT LL
- **System-Wide Information Management National Airspace: System Enterprise Messaging Service**
 - Stephen Link, Harris
- **Corridor Integrated Weather System Data Distribution Service**
 - Carol Kelly, MIT LL
- **Aviation Safety Information Analysis and Sharing**
 - Alex Alshtein, MITRE



Outline



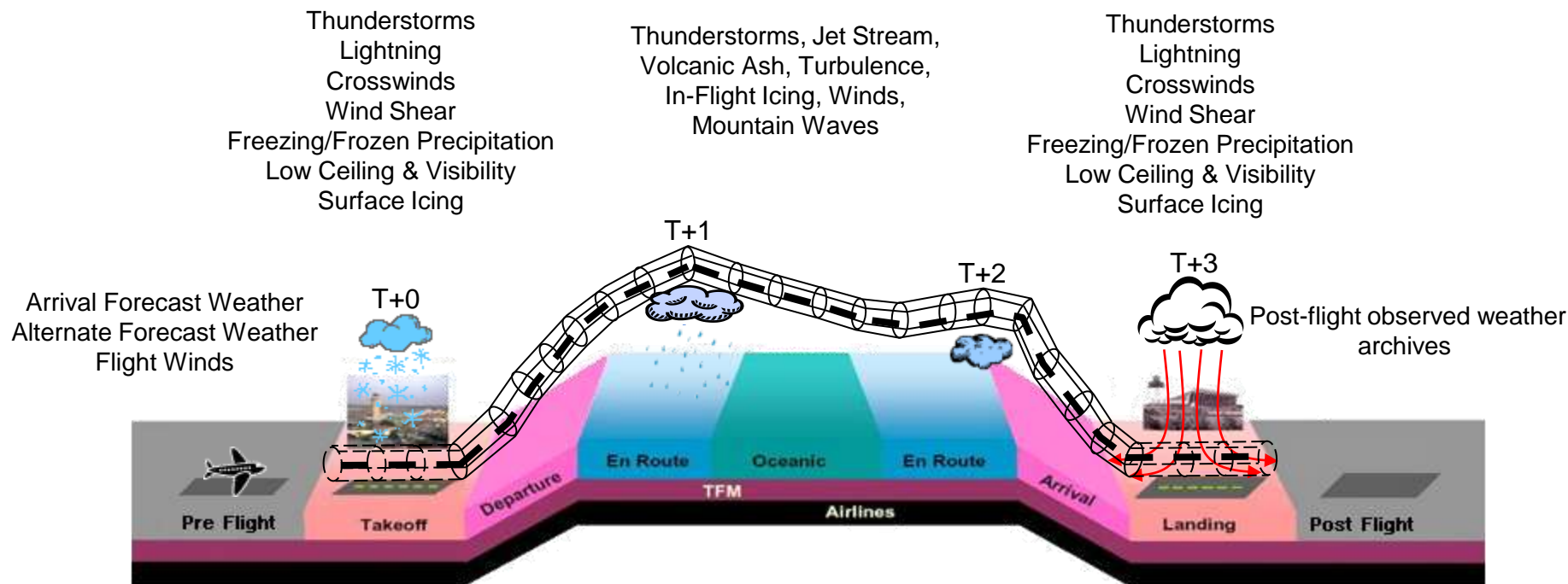
- **Motivation**
- ➔ • **CSS-Wx Deep Dive**
- **Summary & Future Steps**



Weather Along A Route



- **CSS-Wx** targeted for providing flight plan specific weather data
- **Data will be filtered by:**
 - **Route, Time and Wx parameters requested by user**

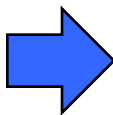
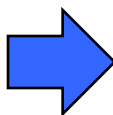




CSS-Wx Objectives



JPDO ConOps and Requirements Documents



Functional Requirements

- Common operational weather picture
- Support observation, forecast and archived weather data
- Single authoritative source for weather
- Weather content delivery network

Non - Functional Requirements

- Scalable
- Secure
- Agile
- Reliable
- Affordable



Key Technology Thrusts



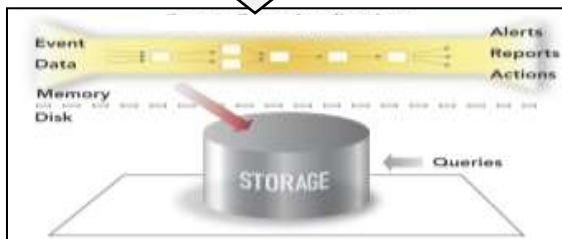
Standardization & Interoperability

Data Standards

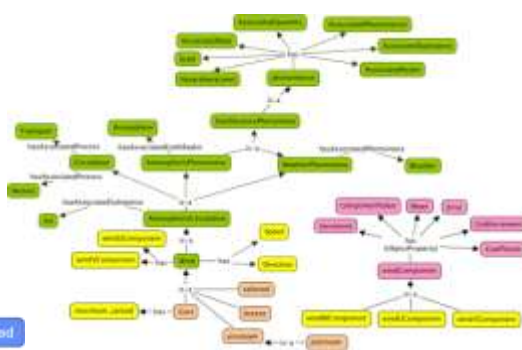
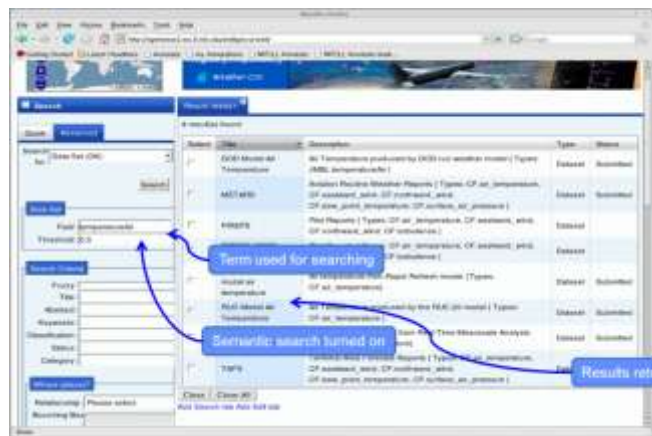


