

Eddy Dissipation Rate (EDR) Automatic Turbulence Reports

NBAA Program Overview – October 2009



Program Background

- FAA Program
- Builds on Delta's previous automatic turbulence reporting efforts
- Uses an open source metric - Eddy Dissipation Rate (EDR)
- Current phase of effort aimed at demonstrating "proof of concept" that automatic turbulence data can deliver benefits to an airline operation in the areas of safety, capacity and operational efficiencies
- EDR: Real time, scientific, objective ***aircraft independent*** measure of atmospheric turbulence, down linked via ACARS
 - Measures "Sea State" rather than vehicle response
- Data Coverage: Now on all Delta B737NGs, about 100 UAL airplanes, and soon, 327 B737NGs at SWA

Program Vision

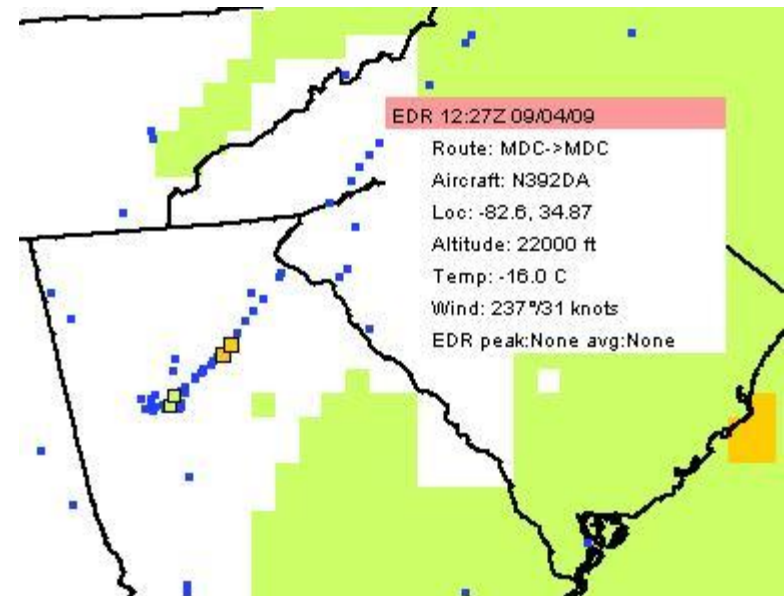
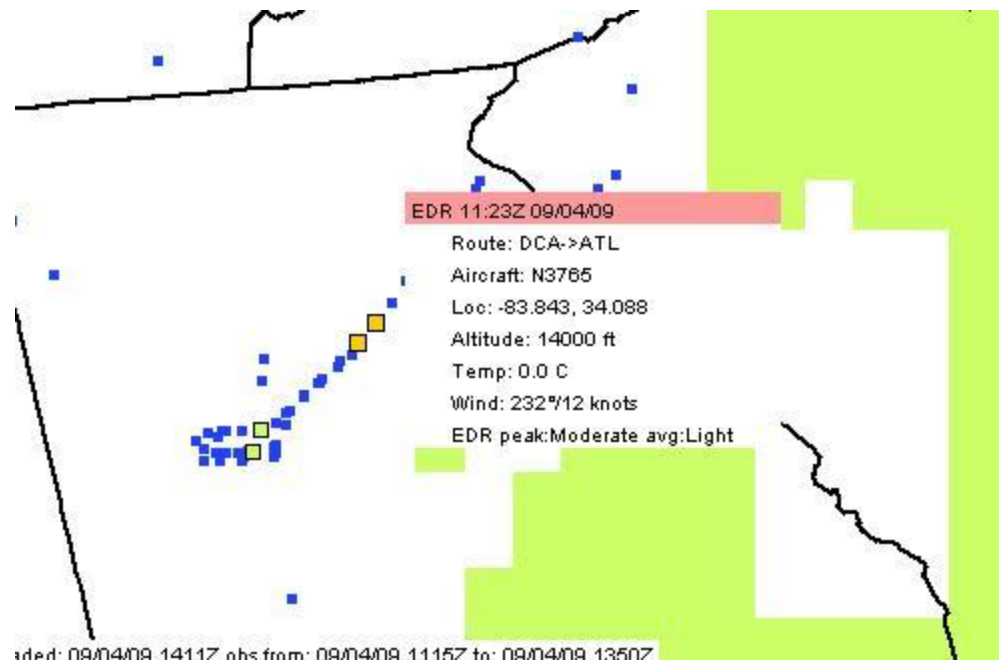
Better Data for Better Decisions

