

NextGen Aviation Weather

--

FAA Overview

Presented to: Aviation Weather Community Forum

By: Rick Heuwinkel, Manager Aviation Weather
Plans and Requirements, FAA

Date: April 15, 2009



Federal Aviation
Administration



What's the Problem?



Weather's Impact on Operations

Delays

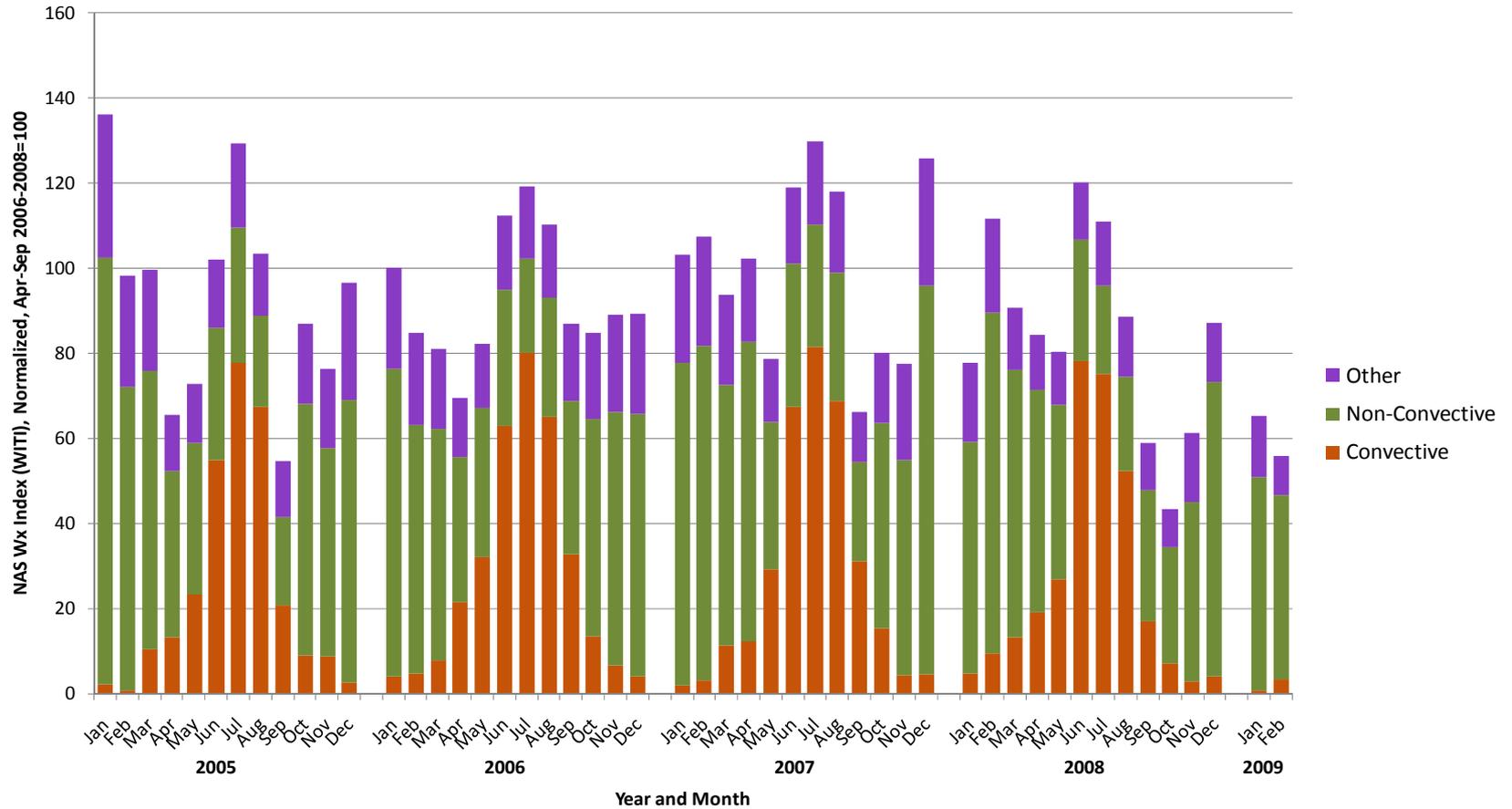
- 70% of delays attributed to weather
- \$28 billion lost annually from commercial delays

Safety

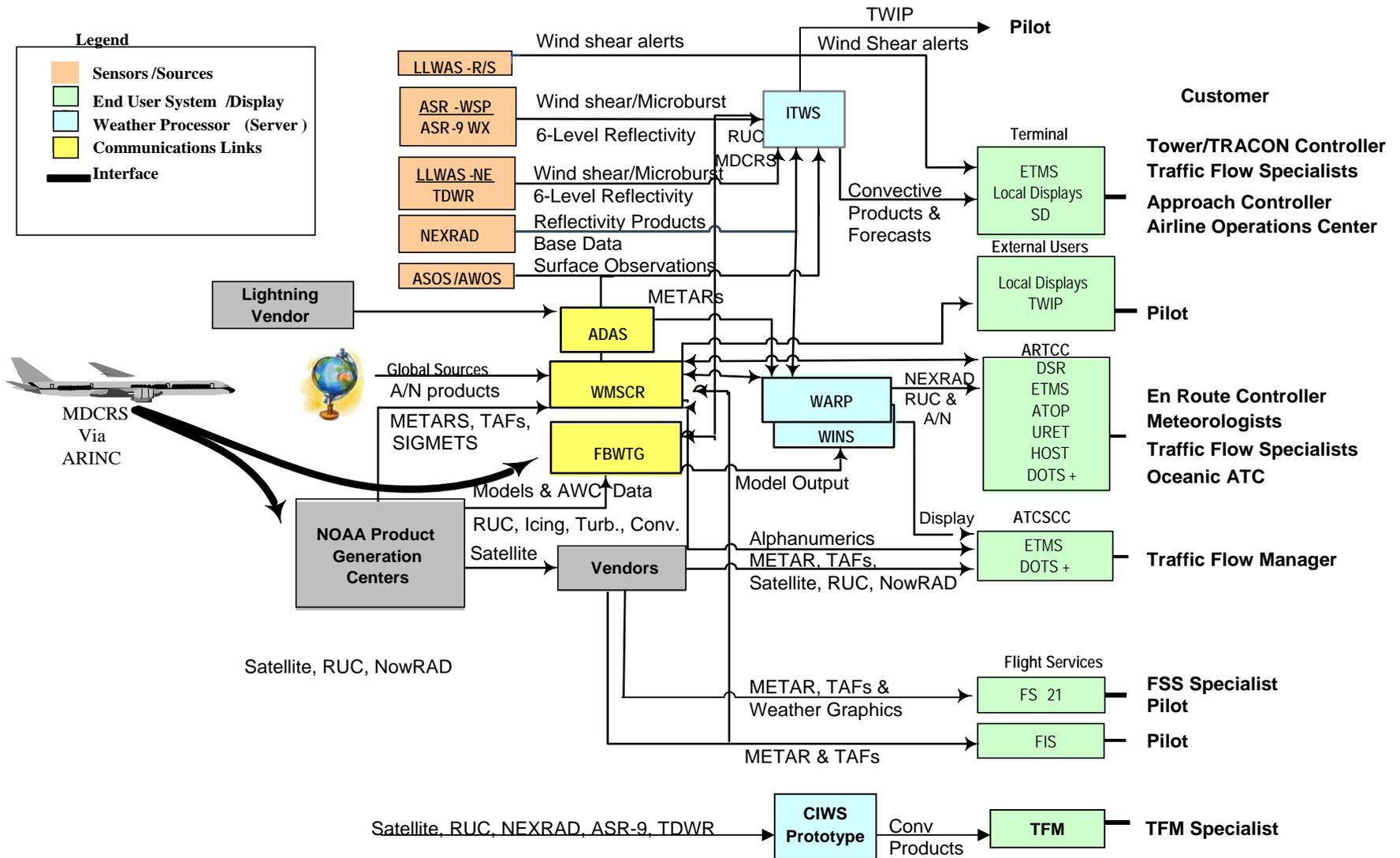
- 14% of GA accidents
- 34% of GA fatalities