Data Access Standards

Open Geospatial Consortium
Web Feature Service/ Web Coverage
Service

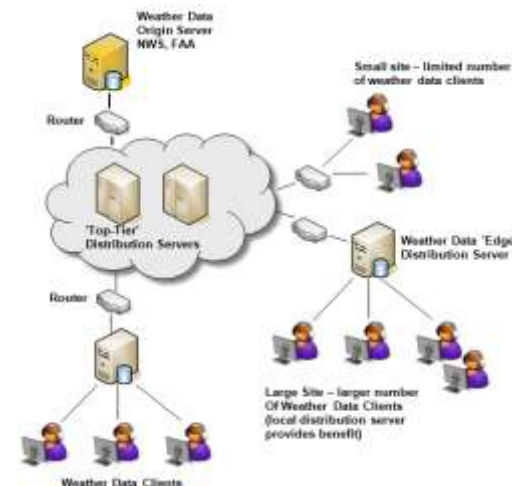


Semantic Technologies

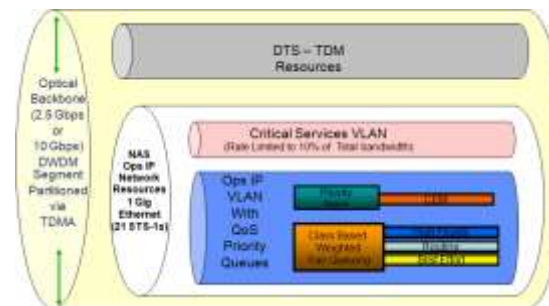


Performance

Dissemination Architecture



Quality of Service

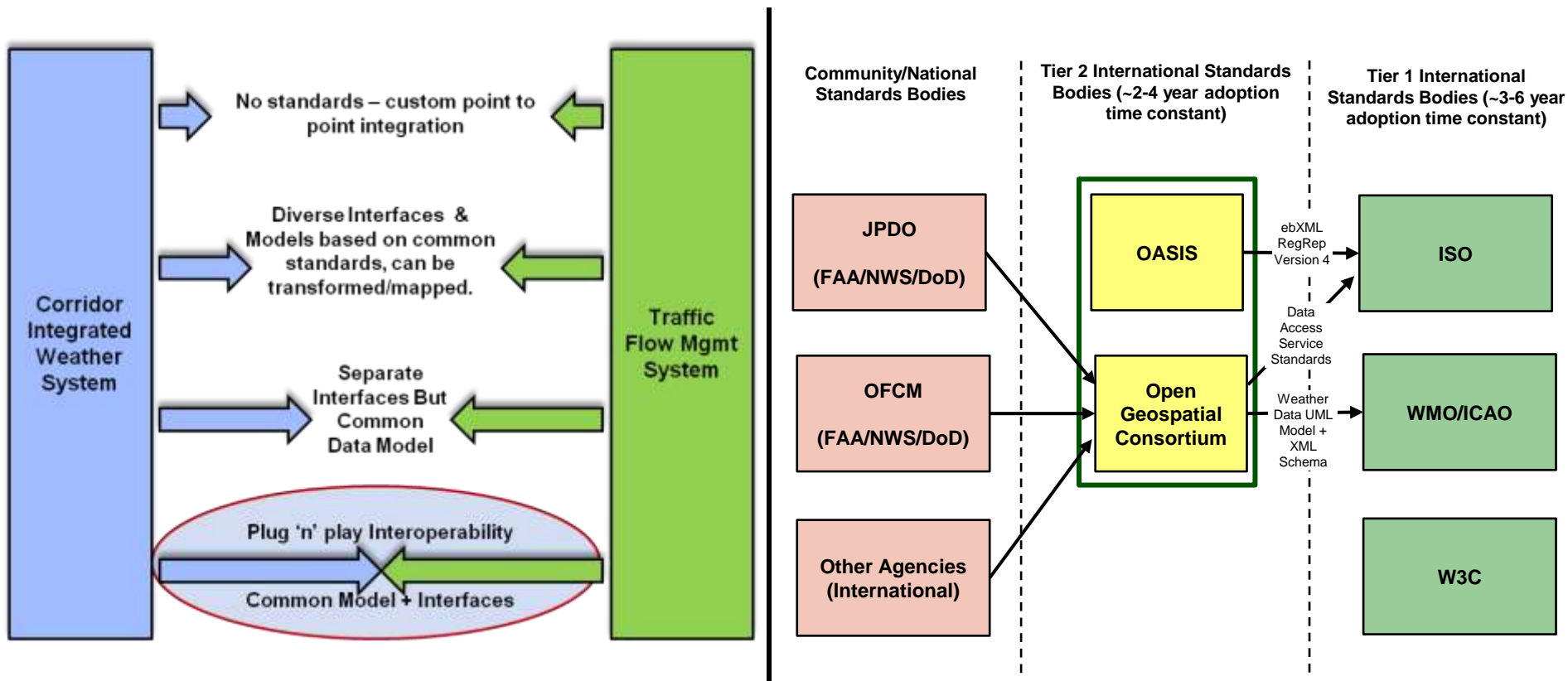




Data and Service Standards



Standardization is key to Interoperability

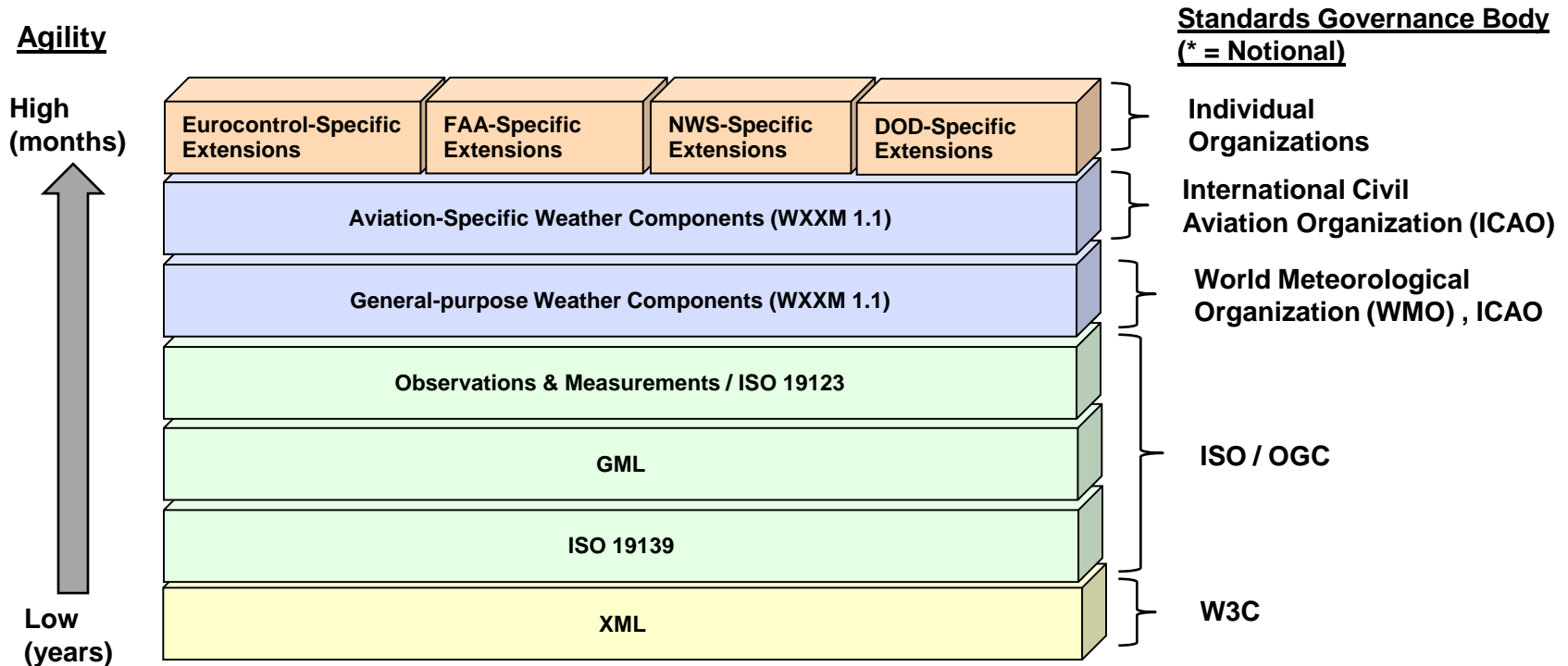




Common Data Model – Weather Information Exchange Model (WXXM)



