Aviation Weather

Segment Three - Concept of Operations and Requirements

Federal Aviation Administration

Presented to: "Friends/Partners in Aviation Weather" Vision Forum

Panel: Richard Heuwinkel, Kevin Johnston, Leo Prusak, and Joe Sherry

Date: July 22, 2009

Outline

- **NextGen Wx Concept of Operations (ConOps)**

- **4D Wx Cube Single Authoritative Source (SAS)**
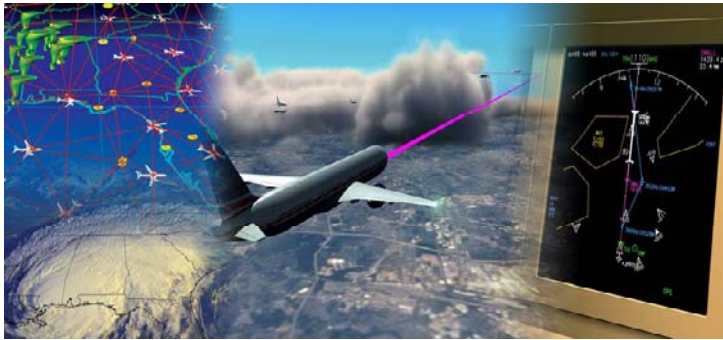
- **NextGen Wx Requirements**

NextGen Wx ConOps

NextGen Weather
Top-Tier ConOps Documents

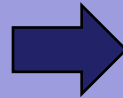**NEXT GENERATION AIR TRANSPORTATION SYSTEM**

WEATHER CONCEPT OF OPERATIONS

Version 1.0

May 13, 2006

Weather ConOps

➡️

Informed

NextGen ConOps

Joint Planning and Development Office

Making the NextGen Vision a Reality

Joint Planning and Development Office

Concept of Operations for the **Next Generation Air Transportation System**

Version 2.0

13 June 2007

NEXTGEN
Next Generation Air Transportation System

NextGen Weather
Guiding Principles/Concepts

- **NextGen Weather guiding principles outlined in the NextGen Weather ConOps include:**
  - Paradigm change from weather products to information
  - Common weather picture (i.e., SAS)
  - Net-centric 4-D Weather Data Cube available to all stakeholders
  - Weather assimilated into decision-making

NextGen Weather
Supports Key NextGen Capabilities

- **NextGen Weather plays an important role in each of the eight key NextGen capabilities:**

  1. Network-enabled information access
  2. Weather assimilated into decision making
  3. Trajectory Based Operations (TBO)
  4. High density arrival/departure operations
  5. Broad-area precision navigation
  6. Performance-based operations and services
  7. Equivalent visual operations
  8. Layered, adaptive security

- **NextGen Weather is critical to NextGen**

NextGen Weather ConOps Provides a Foundation

- **Weather Assimilated into Decision-Making**
  - "*Wx information is designed to integrate with and support NextGen decision-oriented automation capabilities and human decision-making processes.*"
  - "*Wx information…must be translated into information …directly relevant to NextGen users and service providers…*"
  - "*Pre-flight and in-flight decisions are aided by Wx services that assist the user in making tailored inquiries into the common weather picture.*"
  - "*…other commercially available, value-added Wx sources may be used by stakeholders in making their own flight-planning decisions ...*"

NextGen Wx Concepts Continue to Evolve and Build on This Foundation

- **Numerous lower-tier ConOps are being developed:**
  - Subject area (e.g., Net-centric Operations)
  - Solution Set (e.g., Initiate TBO, Increase Arrivals/Departures at High Density Airports)
  - Timeframe (e.g., Near-term Wx in the Cockpit, NextGen Mid-term ConOps)

- **Continued NextGen development (e.g., planning, requirements, R&D, demonstrations, ConUse, scenarios, and lower-tier ConOps) further define/ develop these key NextGen Weather concepts**
  - All of today's briefings build upon these key concepts