NAS Wx Index (WITI) Breakdown by Cause, Monthly Averages, Jan 2005 - Feb 2009



Today Weather is Complex

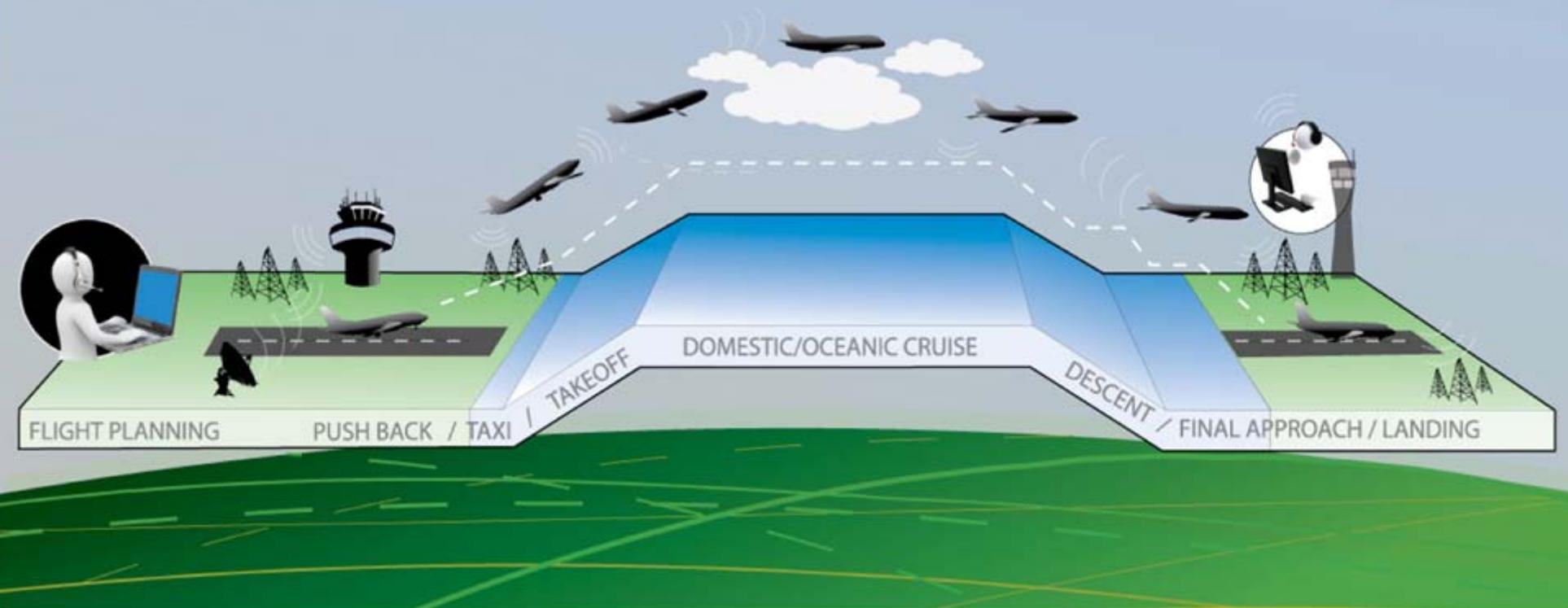


What's the Strategy?



NextGen's Weather Goal

Provide effective weather information to operational decision makers (human & machine) in the NAS to reduce the adverse safety and efficiency impact of weather in every phase of flight.



Evolution

2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

NextGen Weather Information Concepts	NextGen Weather Information Initial Capability	NextGen Weather DSTs Proactive Weather Decision Making	Full Integration of Weather Information into NextGen Operational Decisions
Align Agency Policy and Resources	Build Initial 4-D Weather System	Optimize 4-D Weather System	Integrate/Manage
<ul style="list-style-type: none"> - Aligned research and acquisition plans - Developed concept of operations - Developed requirements - Established inter-agency collaboration - Defined alternatives - Conducted inter-operability demo - Defined enterprise architecture 	<ul style="list-style-type: none"> - Develop weather info protocols & standards - Develop & implement initial 4-D Wx Data Cube - Populate initial 4-D Wx Data Cube with targeted operational data sets - Transition advanced forecast algorithms from research to operations - Begin NextGen Weather Processor (NWP) migration - Initiate integration of weather into ATM decision making 	<ul style="list-style-type: none"> - Mature 4-D Wx Data Cube--(SAS, full grids, all parameters) - Field advanced forecasting capabilities (longer range, more accuracy, finer resolution) - Integrate weather information into selected DSTs - Complete migration of legacy systems into the NWP - Implement initial right-sized sensor ground observing network 	<ul style="list-style-type: none"> - Implement national weather radar replacement network - Finalize right-sized sensor ground network - Fully integrate weather information into automated decision making



NextGen Weather

Today

- Weather forecasts not integrated into Decision Support Systems
- Low time and space resolution
- Fixed graphic or text product formats
- Limited specialized access
- Point-to-point communications
- Inconsistent weather information
- Fragmented approach to aviation weather

NextGen

- **Weather information completely integrated into DSTs**
- Required time and space resolution
- Interactive digital data formats
- Universal common access
- **Net-enabled information sharing**
- Consistent weather information
- Comprehensive and consistent approach to aviation weather



What Are the Solutions?