- WXXM Ad-Hoc Working Group Membership: *Eurocontrol, FAA, NWS, DoD, NOAA, British Atmospheric Data Center*



- Composable, extensible data model balances standardization with the need for individual communities to innovate
- WXXM builds upon many concepts (e.g., 'Core + extensions model') gleaned from Standards Community participation



Adoption of WXXM

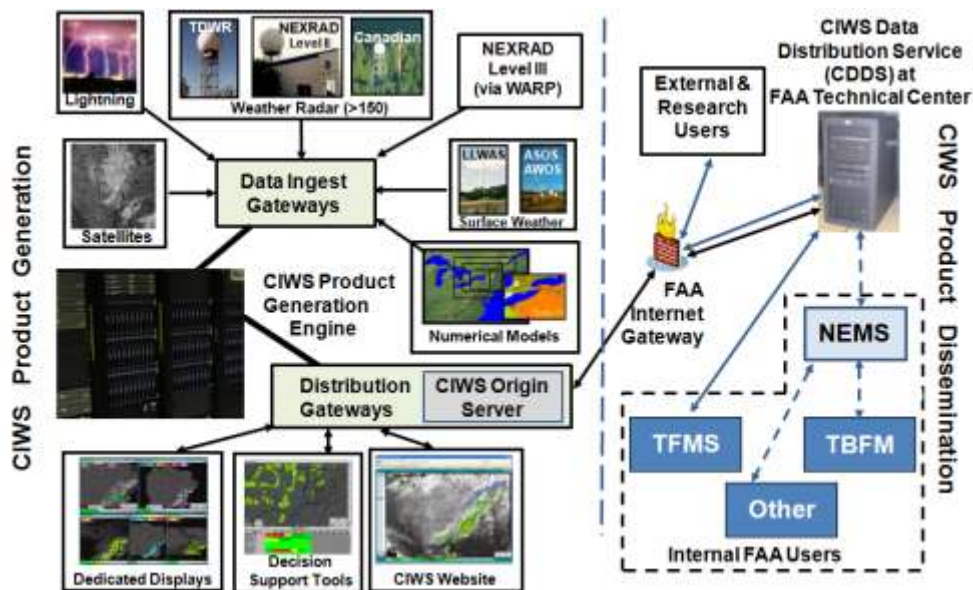


Luciad Demonstration OGC/OWS 8



Use of WXXM to provide Volcanic Ash and Turbulence SIGMETs at OGC/OWS 8

CIWS Data Distribution Service (CDDS)