Later Presentations Build on NextGen Wx Concepts

- **Common weather picture (i.e., SAS)**
  - Rick Heuwinkel will discuss SAS concept/definition
  - Tom Ryan, Jason Tuell, and Doug Wreath will discuss additional SAS aspects in the next session

- **Paradigm change from weather products to Info & Net-centric 4-D Weather Data Cube available to all**
  - Tom Ryan, Jason Tuell, and Doug Wreath will build upon these principles after the lunch break

- **Weather assimilated into decision-making**
  - Steve Bradford and Mark Huberdeau will expand upon this guiding principle in Segment 5

4D Wx Cube SAS

Approach

- **Weather Work Group (Wx WG) Policy Team 2 Developed SAS Definition that:**
  - Provides sufficient guidance for development of detailed specifications at the weather element level by Initial Operational Capability (IOC) Team
  - Applies to Final Operational Capability (FOC)
- **SAS at IOC Will Be Starting Point for Evolution Toward FOC Over Life of NextGen**

Definition* of 4-D Wx SAS

- **Subset of the NextGen 4-Dimensional Weather Data Cube (4D Wx Data Cube)**

- **Supports the Civil Air Navigation Service Provider's (ANSP) Air Traffic Management (ATM) Decisions.**

* Backup slides define "4-D Wx Data Cube," "ANSP," and "ATM."

Definition* of 4-D Wx SAS (cont'd)

By Final Operational Capability (FOC), SAS Will

1. Provide optimal representation of all ANSP-used weather information that is consistent in time, space, and among weather elements,

2. Be accessible to all,

3. Be the source of weather information for the ANSP's ATM decisions,

4. Be specified by the ANSP, and

5. Support network services typical of the 4-D Wx Data Cube.

Evolution of 4-D Wx SAS

- **By IOC**
  - Common interface to most weather information
  - Planned improvements in weather content

- **SAS Change Drivers to FOC**
  - Scientific advances, e.g. higher resolution in space and time
  - Requirements to support changes in NAS operational capabilities, e.g. trajectory based operations

- **Integrated Weather Plan to Identify Key Decision Points in SAS Evolution**

Roles & Responsibilities

- **ANSP:**
  - **Continue to set aviation weather information requirements for ANSP ATM decisions**
  - **Translate weather into ATM impacts**
- **National Weather Service:**
  - **Obtain and determine optimal representation of current and future weather phenomena to meet SAS requirements**
  - **Develop operational capabilities necessary to meet ANSP requirements**
- **Department of Defense:**
  - **Set DoD-specific requirements for aviation weather information**

Coordination and Views

- **Proposed SAS Definition is Consensus View of Weather Policy Team (including industry representation)**