- More and Better Data to drive enhancements in:
 - Safety
 - Capacity
 - Operational Efficiencies
- Ways to improve
 - Recognize Limits of Current State - ATC chat room
 - Better communication = Push & Pull
 - Greater adherence to flight planned altitude
- Proof-of-Concept = Baby Step
 - Greater Integration Necessary

EDR Reports

2 Types

1. Threshold (Light turbulence or greater)
2. MDCRS/routine reports (provides data on smooth rides)



EDR and Alternative Approaches

- “Light, Mod...,” Terminology somewhat arbitrary
 - This terminology is based typically on aircraft response, but EDR defines atmospheric(sea state)
 - EDR thresholds are loosely calibrated to response of B757
 - Much better than current state (i.e. PIREPS)
- Turbulence Depiction different for alternative methods
- Conversion between Atmospheric State & Aircraft Response currently feasible
- EDR Viewer still evolving for all users

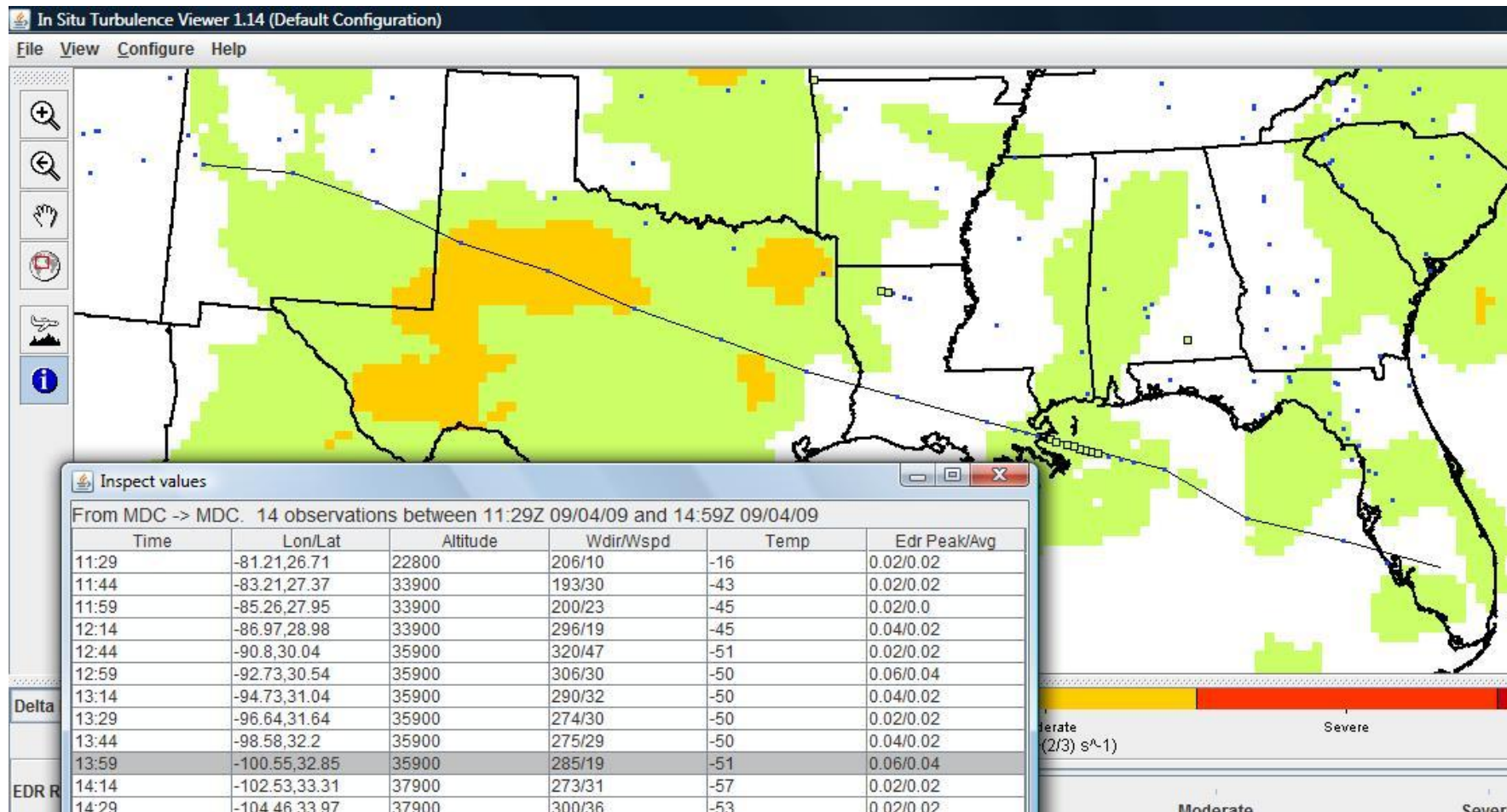
EDR Viewer

- Filters
- GTG2 – Appears to be much improved
- “Inspect Values” for history of EDR reported along the entire route of a given flight
- “Flight Path Tool” for Vertical Cross Section of EDR Data reported along a user defined route
- Viewer quirks and workarounds

Highlights & Challenges

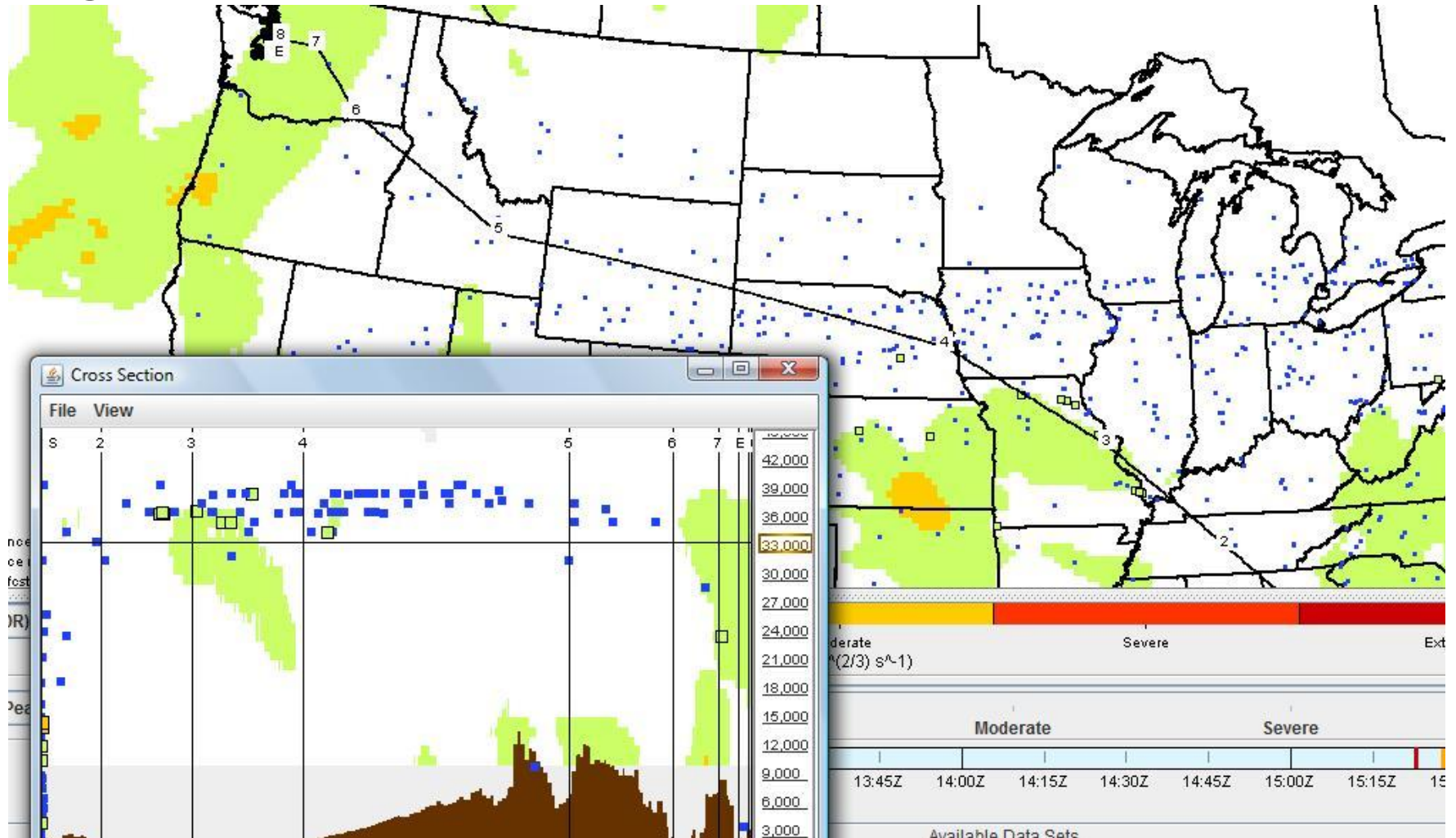
- Highlights
 - Dispatchers - More Numerous and Objective reports
 - Pilots – Dialogue with Dispatchers for reports
 - GTG2 - Valid 2hr fcst., but updates every hour
 - Data Collection – Better Understanding of Turbulence Issues
- Challenges
 - Better integration of Tool with Dispatch functions
 - Cockpit Displays for better Situational Awareness
 - Controller use of Data
 - Turbulence standards need to be established