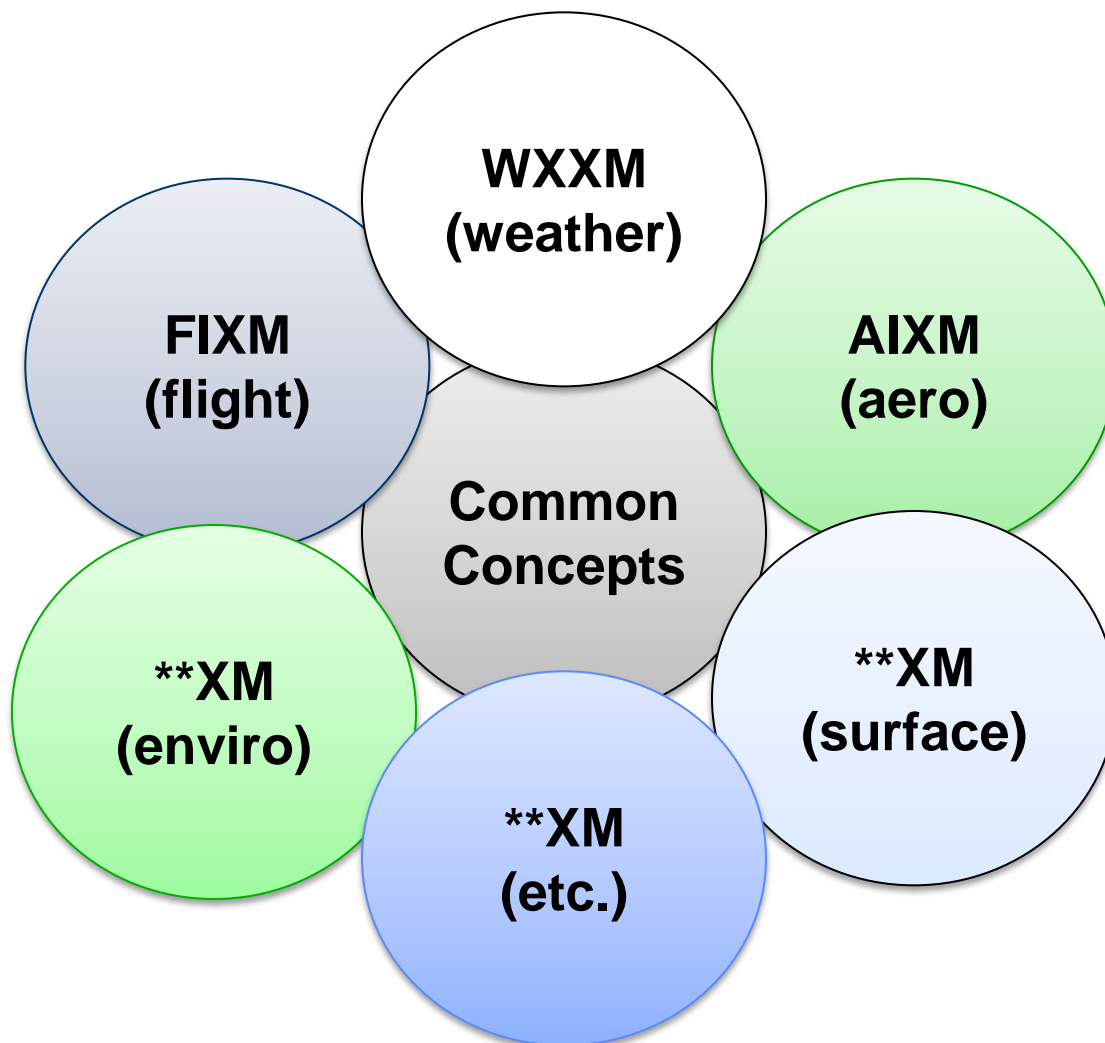


Use of WXXM to provide CIWS Weather Products for Operational Use to Internal/External FAA Users





Air Transportation Exchange Models





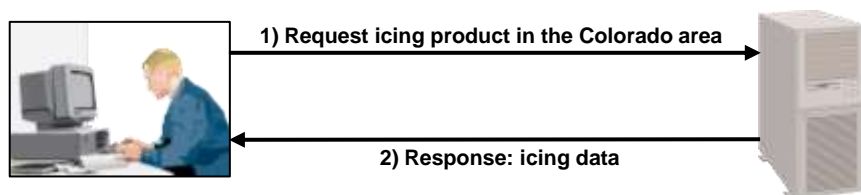
CSS-Wx Message Exchange Patterns



Message Exchange Pattern: Request/Response

5.1.3.3 Retrieve icing forecast product for Colorado

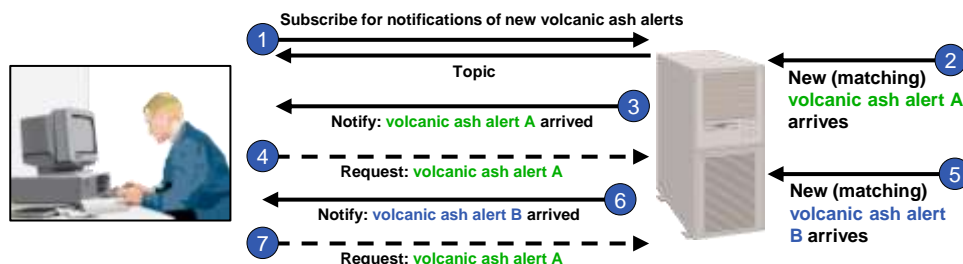
Retrieve (via pull mechanism) icing potential forecast product for the geometry of Colorado for 2007-10-12 12:00Z (future time, 12 hours from the time the request is made), from 5000 ft to 35000 ft



Message Exchange Pattern: Notification

5.1.3.8 Subscribe to volcanic ash alerts for a specified flight path

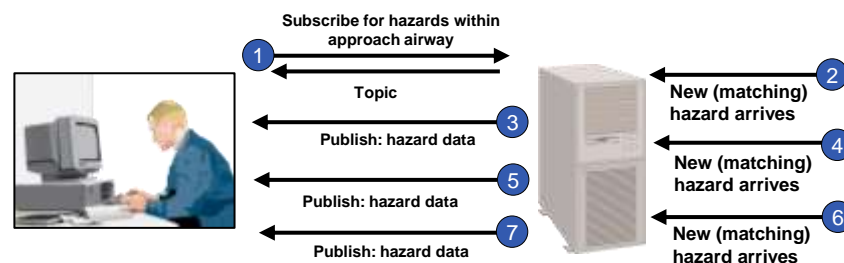
Retrieve (via pull mechanism) icing potential forecast product for the geometry of Colorado for 2007-10-12 12:00Z (future time, 12 hours from the time the request is made), from 5000 ft to 35000 ft



Message Exchange Pattern: Persistent Query

5.1.3.9 Monitor hazard in the terminal approach airway

A TRACON air-traffic controller needs to monitor adverse weather conditions that exist, or are forecasted to exist, within the approach airway. The approach airway is defined as a volume around an airport, defined by a set of XYZ vertices, within which departing and landing flights must fly.