Four Key Thrusts to Reduce Weather Impact

NNEW

Integrating weather information into operational decisions

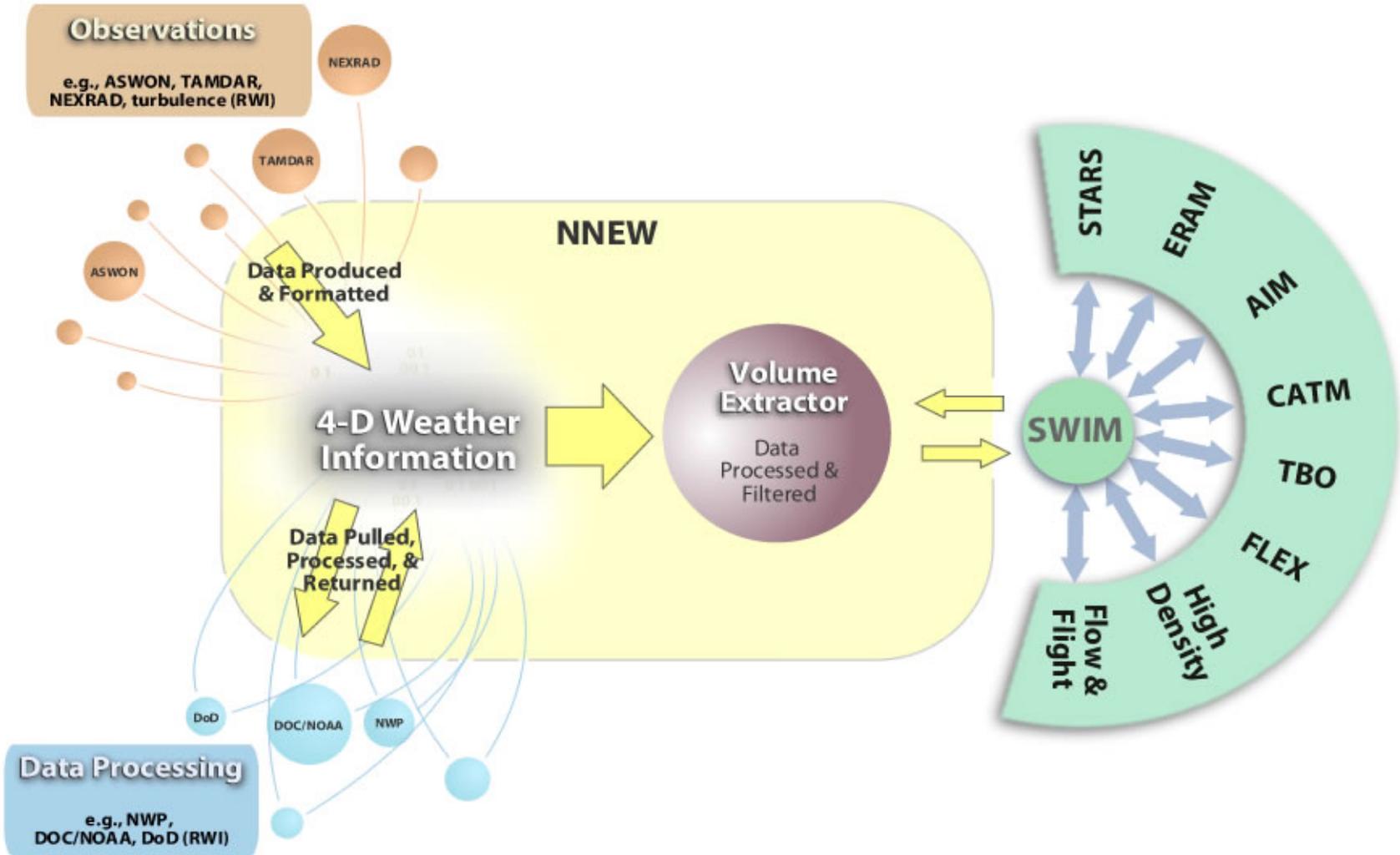
RWI

Improving
Weather
Observation

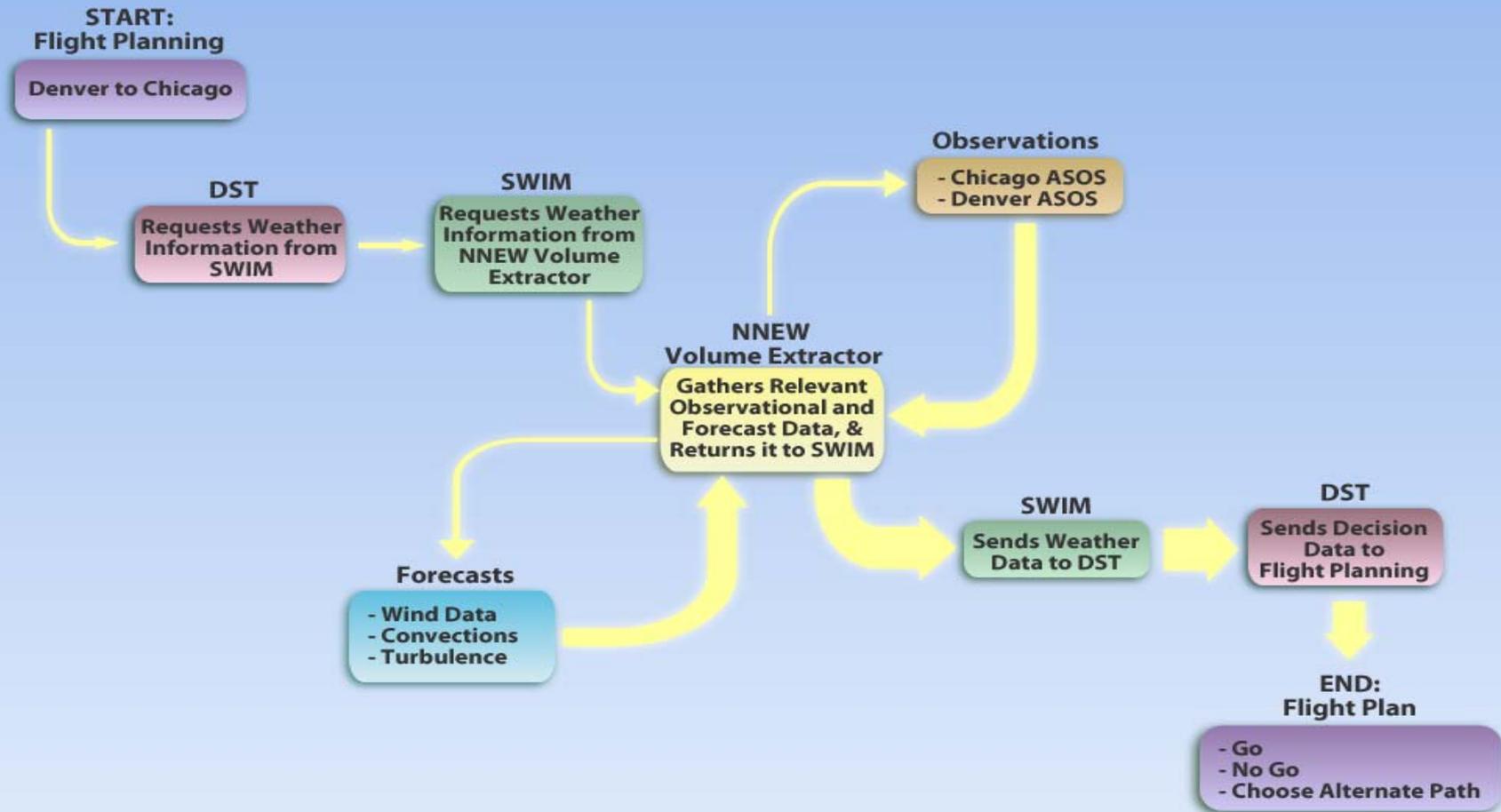
Improving
Weather
Forecasts

Improving access
to crucial weather information

RWI/NNEW Provides Weather Information



RWI/NNEW Use Core SWIM Functionality to Provide Weather Information to Users



Weather in the Cockpit Program (WTIC)

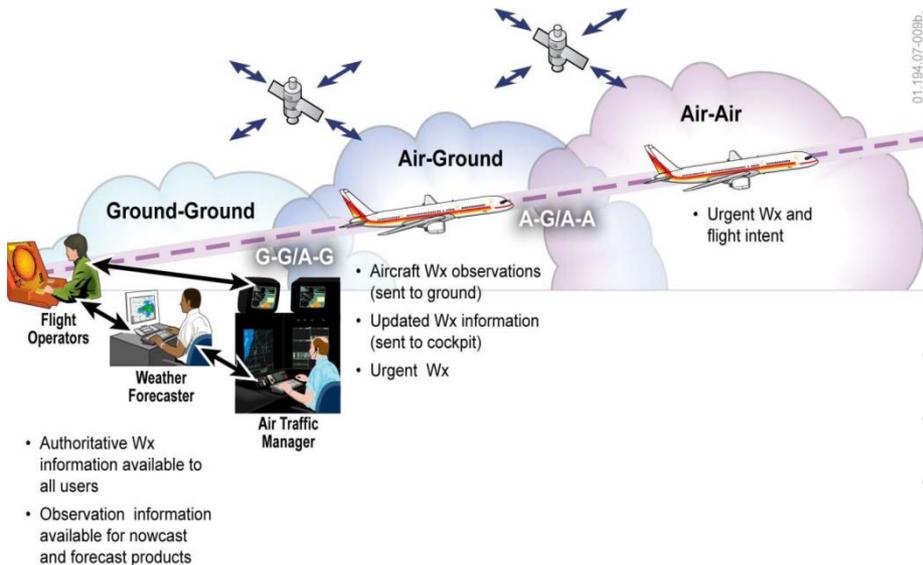
Ground-Air Provision of Weather Information for:

- Flight Re-planning
- Tactical Hazard Avoidance
- NextGen Operations Compliance, e.g., TBO, CDA

Air-Ground Provision of In-Situ Observations for:

- Use by ATC, TFM, Dispatchers
- Bounce to Other Aircraft
- Ingest into Analyses/Forecasts

Air-Air Alerts to Nearby Aircraft



What Are the Components?