- **Incorporates:**
  - Review by IOC Team
  - Review by Integration Team
  - Review by Weather Requirements Team
  - Discussion at Weather Work Group Executive Committee (5/26/09)
  - Briefed to NextGen Executive Weather Panel (NEWP) (6/17/09)
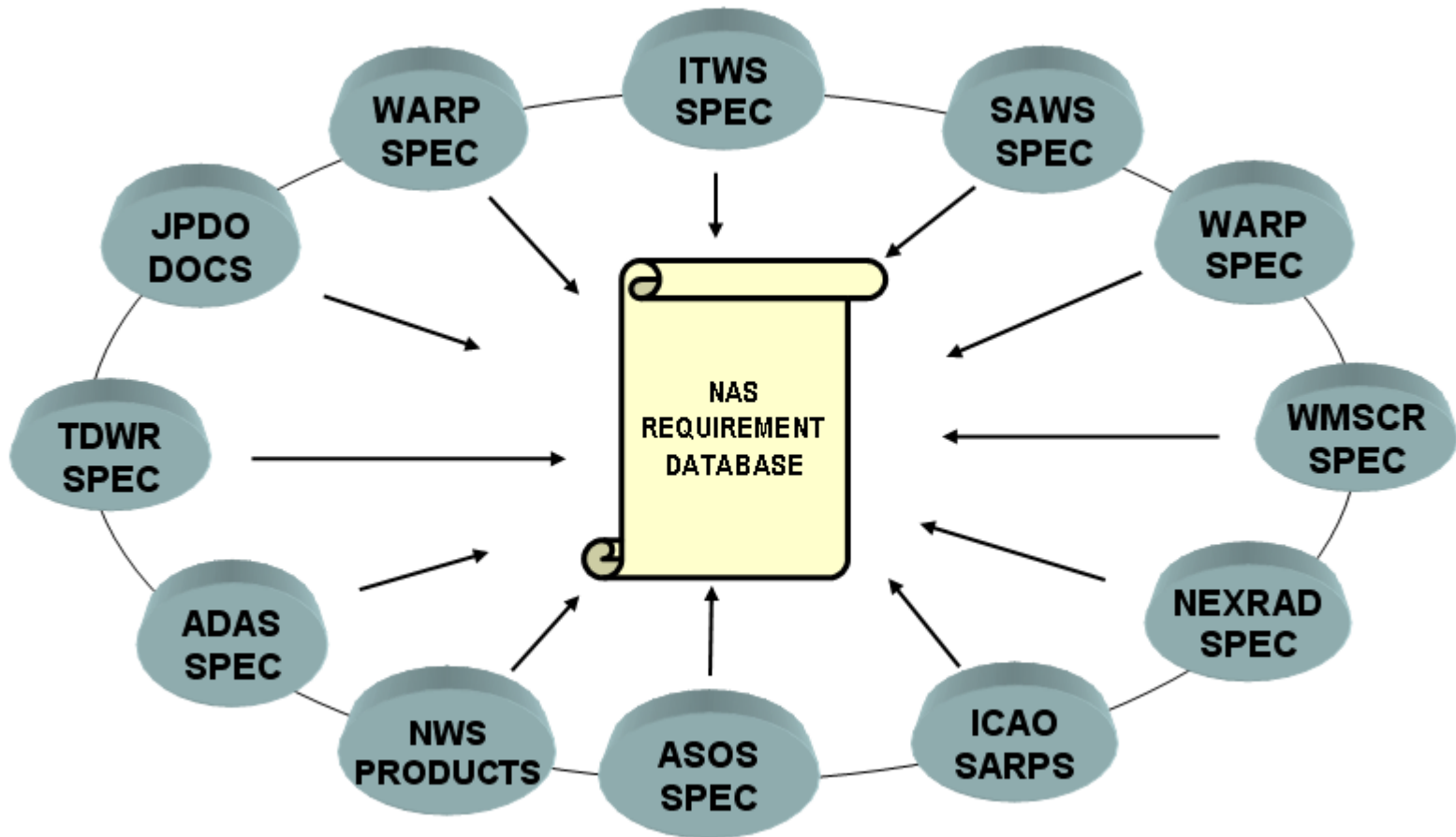
NextGen Wx Requirements
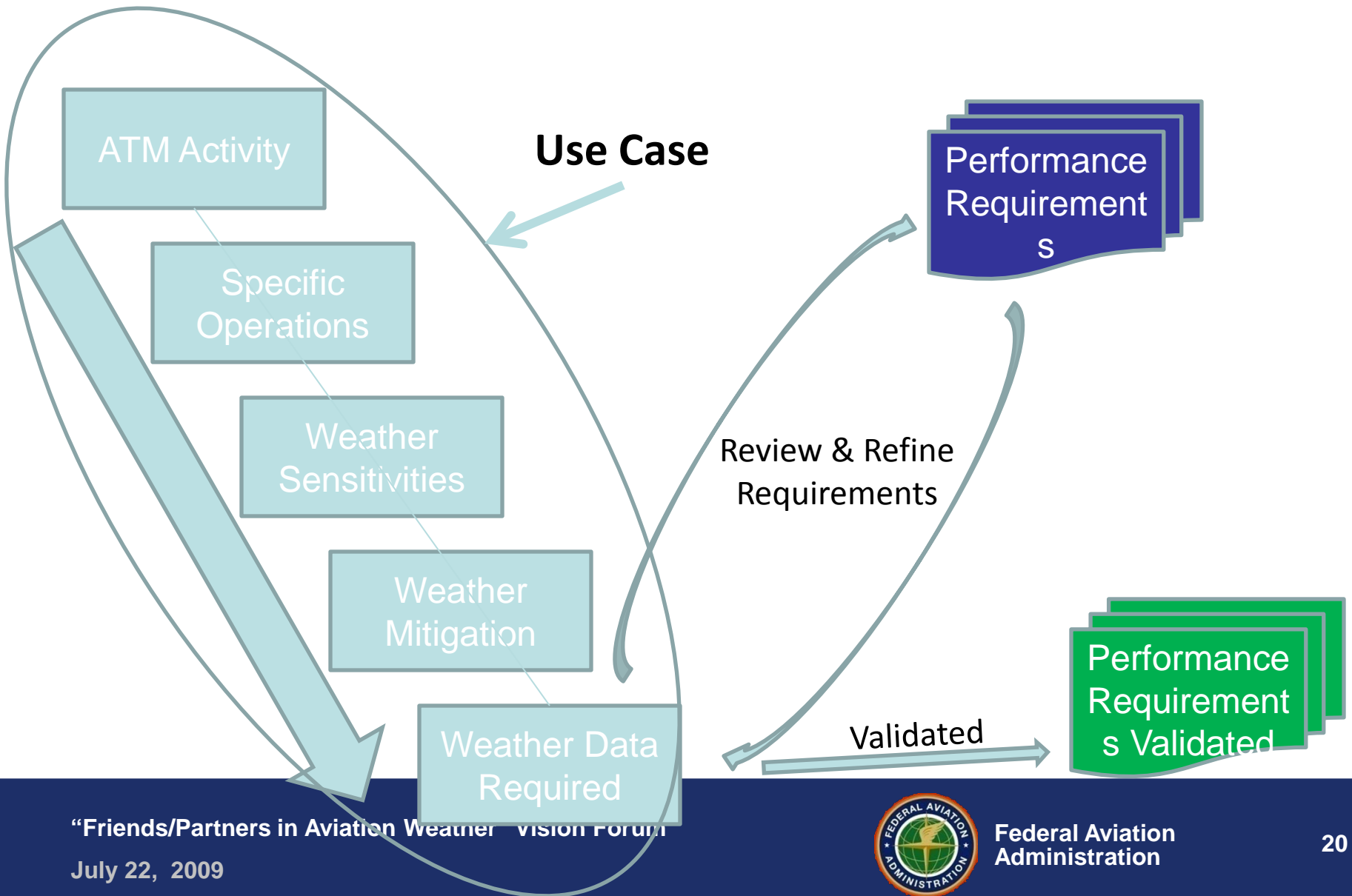
Weather Requirements Objectives