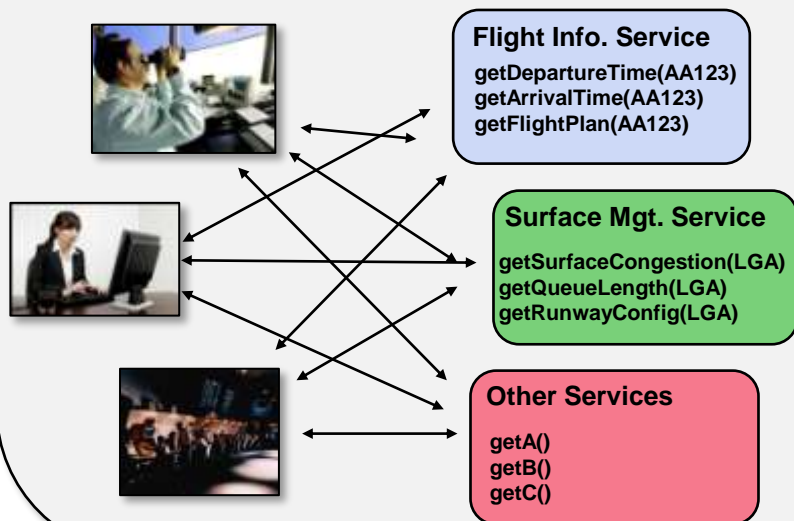


CSS-Wx Net-Centric Service Standardization



'Conventional' SOA design is not scalable!

- N-squared problem as more users and service providers connect
- Semantic divergence as service providers provide variations on the same theme (e.g. pub/sub)



Standards-based Information Management Architecture scales well as users and services are added

- Filtered data access interface makes it easy for users to ask for the data they need
- Producers logically decoupled from consumers



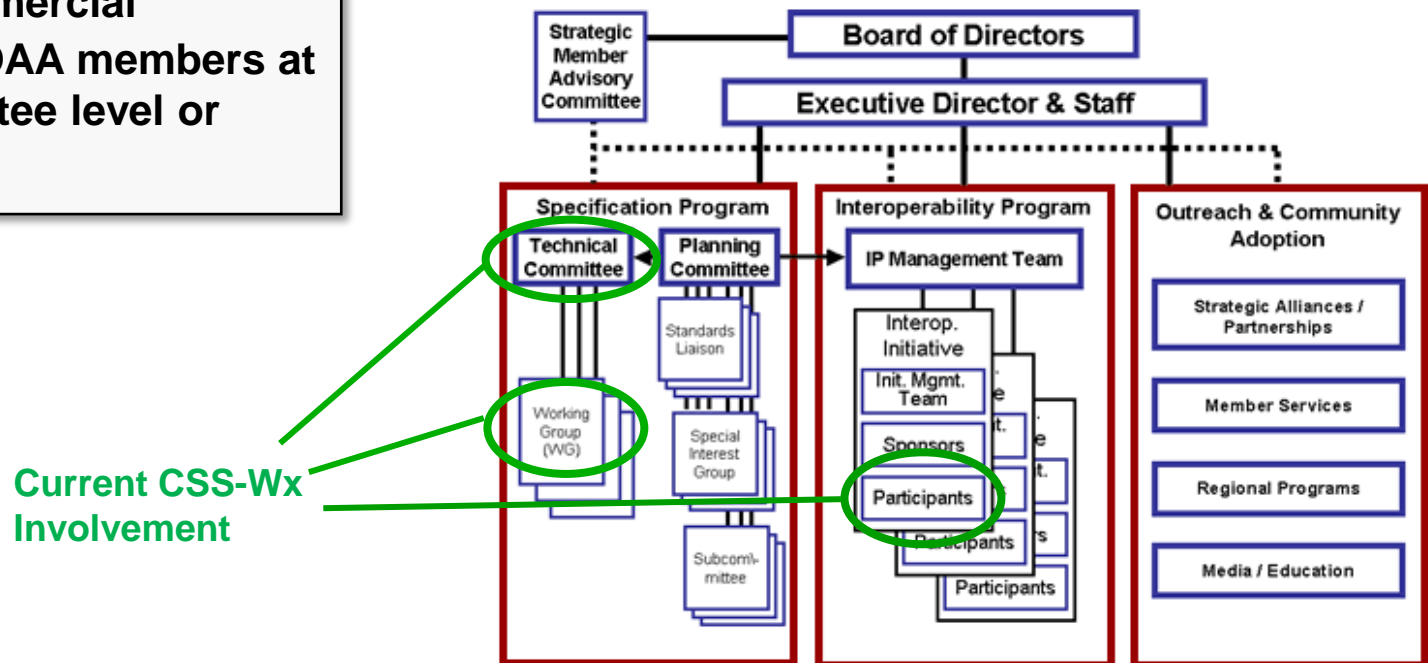
Data standardization provides foundation for service interface standardization



Standards Development Open Geospatial Consortium



- **OGC - Geospatial standards body**
 - Data models & schemas
 - Services Reference Architecture
 - Service Standards
 - What, When, Where data access*
 - Strong coupling to ISO
- **Founded in 1994. 350+ members - national, international, government, commercial**
- **MIT/LL, NCAR, NOAA members at Technical Committee level or higher (NOAA)**