Improving Weather Observations



Focus:

Enhancing operational decision making through improved knowledge of the current state of the atmosphere

- New sensor technology and enhancements
- Right sensors, right places, right data (optimization)
- Reduce lifecycle cost through consolidation of surface sensors

RWI: Observation Improvements

Improving Weather Forecasts



Focus:

Enabling better decision making by integrating improved weather information into decision support tools.

- Tailor forecasts to aircraft types & configurations (e.g., Eddy Dissipation Rate for DAL 737 fleet turbulence)
- Provide weather forecasts with high confidence level
- Reduce lifecycle costs by moving to NAS optimized processing from domain focused processors

RWI: Forecast Improvements

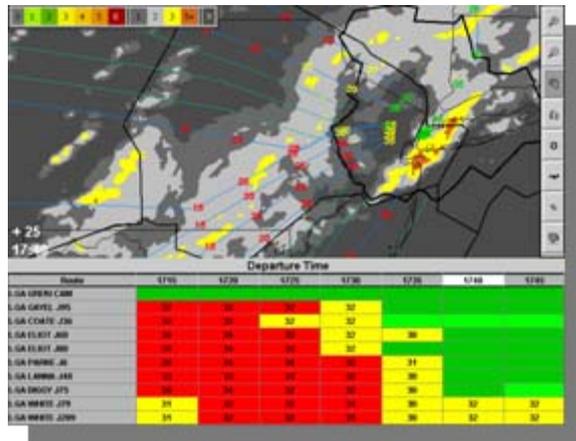
Integrating Weather into Decision Making

High Density, Flexible Terminal, TBO, and CATM introduce new operational capabilities for increasing capacity and efficiency.

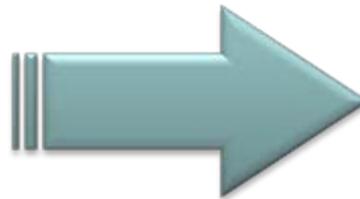
To maximize benefits:

- Identify, process and request for weather information
- Integrate that information into decision making processes and tools

RAPT: Wx and Routes



IDRP: Adds Flight Specifics & Traffic

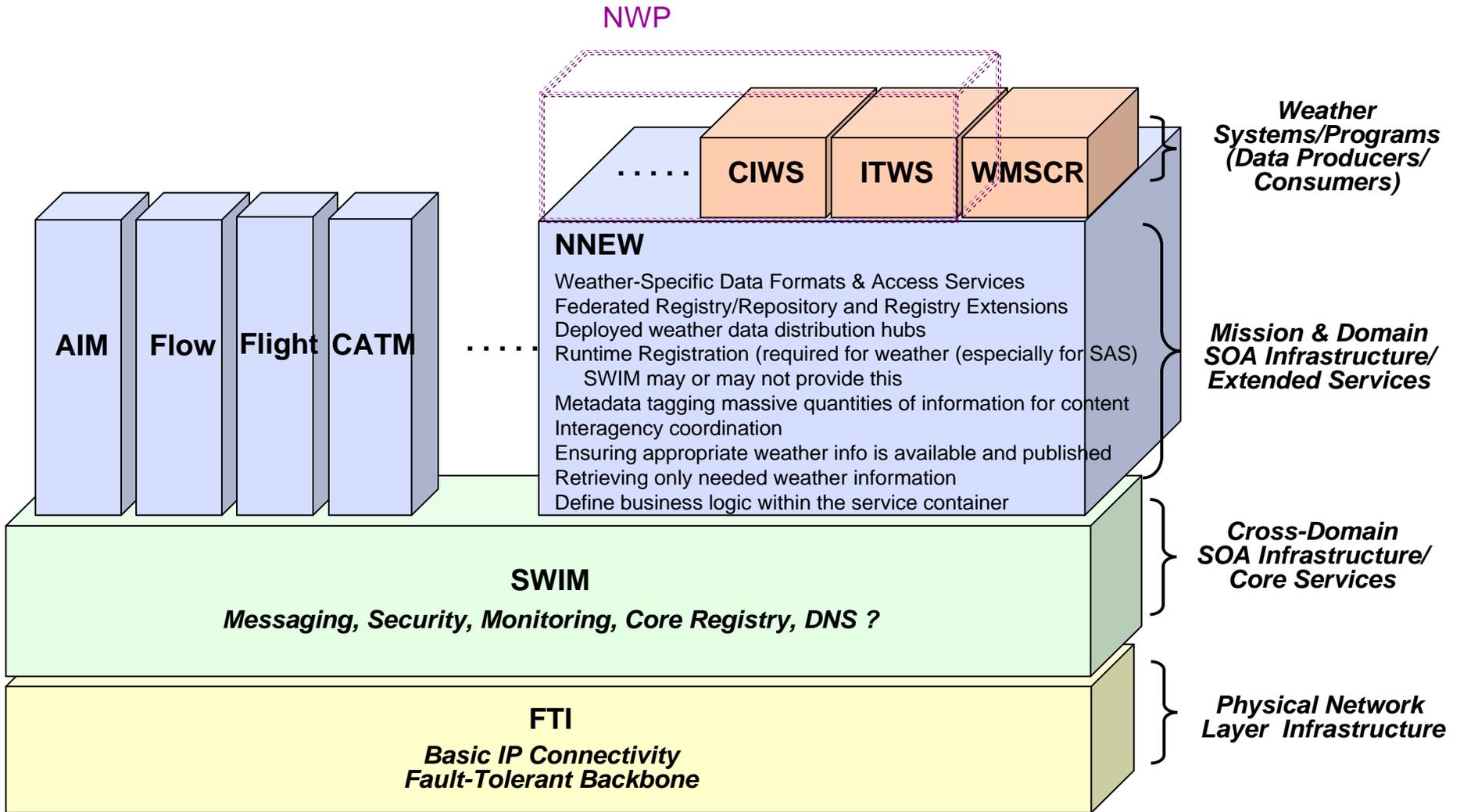


Account ID	Origin	Destination	Clearance Fix	Route	Sector	Departure Time	Departure Time Slot
ALG701	JMS	COE	PHOTO	J36	ZNY36	1810	
ALG710	LGA	SPB	PHOTO	J36	ZNY36	1810	
ALG715	LGA	SEA	PHOTO	J36	ZNY36	1810	
COG400	JMS	LGA	PHOTO	J36	ZNY36	1810	
COG404	LGA	COE	PHOTO	J36	ZNY36	1810	
COG410	JMS	SPB	LAWA	J40	ZNY40	1810	
COG412	JMS	ATL	LAWA	J40	ZNY40	1810	
COG415	JMS	SEA	LAWA	J40	ZNY40	1810	
COG420	JMS	AUS	LAWA	J40	ZNY40	1810	
ALG710	LGA	SPB	LAWA	J40	ZNY40	1810	
COG410	LGA	COE	LAWA	J40	ZNY40	1810	

	1810	1830	1850	1910	1930
LGA10030	1	0	1	1	2
LGA10070	2	1	2	3	1
COG400	2	1	0	2	1

RWI: Forecast Improvements

NextGen Infrastructure Program Stack (Long-Term Outlook)



What's Our Progress?