Backup Slides - Inspect Values

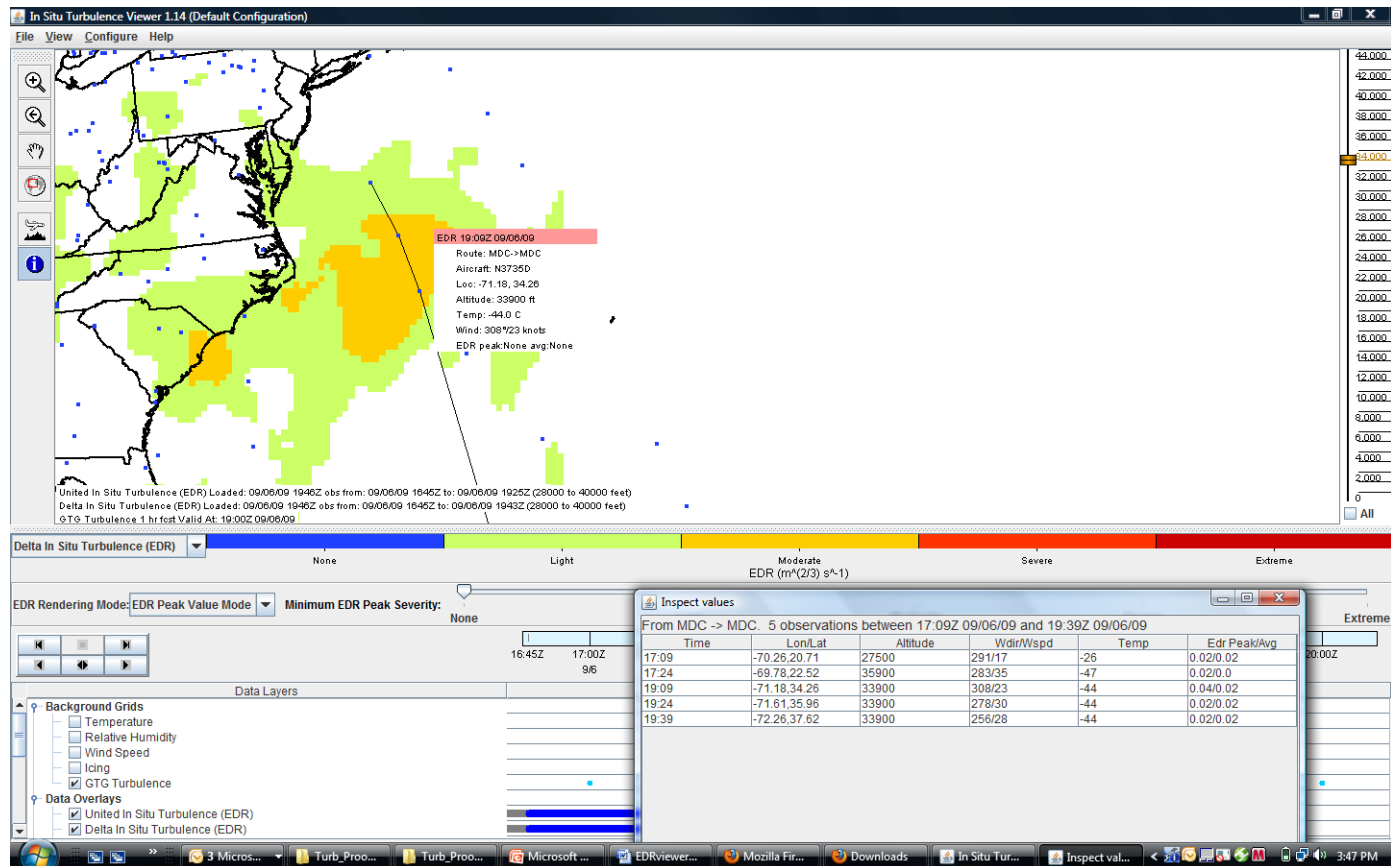


Backup Slides (continued)