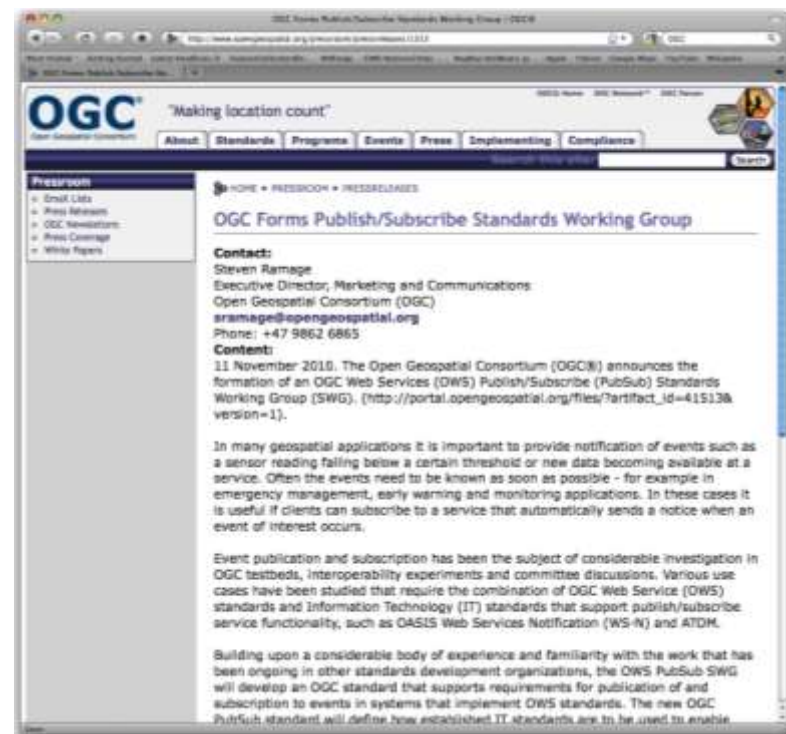




Web Feature Service



- **Filtered access to non-gridded data formatted as XML**
 - Query model is based on OGC Filter 2.0 specification, which can be (loosely) thought of as a set of spatial and temporal operators that extend the core Xpath filter specification
- **Version 4.0 released July 1, 2012:**
 - Enabled with 2 of the 3 message exchange patterns
 - Full Spatial and Temporal filtering
 - Request delegation to another WFSRI
 - Client request limitations
 - Self-test diagnostics following installation
 - Monitoring of performance metrics
 - XML Schema validation
 - Support for different underlying data stores





Outline

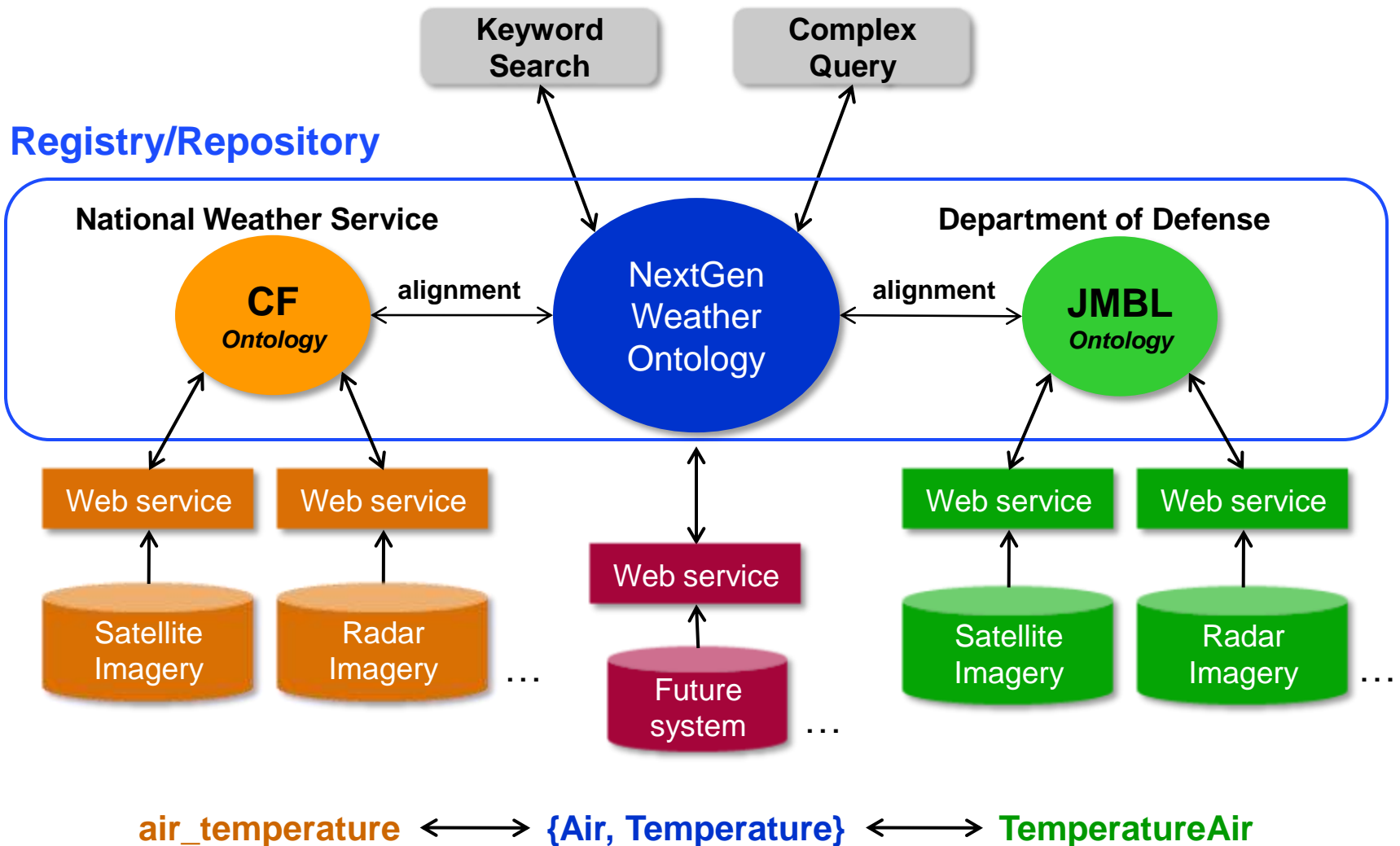


- **Motivation**
- **CSS-Wx Deep Dive**
 - Standardization & Interoperability
 - Semantic Technologies
 - Architecture & QoS
- **Summary & Future Steps**