Deliverables/Schedule for Segment 1

- **Integrated Weather Strategy V1.0**
 - Cross-disciplinary team to develop
 - Due to NextGen Executive Weather Panel by Sept. 30, 2009
- **Interagency NextGen Weather Plan**
 - FAA, DoD, National Weather Service, Industry
 - Delivered to NextGen Executive Weather Panel March 31, 2009
- **NextGen Weather Demonstrations (examples)**
 - 0-6 hour convective weather forecast
 - Limited HITL (FY09)
 - Real-time operations (FY10)
- **Final Investment Decision for Segment 1, 2011**
- **Initial Operating Capability, 2013**



Major Accomplishments

- **Stand up multi-agency NNEW virtual program office**
- **Continue NNEW standards identification and development**
- **Document NextGen wx requirements**
- **Lab demonstration of 0-6 convective product**
- **RWI and WTIC planning**
- **Begin analysis for alternative processing architecture**
- **Integrative planning begun**



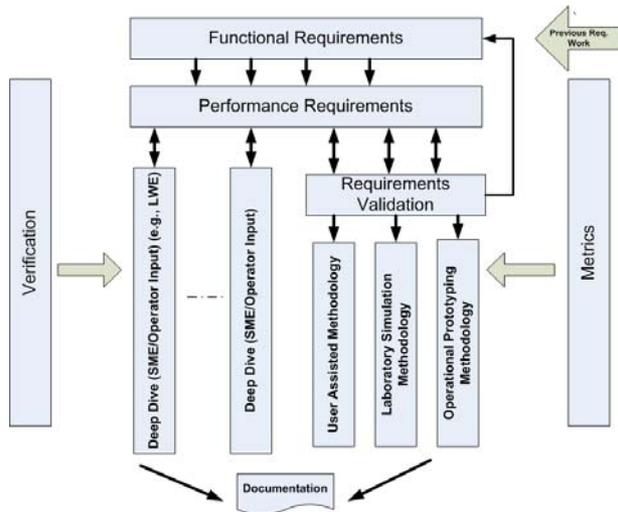
Questions



Backup Slides



NAS Requirements



Description of Program

- Refinement and validation of weather performance requirements for NextGen
- Development and coordination of the plan for integration of weather into TFM processes and tools
- Establishment of improved processes and procedures for transition of research products into operations and to implement changes and improvements to existing weather products
- Development of policies in the areas of NNEW, RWI, and WTIC, including definition of Domain Authority functions and safe use of gridded information within network enabled operations concepts
- Ensuring FAA harmonization with ICAO and SESAR

FY 2008 Accomplishments

- Completed NAS-wide Weather Functional Requirements Definition with Chief Systems Engineer
- Defined/Assigned Domain Authority Functions (continue into 09)
- Gained agreement with EUROCONTROL on concept for Weather Exchange Model
- Developed and gained interagency executive approval of the Weather Data Cube concept composed of a Regulatory, a Single Authoritative Source, and other related subdomains
- Completed preliminary requirements for weather information support to airline ground de/anti-icing operations

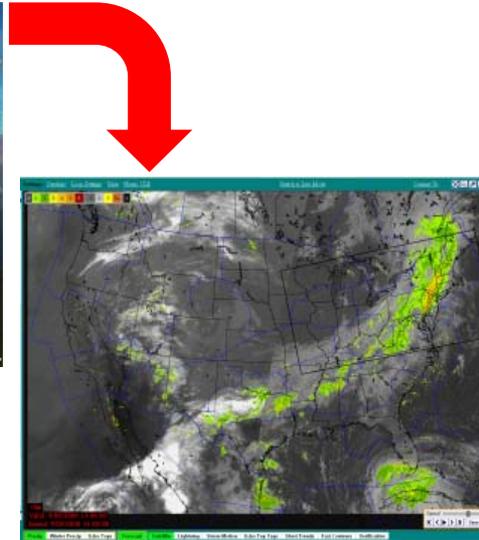
FY 2009 Planned Tasks

- Convene JPDO Policy Team with Domain Authority and SAS Proposal
- Develop regulatory concept that assures safe use of gridded information
- Complete streamlined Aviation Weather Technology Transfer Process geared to NextGen
- Reach agreement with EUROCONTROL for aligning ICAO SARPS and guidance with NextGen/SESAR
- Develop ICAO Strategic Plan to align NextGen, SESAR, and ICAO weather standards
- Develop metric for calculating avoidable delays, cancellations, excess fuel burn, and diversions

Aviation Weather Research Program



Aviation Wx Hazards



Aviation Wx Info

Description of Program

AWRP helps achieve the FAA's strategic goal of increasing aviation safety by reducing the number of accidents associated with hazardous weather conditions, while increasing capacity by reducing the impacts of adverse weather events on the operational capacity of the NAS. AWRP is performing the research to address enablers identified in the JPDO IWP including: Weather Forecasts - Consolidated icing, turbulence, etc., Foundational breakthroughs in atmospheric science, and Network-enabled weather information. Research efforts undertaken in collaboration with the NWS and NASA increase the FAA's ability to provide improved short-term and mid-term forecasts of naturally occurring atmospheric hazards, such as turbulence, icing, severe convective activity, and restricted visibility to meet current and regulatory requirements.

The AWRP develops new and improved weather algorithms for implementation on NAS and NWS platforms.

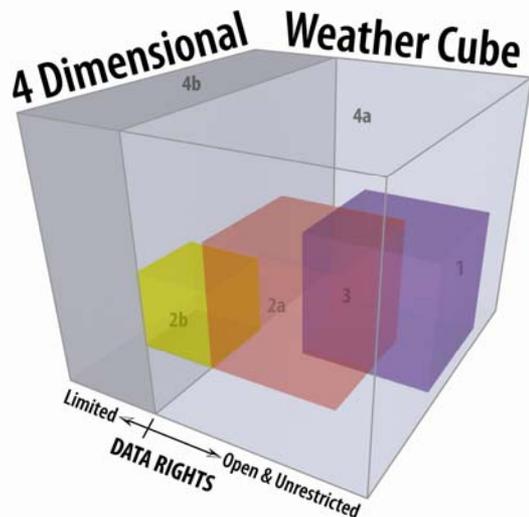
FY 2008 Accomplishments

- Implemented Turbulence Detection Algorithm into NEXRAD OPS
- Migrate CIP/FIP Algorithms – AK on the NAM over to the WRF RR
- Implemented experimental WRF rapid refresh model at NOAA GSD
- Supported the Graphical Forecast Evaluator (GFE) that included the FIP-severity
- Research Convective Forecast demonstration of 0-6 hour Advanced Storm Prediction capability for NE corridor
- Refinement of the agile selection process used in the CONUS Deterministic Forecast product
- Developed requirements for extension of RTVS new framework to SWIM architecture

