To: FPAW – Fall Forum
By: Alfred Moosakhanian (FAA)
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FAA NextGen Weather Systems

Common Support Services – Weather (CSS-Wx)
and
NextGen Weather Processor (NWP)
Benefits of CSS-Wx and NWP

Reduce FAA Operations Costs

- Significant Cost Avoidance Over Lifecycle FY14-40
- Payback After 6 Years

Modernize National Airspace System

- Decommission Outdated Systems
- Leveraging SWIM and FTI
- Cloud Compatibility
- Global Data Standardization

Improve Efficiency

- Over $2.9B of User Benefits
- Reduce Flight Delays
- Enable Collaborative Decision-making

Improve Safety

- Enhanced Weather Information
- Greater Access
- Common Situational Awareness
NextGen Weather Systems

Efficient, Flexible Routing

Reduce Weather Impact

All-weather Departures

All-weather Approaches

Current Wx Dissemination
- ITWS NFU, ITWS VOLPE
- WARP WINS, FBWTG
- CIWS CDDS
- WARP WINS, FBWTG
- ITWS NFU, ITWS VOLPE
- WARP WINS, FBWTG
- ITWS NFU, ITWS VOLPE

Future

CSS-Wx

Current Wx Processing
- ITWS
- WARP

Future

NWP

Screening Information Requests (SIRs) Release 1/2014
Final Investment Decisions (FIDs) 2014
Contract Awards 2014
Last Site IOCs 2019
NextGen Weather Roadmap

Current Wx Dissemination:
- WARP WINS & FBWTG
- CDDS
- ITWS Web Server & NFU
- CREWS

Legacy Wx Dissemination:
- WMSCR
- ADAS

Current Wx Processing:
- WARP RAMP
- CIWS
- ITWS

CSS-Wx Work Package 1
CSS-Wx FID Sept 2014

NWP Work Package 1
NWP FID Sept 2014

NWP Work Package 2
NWP Work Package 3
NextGen Weather Architecture

- ASR-9 / ASR-11
- Surface Stations
- TDWR
- LLWAS
- NEXRAD
- GOES Satellite
- Canadian Radar

NWP

AWD

Service Adaptors

CSS-Wx

ADAS WMSCE

Airborne Obs

NOAAPort

NAS Enterprise Security Gateway (NESG)

External Aviation Users

User Systems (ERAM, MicroEARTS, ATOPI, DOTS*, FDP2K)

Decision Support Tools (TFMS, TBFM, TFDM)

SWIM

IDS-R

NOAA
NWP Program Scope

• Produces advanced aviation specific weather products
• Translates weather information into weather avoidance areas for integration into decision support tools
• Enables decommissioning of legacy weather processor systems (e.g., WARP, ITWS, CIWS)

• NWP collocated with CSS-Wx equipment at central, TRACONs and CERAPs

• Aviation Weather Displays (AWDs) at ARTCCs, CERAPs, ATCSCC, and designated TRACONs/ATCTs
NWP Benefit Categories

• Improved NAS-wide routing/resource convective weather impact management
  - Dynamic, flexible, and “opportunity-driven”
  - More than one beneficial, tactical and/or strategic NWP beneficial resource impact management decision can be made at any given time

NWP Routing / Resource Impact Management Benefits Categories Include:

- Enhanced Reroute Planning (Non-Playbook)
- Reroute Assistance, Individual Flights of City-Pairs
- Routes Open Longer
- Reopen Closed Routes Sooner
- Enhanced Terminal Airspace Impact Management
  - Airport
  - TRACON
  - Arrival / Departure Transition Areas (ATA / DTA)
NWP Benefit Categories (continued)

• Improved Airspace Flow Program (AFP) execution/management
  - NWP provides a higher-resolution, deterministic strategic convective weather forecast that allows ATM to implement more targeted and precise AFPs / FCAs in regards to convective weather

• Enhanced Playbook reroute planning/execution
  - NWP provides a higher-resolution, deterministic strategic convective weather forecast that allows ATM to implement more efficient coordinated (e.g., “Playbook”) reroutes