Semantic Search





Application: Semantic Search



Search

Quick Advanced

Search for: Data Set (OK)

Search

Data Set

Field: temperatureAir

Threshold:

Search Criteria

Fuzzy: Title: Abstract: Keywords: Classification: Status: Category:

Where (place)?

Relationship: Please select

Bounding Box:

Done

Result 165423

1 result(s) found

Select	Title	Description	Type	Status
<input type="checkbox"/>	DOD Model Air Temperature	Air Temperature produced by DOD-run weather model (Types: JMBL.temperatureAir)	Dataset	Submitted

Close Close All

Add Search tab Add Edit tab

Term used for searching

Semantic search turned off

Results returned



Application: Semantic Search



Result 165421

8 result(s) found

Select	Title	Description	Type	Status
<input type="checkbox"/>	DOD Model Air Temperature	Air Temperature produced by DOD-run weather model (Types: JMBL.temperatureAir)	Dataset	Submitted
<input type="checkbox"/>	METARS	Aviation Routine Weather Reports (Types: CF.air_temperature, CF.eastward_wind, CF.northward_wind, CF.dew_point_temperature, CF.surface_air_pressure)	Dataset	Submitted
<input type="checkbox"/>	PIREPS	Pilot Reports (Types: CF.air_temperature, CF.eastward_wind, CF.northward_wind, CF.turbulence)	Dataset	
<input type="checkbox"/>	PIREPS (ADCS)	Pilot Reports (Types: CF.air_temperature, CF.eastward_wind, CF.turbulence)	Dataset	
<input type="checkbox"/>	model air temperature	Air temperature from Rapid Refresh model. (Types: CF.air_temperature)	Dataset	Submitted
<input type="checkbox"/>	RUC Model Air Temperature	Air Temperature produced by the RUC-20 model (Types: CF.air_temperature)	Dataset	Submitted
<input type="checkbox"/>		from Real-Time Mesoscale Analysis.	Dataset	Submitted
<input type="checkbox"/>	TAFS	Terminal Area Forecast Reports (Types: CF.air_temperature, CF.eastward_wind, CF.northward_wind, CF.dew_point_temperature, CF.surface_air_pressure)	Dataset	

Search for: Data Set (OK)

Search

Data Set

Field: temperatureAir

Threshold: 0.5

Search Criteria

Fuzzy:

Title:

Abstract:

Keywords:

Classification:

Status:

Category:

Where (place)?

Relationship: Please select

Bounding Box:

Done

Close Close All

Add Search tab Add Edit tab

Term used for searching

Semantic search turned on

Results returned



Outline



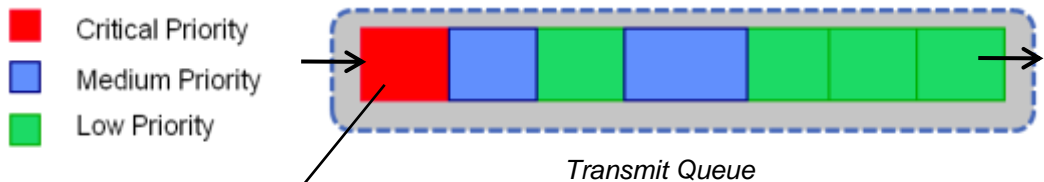
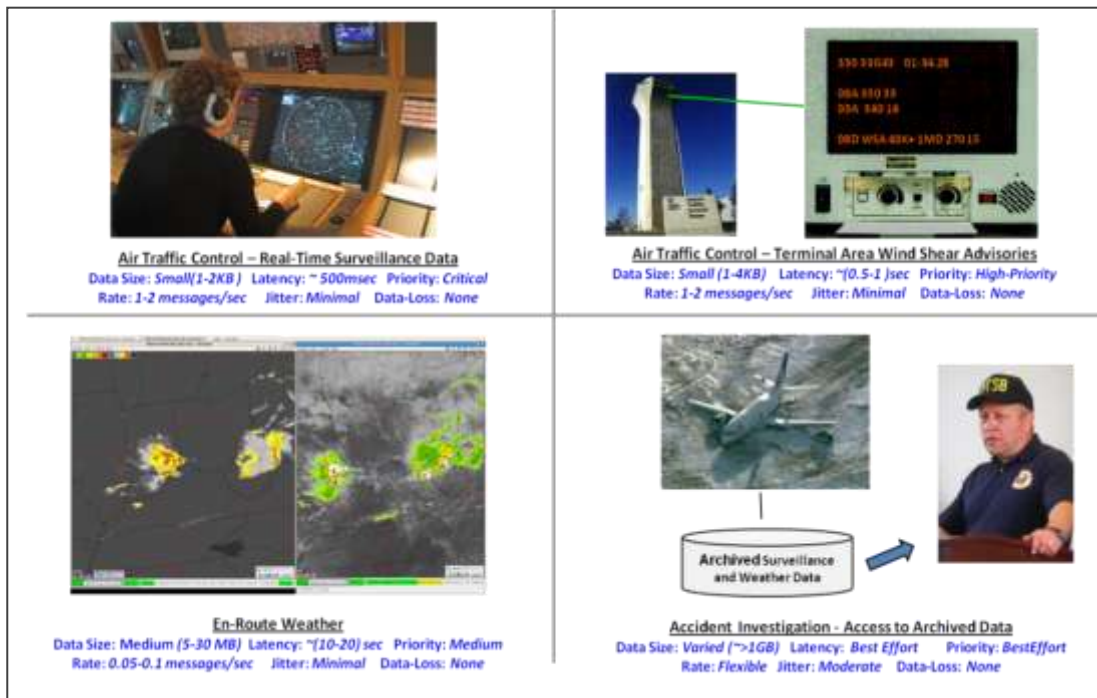
- **Motivation**
- **CSS-Wx Deep Dive**
 - **Standardization & Interoperability**
 - **Semantic Technologies**
 - **Architecture & QoS**
- ➔ • **Summary & Future Steps**