- **Develop the Authoritative Set of Aviation Weather Requirements for the NextGen NAS**
  - **Generate current baseline**
    - **NextGen**
    - **Assess gaps**
    - **Allocate (R&D, operational systems & procedures, agencies, and commercial sector)**
  - **Validate**
  - **Verify**

- **Do So Using Industry Best Practices for Reliable and Credible Results**

Sources of Weather Requirements

Use Case – Requirements Analysis

Use Case

ATM Activity

Specific Operations

Weather Sensitivities

Weather Mitigation

Weather Data Required

Performance Requirements

Review & Refine Requirements

Validated

Performance Requirements Validated

Program Status – FY09

- **Develop Requirements Management Methodology – 3/09**

- **Select Requirements Management Tool (DOORS) – 5/09**

- **Performance Requirements, Version .01, to JPDO Agencies & Industry Partners for Comment – 9/09**

- **Capture NextGen Functional and Performance Requirements in DOORS Tool – 9/09**

Next Steps

- **Adjudicate Comments & Create Version .02 – 12/09**
- **Complete Weather Requirements Baseline – 12/09**
- **Establish User Validation Groups– 12/09**
- **Develop Use Cases for Validation – 12/09**
- **Allocate Requirements to Providers/Systems – 3/10**
- **Conduct Validation Workshops – 1/10, 4/10, 7/10, 10/10, 1/11**
- **Requirements Modeling/Simulation Verification Pilot – 3/11**
- **Complete Verification – FY13**

Questions

4-D Wx Data Cube Definition

The 4-D Wx Data Cube will be comprised of aviation-relevant observations, analyses, forecasts (including probability), space weather information, and climatology organized by 3-dimensional spatial (latitude, longitude, altitude) and time components.

ANSP Definition

The JPDO Concept of Operations for the Next Generation Air Transportation System (version 2.0, 13 June 2007) defines Air Navigation Service Provider as follows: "An organization responsible for and authorized to provide air traffic management (ATM) services; communications, navigation, and surveillance (CNS) services; meteorological services for air navigation; and aeronautical information services."

ATM Definition

ICAO Document 9854 *Global Air Traffic Management Operational Concept* (1st ed., 2005) and the JPDO *Concept of Operations for the Next Generation Air Transportation System* (version 2.0, 13 June 2007) define ATM as follows: "The dynamic, integrated management of air traffic and airspace—safely, economically and efficiently—through the provision of facilities and seamless services and in collaboration with all parties." In addition, ICAO Document 9854 describes the ATM community as including the following: aerodrome community, airspace providers, airspace users, ATM service providers, ATM support industry, ICAO, regulatory authorities, and states.

SAS FOC Characteristics

(1) Consistent* answer in time, space, and among weather elements

This characteristic is necessary to provide:

- Efficient operation of NAS

- Optimal representation for all SAS queries for the same place, time, and parameter regardless of format, product, user, …

Where applicable, SAS is also consistent in probabilistic terms.

SAS FOC Characteristics (cont'd)

(4) Specified by ANSP*

- **ANSP will specify characteristics of weather information needed to support its ATM decision making / decision tools**
  - ANSP requirements will evolve as NextGen matures, e.g., transition to Trajectory-Based Operations and risk-based decision tools
- **NWS will determine what weather information best meets SAS requirements specified by ANSP**

In current practice FAA is the ANSP for the United States

SAS FOC Characteristics (cont'd)

(5) Support network services typical of the 4-D Wx Data Cube:

- **Distributed source, "virtual" operation**

- **Network services ("publish," "subscribe," …) common to 4-D Wx Data Cube**

- **Physical implementation transparent to functional characteristics***

*For example, dual paths may be needed to achieve necessary performance

SAS Evolution -- Consistency

- **Today's aviation weather products often not consistent:**
  - Different products have different values for the same weather element at the same time and location
  - Some weather products not even internally consistent
  - Multiple products available (no single authoritative source)
- **IOC SAS:**
  - Identify authoritative information for ATM decision-making
  - Reduce internal inconsistencies
  - Some inconsistencies between products (especially legacy products still in use at IOC)
- **Complete consistency at FOC (target is Midterm Operational Capability (MOC))**

SAS Evolution -- Accessibility

- **Today's aviation weather products supporting ANSP's ATM decisions not accessible to everyone**

- **At IOC:**

  - SAS information will be open and available to all
  - Some information used to support ANSP ATM decisions will not be in the SAS, e.g., cannot achieve network-enabled delivery of very high performance products such as wind shear alerts

- **Complete accessibility at FOC**

  - May still have dual paths for some very high performance products (engineering decision), but all SAS information available through network

SAS Evolution -- Probability

- **Few of today's aviation weather products supporting ANSP's ATM decisions are probabilistic**

- **Little progress by IOC SAS**
  - Fundamental science questions on how to produce probabilistic weather description
  - Questions on how probabilistic information will be used operationally
  - Regulatory issues regarding use of probabilistic information

- **Complete at FOC (some progress at MOC)**

END