• Improved utilization of available airport capacity through better anticipation of terminal area convective weather
  - Earlier detection of convective weather impact on airport
  - More consistent, reliable predictions
Notional NWP Products

Mosaics

- Precipitation (VIL) Mosaic
- Composite Reflectivity Mosaic
- Base Reflectivity Mosaic
- Echo Tops Mosaic
- Winter Precipitation / Phase Mosaic
- Echo Tops Mosaics (2-6)
- Satellite Mosaic
- ASR Mosaic

Translation Products

- Convective WAF Mosaic and Prediction
- RAPT Convective WAF and Prediction
- Convective Weather Avoidance Polygons
Support for Future Mobile Users

Mobile weather demonstrates terminal and en route weather information for users on iPAD, iPhone, and other mobile devices.
CSS-Wx Program Scope

• Provides a single source for FAA weather information and establishes enterprise level common support services using SWIM
• Provides users with the right information at the right time
• Consistent with global standards (e.g., WXXM)

• Commercial, off-the-shelf (COTS) hardware
• Located at 2 NEMCs, 21 ARTCCs, 3 CERAPs, 33 TRACONs, ATCSCC, 1 Support System at WJHTC
• Developmental and modified COTS software
CSS-Wx Benefit Categories

• Reduced costs to develop future custom weather interfaces
  – Provides a single source for weather data (“one-stop shop”)
  – Provide common standards for systems to utilize, removing the need for custom interfaces

• Reduced future infrastructure costs to support forecast data bandwidth needs
  – Allows user to receive only the weather information needed

• Increased weather access leading to reduced accidents
  – CSS-Wx will improve the availability of aviation weather information and forecasts resulting in improved situational awareness
CSS-Wx Products from NOAA

Numerical Forecast Model Data

Surface Temp (F)
Surface Wind (knots)
Vert Wind Prfl (no 2GYS)
Upper Air Temp (K)
Cloud Fraction > 0.65

Icing and Turbulence Forecasts

Satellite Images

METARS, TAFS
and other alphanumeric
## CSS-Wx Interdependencies

<table>
<thead>
<tr>
<th>Data / Service Providers</th>
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<tbody>
<tr>
<td>• Weather Radar; Sensor Systems; and Aircraft Observations</td>
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<tr>
<td>• FAA Telecommunications Infrastructure (FTI)</td>
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<td>• System Wide Information Management (SWIM)</td>
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<tr>
<td>• National Oceanic and Atmospheric Administration (NOAA)</td>
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<tr>
<th>FAA Data / Service Consumers</th>
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<tr>
<td>• NAS consumer systems, including:</td>
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<tr>
<td>– En Route Automation Modernization (ERAM)</td>
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<td>– Advanced Technologies and Oceanic Procedures (ATOP)</td>
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<td>– Time Based Flow Metering (TBFM)</td>
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<td>– Traffic Flow Management System (TFMS)</td>
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<tr>
<td>– Micro En Route Automated Radar Tracking System (Micro-EARTS)</td>
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<td>– Information Display System Replacement (IDS-R)</td>
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<td>• NAS Users, e.g. Collaborative Decision Makers, Traffic Management Unit (TMU)</td>
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<th>External to FAA Data / Service Consumers</th>
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<tr>
<td>• NOAA</td>
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<tr>
<td>• Department of Defense (DoD)</td>
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<tr>
<td>• Department of Homeland Security (DHS)</td>
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<tr>
<td>• Airline Operations Centers (AOCs)</td>
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<tr>
<td>• Weather Vendors / Other Authorized Users</td>
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<th>International</th>
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<tr>
<td>• Global harmonization with EUROCONTROL and ICAO through the use of standards</td>
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NextGen Weather Programs Support FAA Strategic Initiatives

Once implemented, CSS-Wx and NWP will:

• **Make aviation safer and smarter**
  – Improve standardization and data access
  – Enhance decision-making process

• **Deliver benefits through technology and infrastructure**
  – Achieve benefits of NextGen
  – Right-size the NAS

• **Enhance global leadership**
  – Transform our internal structure (e.g. stakeholder collaboration)
  – Ensure global Interoperability of NextGen
CSS-Wx Geospatial Data Access Services

• Web Feature Service (WFS):
  – Filtered access to non-gridded data formatted as XML (WXXM GML)
  – Provides Common Geospatial constructs for other NAS data (aeronautical, air traffic)

• Web Coverage Service (WCS):
  – Filtered access to gridded data formatted as NetCDF4
  – Uses OGC Reference Model

• Web Map Service (WMS):
  – Image of Weather data formatted as gif, png, jpeg, etc.