Quality of Service



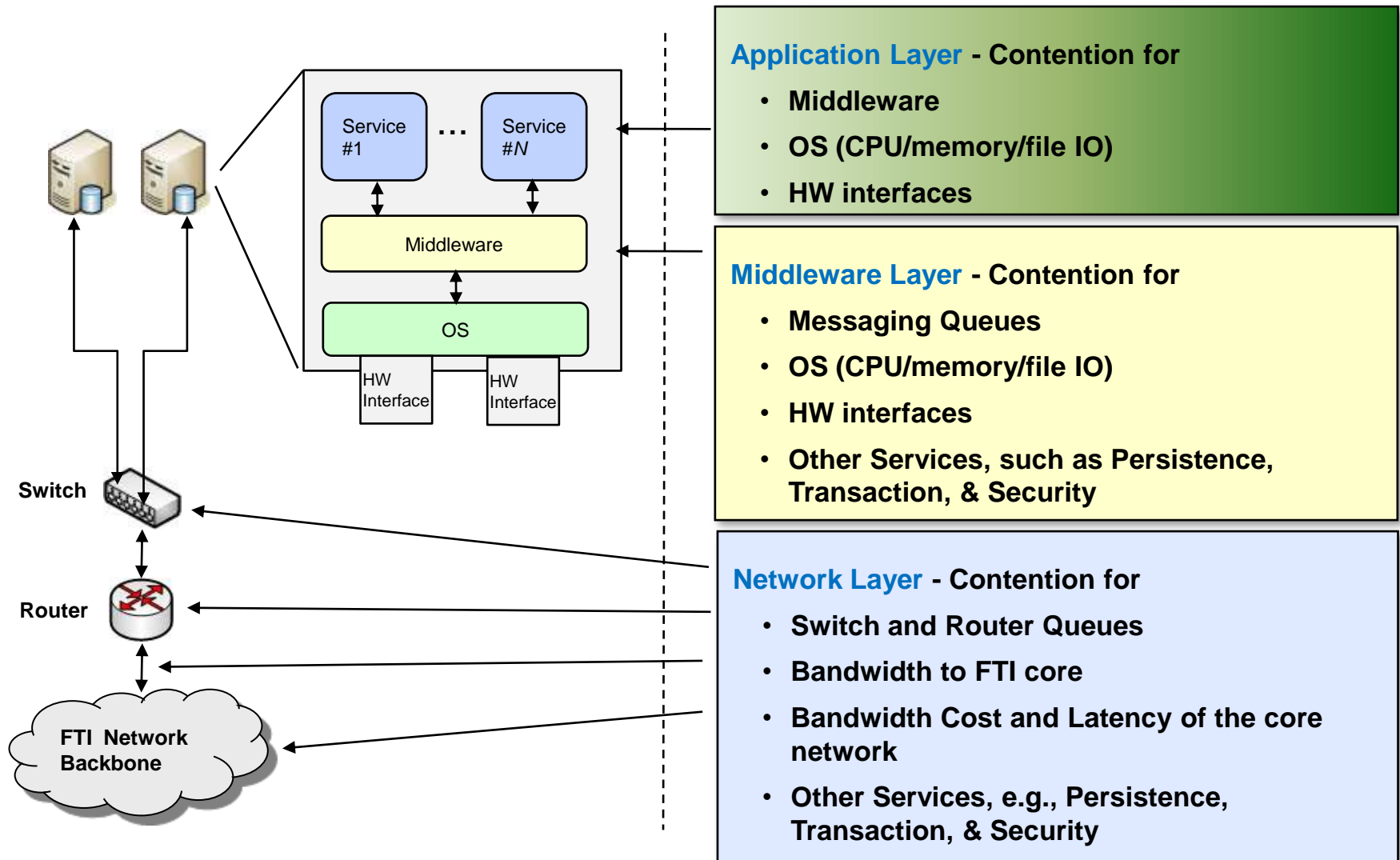
- **FAA CSS-Wx moving towards a centralized cloud architecture**
 - Eliminates the Top-Tier Distribution servers
- **Quality of Service a higher priority**
 - Different CSS-Wx applications have different needs for
 - Timeliness and Jitter
 - Data rate
 - Data loss
- **Different data-types with varying ranges of size, and rate of production and consumption**



Critical Priority traffic stuck behind large number or large size of traffic of lower priorities at a constrained site (queues, or hardware interfaces, e.g.)



Potential QoS Bottlenecks Across the Different Layers





Summary and Future Work



- **Standardization efforts crucial for the success of NextGen**
 - **Standards tend to be vetted by broad community**
 - **Facilitate development and adoption of common data access and support services**
 - **Provide fundamental basis of situational awareness and interoperability among FAA, DoD and international partners**
 - **FAA Towers, TRACONs, ARTCC, ATCSCC, etc**
 - **Airlines, DoD and NWS**
 - **ICAO, Eurocontrol, SESAR partners**
 - **Reduce time, cost, and complexity of new data integration, for both producers and consumers**
- **Other ongoing efforts**
 - **Aeronautical Information Management, Flight object**