FY 2009 Planned Activities

- Forecast Icing Product - Severity approval for operational readiness on ADDS
- Graphical Turbulence Guidance-2 (FL100+) approval for OPS readiness on ADDS
- In-Situ turbulence algorithm implemented on DAL 737 fleet
- Demo w/Delta Airlines (DAL) to verify increased safety & capacity, & cost savings assoc'd w/in-situ turb data utilization by DAL flight ops
- Demo 0-6 hour Advanced Storm Prediction capability for NE corridor at command center
- Conduct testing of WRF rapid refresh at NCEP
- Develop prototype Network-Enabled Verification System for meeting SWIM architecture requirements

NextGen Network Enabled Weather



Description of Program

- NextGen Network Enabled Weather (NNEW) is the FAA Program that will define and provide the infrastructure for the FAA's portion of the interagency 4-D Wx Data Cube. The 4-D Wx Data Cube will provide common, universal access to aviation weather data. The 4-D Wx Data Cube consists of (1) weather data published in various databases within NOAA, FAA, and perhaps DoD, and commercial weather data providers that may participate; (2) registries/ repositories needed to locate and retrieve published data; (3) the capability to translate, using ontologies, among various standards that will be employed, and to provide data to users in their choice of units and coordinate systems (e.g., the NAS plane); and (4) the capability to support retrieval requests for data (such as along a flight trajectory). A subset of the data published to the 4-D Wx Data Cube will be designated the Single Authoritative Source (SAS). The SAS is that data that must be consistent (only one answer) to support collaborative (more than one decision maker) air traffic management decisions.

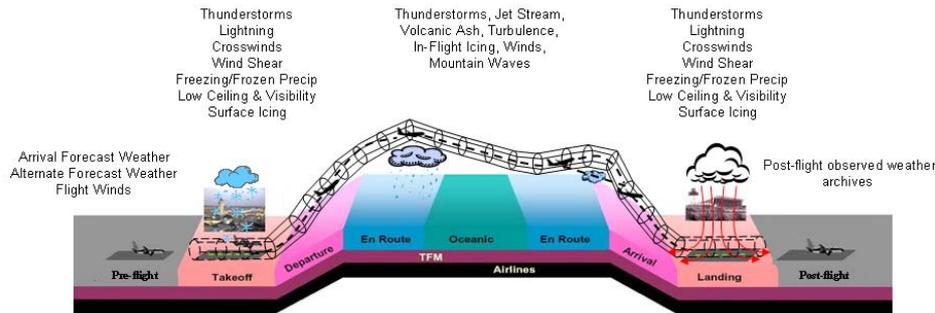
FY 2008 Accomplishments

- Completed CRD Documentation
- Made decision to adopt OGC standards within FAA
- Procured JET node and installed it at the WJHTC
- Developed and worked within OGC to incorporate a cross section extension to OGC WCS Standard
- Demonstrated capabilities of the virtual 4-D Wx Data cube in a developmental environment
- Developed Weather Specific Services Design Standards v1
- Developed Weather Product Data Format Standards v1
- Established detailed NNEW schedule
- Developed 4-D Wx Data cube IOC Plan (in conjunction with JPDO)
- Provided numerous briefings on NNEW
- Developed policy questions related to the 4-D Wx Data Cube
- Coordinated with other FAA programs (e.g., SWIM, FS, CIWS, ITWS, AIM) and the JPDO

FY 2009 Planned Initiatives

- Obtain Investment Analysis Readiness Decision (IARD)
- Conduct Initial Investment Analysis
- Conduct Interoperability demonstration with DoD/DoC
- Conduct real-time evals of Wx comms and 4-D Weather Data Cube
- Develop Weather Specific Services Design Standards v2
- Develop Weather Product Data Format Standards v2

Reduce Weather Impact



End-to-end Integration of Weather Information into Flight Trajectory

Description of Program

A portfolio of NextGen capability improvements to mitigate impact of weather in the NAS consisting of two major elements:

- **Weather Observation Improvements:** 1) Determine the right sensor mix among ground-based, airborne, and satellite atmospheric-sensing networks, 2) Improve resolution of weather sensor network, including development of phased array radar capability
- **Weather Forecast Improvements:** 1) integrate weather information tailored for decision support tools (DST) and systems into NextGen operations, 2) implement improved forecasts by transitioning advanced capability from aviation weather research, 3) develop metrics to evaluate the effectiveness of weather improvements in the NAS, 4) develop probabilistic forecasts which can be effectively used in traffic flow management, and, 5) determine most effective solution for a processor architecture to support these capabilities. RWI Weather Forecast Improvements will propose recommendations for transitioning for FAA legacy weather systems into NextGen.

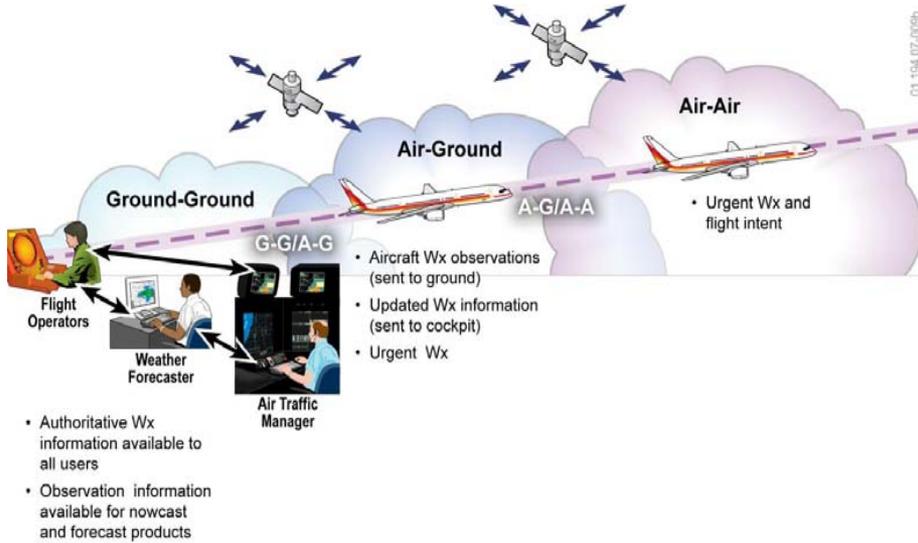
FY08 Accomplishments

- Developed initial statements of work for right-sizing weather observation network
- Generated Segment One definition and description of alternatives for the Concept & Requirements Definition

FY 2009 Planned Initiatives

- NAS legacy system migration architecture
- Demonstrate 0-6hr convective forecast in the NE corridor
- Investment analysis of alternatives
- Establish lab environment for NextGen Weather Processor (NWP)
- Right-size sensor network study
- Develop MPAR Concept of Use (ConUse) in preparation for Initial Investment Analysis for IOC
- Conduct 0-6 hour northeast corridor convective forecast

Weather Technology in the Cockpit



Description of Program

- The Weather Technology in the Cockpit (WTIC) program is the FAA R&D program to facilitate the development of cockpit, ground, and communications technologies, standards, and procedures to support common situational awareness and shared decision-making responsibility in the National Airspace System.
- The WTIC program will address ground-air and air-air communications, airborne sensors, cockpit displays, and integration of weather information into flight deck decision making processes for both machine-to-machine and machine-to-human interfaces.
- The WTIC program is comprised of five areas: Concept and Requirements Development, Technology Assessment, Proof of Concept Demonstrations, WTIC Prototype(s), and Policy, Standards, and Requirements development.