• Web Map Tile Service (WMTS):
  – Image of Weather data as set of tiles formatted as gif, png, jpeg, etc.
CSS-Wx Sample Weather Products

- **WCS (gridded data):**
  - NOAA model data, e.g. RAP, GFS, UKMET, NAM
  - AWC data, e.g. CIP, NCWD
  - NWP products, e.g. VIL, ET

- **WFS (alphanumeric data):**
  - AWC data, e.g. NCWF
  - Observations, e.g. MDCRS, METAR
  - NWP products, e.g. storm motion

- **WMS:**
  - NWP products, e.g. weather radar mosaics
  - Satellite image
  - Lightning data
  - NWS data

- **WMTS:**
  - Weather Radar/Satellite Imagery – Set of Tiles
Integrated Web Services Benefits

• OGC Web services provide standardized methods for filtered weather data transfer using modern standards

• Weather data transferred in standardized formats
  – netCDF-4 for gridded data
  – Weather Information Exchange Model (WXXM) and North American Weather (NAWX) for alphanumeric products

• Publish/Subscribe message pattern for continuous data transfer for automated systems

• SWIM interface provides a unified interface for NAS consumers weather access

• Reduced bandwidth utilizations by only transferring filtered coverage areas and one-to-many tiered design
CSS-Wx and NWP Accomplishments

• **CSS-Wx early success demonstrating viability of new technology**
  – Joint Capability Evaluations between multiple agencies
  – SOA Interface for limited set of weather Information

• **NWP planned extended convective weather capability demonstrated**
  – Utilized at operational facilities
  – Collected feedback from multiple agencies

• **Developed Government Furnished Information (GFI) Packages**
Joint Capability Evaluation (CE)

• Demonstrated capability for data exchange:
  – Ground-Ground between NOAA and FAA
  – Air-Ground between FAA and Aircraft
    • FAA CSS-Wx published weather data to Aircraft:
      – NOAA Web Services
      – WTIC turbulence research
    • Aircraft accessed via AAtS Data Management Service (DMS)

• Demonstrated NextGen Weather Capabilities
  – Providing common weather picture to aircraft as well as ground users
  – Enabling more proactive Pilot-ATC interaction
FAA/NOAA Joint Concept Demo
CSS-Wx: R&D Environment

• Weather for users in NextGen Prototype Network

• CSS-Wx Data Products
  – METARs (Routine Aviation Meteorological Report)
  – TAFs (Terminal Aerodrome Forecast)
  – NEXRAD (Doppler Radar)
  – PIREP (Pilot Reports)
  – AIRMET/SIGMET
  – Terminal Wind Forecast
  – Terminal Icing Probability and Severity Forecast
  – GTG (Graphical Turbulence Guidance)
CSS-Wx & NWP Procurements

• **Procurements are in progress**
  – Screening Information Requests (SIRs) released in January 2014
  – Contract awards after approval at Final Investment Decisions (FIDs)

• **Government Furnished Information (GFI) software packages are ready**
  – Developed CSS-Wx Web Services standards and corresponding software
  – Modified research algorithms into validated, reusable software modules for NWP
NextGen Weather Summary

- CSS-Wx and NWP programs are ready for implementation
  - NWP will generate advanced aviation weather products for NAS operations
  - CSS-Wx will provide NWP and NOAA products along with other weather data to FAA users via SWIM
  - Early risk reduction activities have taken place using SWIM

- NextGen Weather Systems will bring $2.9B user benefits with significant cost avoidance/savings