FY 2008 Accomplishments

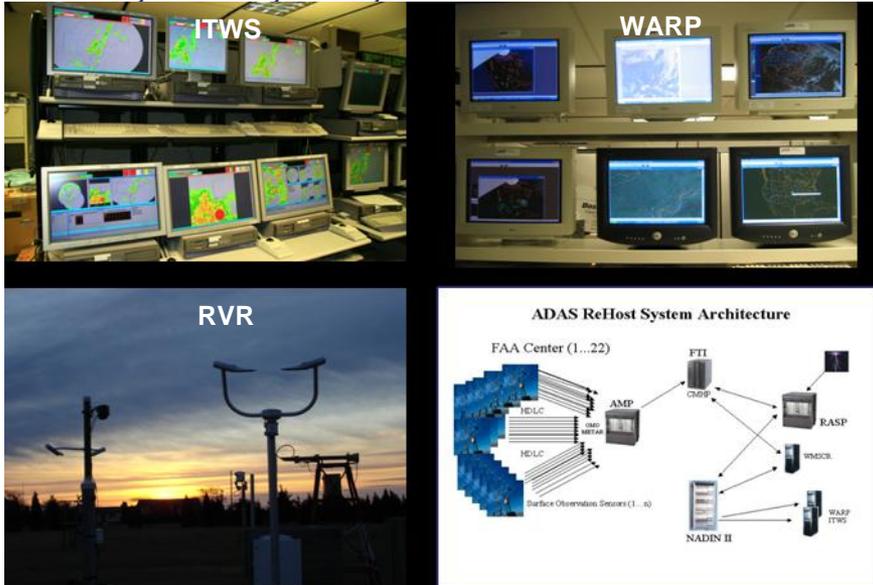
- New Start in FY09
- Began development of detailed R&D program plan
- Identified discreet tasks
- Began development of contract strategy and solicitation plan
- Developed FY09 and FY10 Spend Plan

FY 2009 Planned Initiatives

- Develop Concept of Operations specific to weather technology in the cockpit in the NextGen environment
- Assess available onboard Wx information processing technology
- Assess currently available and emerging ground and cockpit communications interface technologies
- Conduct research to develop airman training and evaluation criteria
- Conduct research to develop guidance to enhance use of forecast weather information in pilot decision-making
- Conduct research to evaluate procedures for integrating weather information into flight deck decision-making processes
- Initiate proof of concept and prototype development activities

Legacy Systems / Transition

ITWS, WARP, RVR, ADAS Re-Host and IDS-R



Description of System

ITWS: Fully automated, integrated terminal weather information system. Improves the safety, efficiency, and capacity of terminal area aviation operations. 37 systems (25 installed and 11 to be installed in 2009). Sixteen secondary and reliever airports will be added in FY10 and FY11 (SDs only, no additional PGs).

WARP: En-route weather system that provides NEXRAD mosaic information to the DSR and provides weather products to (CWSU) meteorologists and Traffic Management Specialists (TMU).

PC-RVR: Runway Visual Range (RVR) system measures the distance the pilot is expected to recognize runway markers and lights. PC-RVR uses Non-Developmental Item (NDI) software and hardware and is expected to exceed reliability, maintainability and availability of the RVR systems currently in use while retaining concepts that have proven successful with the NGRVR.

ADAS Re-Host: Replaces unsupportable hardware with scalable hardware to meet SWIM and NextGen goals.

IDS R: Competitive procurement for replacement of the obsolete IDS4 assets (2,230) workstations. IDS-R is a local and wide area network information collection, dissemination and display system that consolidates operational NAS systems and operational data into a single display for AT Terminal, En Route and DOD facilities

FY 08 Accomplishments

ITWS

- Conducted FAT (IND, LAS, MSY)
- Conducted Comms Testing (JAN/LIT, IND)

WARP

- Developed Publish/Subscribe client for SWIM Testing
- Conducted ECP-02 Beta System Test Phase 2
- Initiated FTI data circuit tests (Anchorage ARTCC to 7 NEXRADs)

PC-RVR

- Successfully completed Operational Testing (OT)

ADAS Re-Host

- Supported ADAS-Re-host development activities and simulation test too (System Wide Information Simulator (SWIS)) activities

IDS R

- Supported development of system specification for competitive procurement

FY 09 Planned Activities

ITWS

- Factory Acceptance Test (FAT) (8 sites)
- Communications Testing (8 sites)
- Site Acceptance Test (SAT) / CAI (8 sites)

WARP

- Complete FTI Testing
- Conduct testing of new WARP H/W & S/W for NEXRAD Radar Ops Center (ROC) Certification
- Conduct Regression Testing of WARP Build 11 (ECP-02)

PC-RVR

- Complete OT Quick Look and Final Reports
- Support Production Acceptance Test (PAT) and SAT

ADAS Re-Host

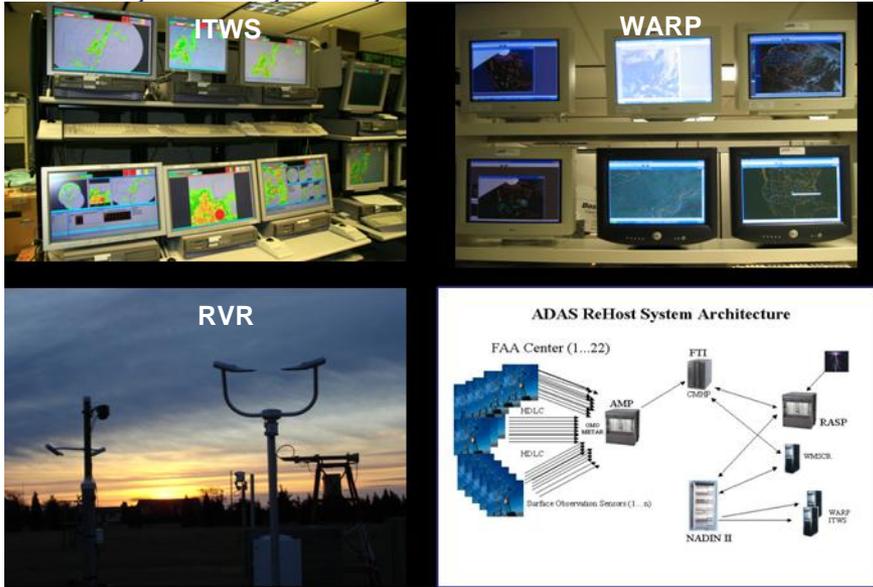
- Support software development of ADAS re-host
- Support SWIS software development

IDS R

- Establish IDS-R lab with winning vendors' prototype
- Develop simulators for system interfaces not available at the Technical Center
- Commence Testing of IDS Replacement

Legacy Systems / Transition

ITWS, WARP, RVR, ADAS Re-Host and IDS-R



Description of System

ITWS: Fully automated, integrated terminal weather information system. Improves the safety, efficiency, and capacity of terminal area aviation operations. 37 systems (25 installed and 11 to be installed in 2009). Sixteen secondary and reliever airports will be added in FY10 and FY11 (SDs only, no additional PGs).

WARP: En-route weather system that provides NEXRAD mosaic information to the DSR and provides weather products to (CWSU) meteorologists and Traffic Management Specialists (TMU).

PC-RVR: Runway Visual Range (RVR) system measures the distance the pilot is expected to recognize runway markers and lights. PC-RVR uses Non-Developmental Item (NDI) software and hardware and is expected to exceed reliability, maintainability and availability of the RVR systems currently in use while retaining concepts that have proven successful with the NGRVR.

ADAS Re-Host: Replaces unsupportable hardware with scalable hardware to meet SWIM and NextGen goals.

IDS R: Competitive procurement for replacement of the obsolete IDS4 assets (2,230) workstations. IDS-R is a local and wide area network information collection, dissemination and display system that consolidates operational NAS systems and operational data into a single display for AT Terminal, En Route and DOD facilities

FY 08 Accomplishments

ITWS

- Conducted FAT (IND, LAS, MSY)
- Conducted Comms Testing (JAN/LIT, IND)

WARP

- Developed Publish/Subscribe client for SWIM Testing
- Conducted ECP-02 Beta System Test Phase 2
- Initiated FTI data circuit tests (Anchorage ARTCC to 7 NEXRADs)

PC-RVR

- Successfully completed Operational Testing (OT)

ADAS Re-Host

- Supported ADAS-Re-host development activities and simulation test too (System Wide Information Simulator (SWIS)) activities

IDS R

- Supported development of system specification for competitive procurement

FY 09 Planned Activities

ITWS

- Factory Acceptance Test (FAT) (8 sites)
- Communications Testing (8 sites)
- Site Acceptance Test (SAT) / CAI (8 sites)

WARP

- Complete FTI Testing
- Conduct testing of new WARP H/W & S/W for NEXRAD Radar Ops Center (ROC) Certification
- Conduct Regression Testing of WARP Build 11 (ECP-02)

PC-RVR

- Complete OT Quick Look and Final Reports
- Support Production Acceptance Test (PAT) and SAT

ADAS Re-Host

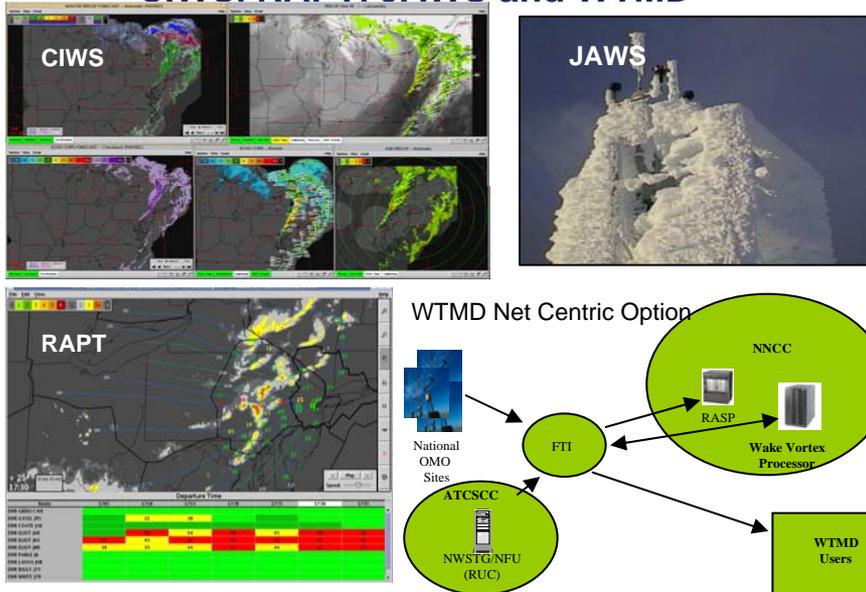
- Support software development of ADAS re-host
- Support SWIS software development

IDS R

- Establish IDS-R lab with winning vendors' prototype
- Develop simulators for system interfaces not available at the Technical Center
- Commence Testing of IDS Replacement

Prototype Engineering

CIWS. RAPT. JAWS and WTMD



Description of Program

CIWS: Improves traffic flow management tactical weather decision-making. Initially designed to provide Air Traffic and Airline Operations Centers with convective weather information along Great Lakes and Northeast Corridors, expanded to CONUS coverage in 2008.

RAPT: Integrates CIWS weather products into a Decision Support Tool (DST) that maximizes departure route use during convective weather.

JAWS: Provides alerts to address terrain induced wind shear and turbulence that adversely impact the Juneau airport.

WTMD: Current departure wake turbulence separation standards could be reduced with the implementation of WTMD. The intended sites are those with Closely Spaced Parallel Runways (CSPR). The planned WTMD system will ingest ASOS and RUC data by tapping into existing FAA interfaces.

FY 08 Accomplishments

CIWS

- Completed final Requirements Document (fRD)
- Finalized Business Case Analysis Report (BCAR)
- Began development of Transition Plan
- Began development of Configuration Management (CM) Plan
- Supported Prototype Re-engineering

RAPT

- Conducted 2008 Field Evaluations with MIT/LL
- Conducted data reduction and analysis (DR&A) of 2008 Field Evaluation Data
- Conducted User Group Meeting at New York ARTCC (ZNY)

JAWS

- Completed draft HF plans for planned operational evaluation
- Began development of HF procedures for operational evaluation

WTMD

- Developed and submitted proposal to develop WTMD in-house
- Participated in documentation development
- Support procurement efforts

FY 09 Planned Activities

CIWS

- Develop Quality Assurance (QA) Plan
- Complete CM Plan
- Complete Transition Plan for move of prototype from MIT/LL to WJHTC
- Continue to support Prototype Re-engineering

RAPT

- Support Development of Final Report for 2008 Field Evaluations
- Support 2009 Field Evaluations

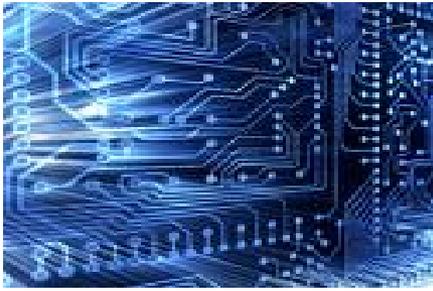
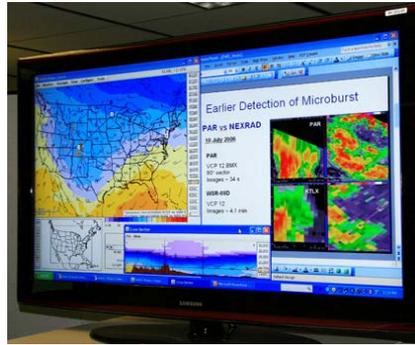
JAWS

- Finalize HF Plan and Procedures for operational evaluation
- Support Review technical documentation generated by NCAR.
- Develop Alert Accuracy Assessment Plan & Conduct Alert Accuracy Assessment
- Provide Alert Accuracy Assessment Report.
- Support AJW in developing JAWS-E Specification

WTMD

- Continue to support procurement efforts
- Participate in documentation development and RFP evaluations
- Support development of IRDs

NextGen Weather Evaluation Capability (NWECC) Labs



Description

Provides a laboratory environment for data ingest, integration and evaluation of weather data and systems (both legacy and prototype) in support of NextGen NNEW and RWI activities and goals.

FY 08 Accomplishments

NWEC

- Established initial NWEC lab capability
- Supported effort to define RTO process
- Began development of interfaces between NWEC and the NextGen Integration and Evaluation Capability (NEIC) Lab
 - Supported SWIM legacy adaptor development
- Conducted initial integration of airborne micro-server to NWEC lab (TAMDAR)
- Roadmaps
 - Provide direction and oversight of interface development
 - Provided support to the database and roadmap development

FY 09 Planned Activities

NWEC

- Develop Legacy Transition Plan
- Continue effort to define RTO process
- Integrate NextGen Evaluation Verification Services (NEVS) prototype capability into the NWEC lab
- Prototype WARP RAMP Mosaics to open system NWP
- Begin development of service adapters for legacy and other systems
- Develop capability to record and playback weather scenarios for distribution and display
- Continue Roadmaps Activities
- Expand weather ingest capabilities