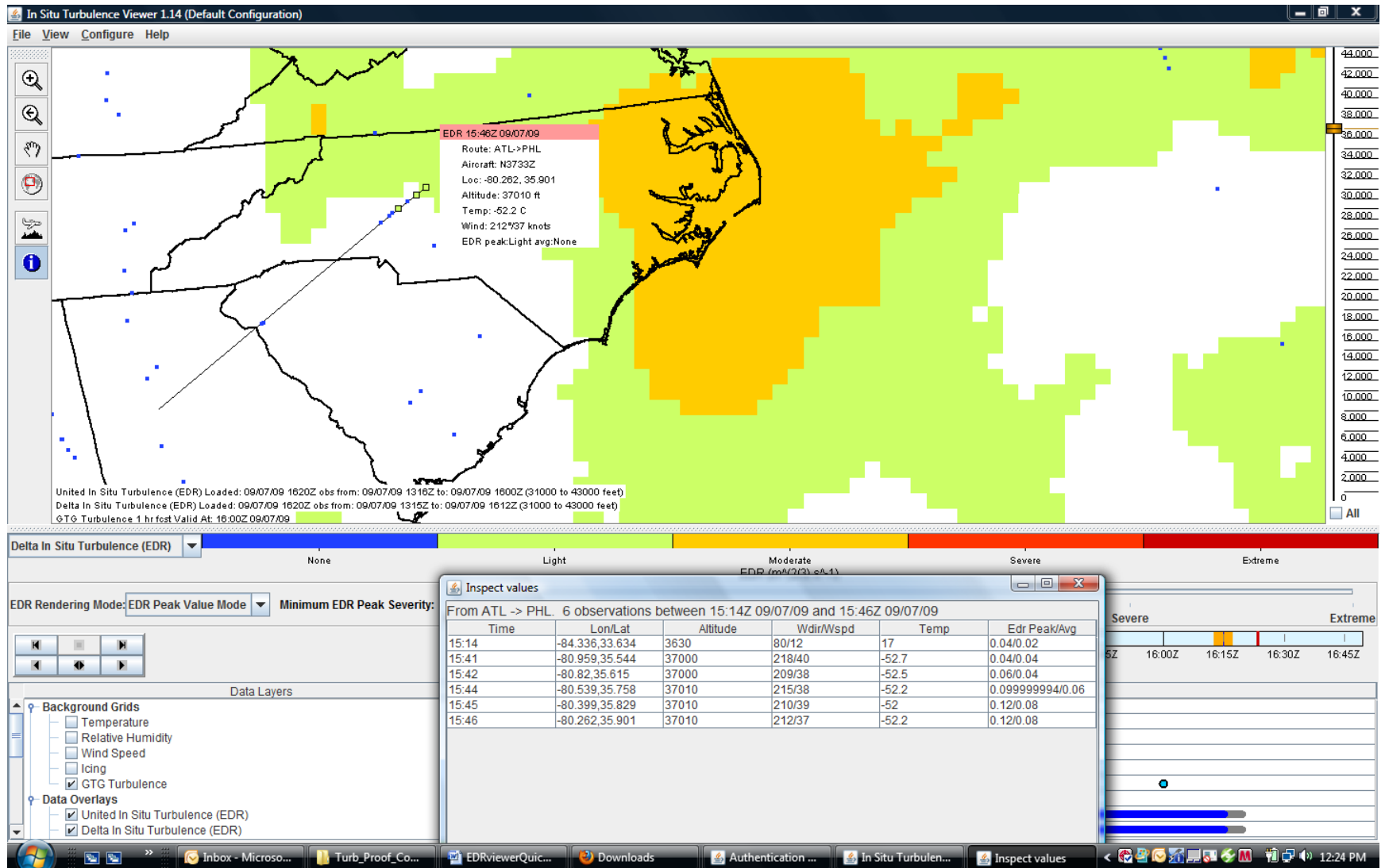
Flight Path Tool



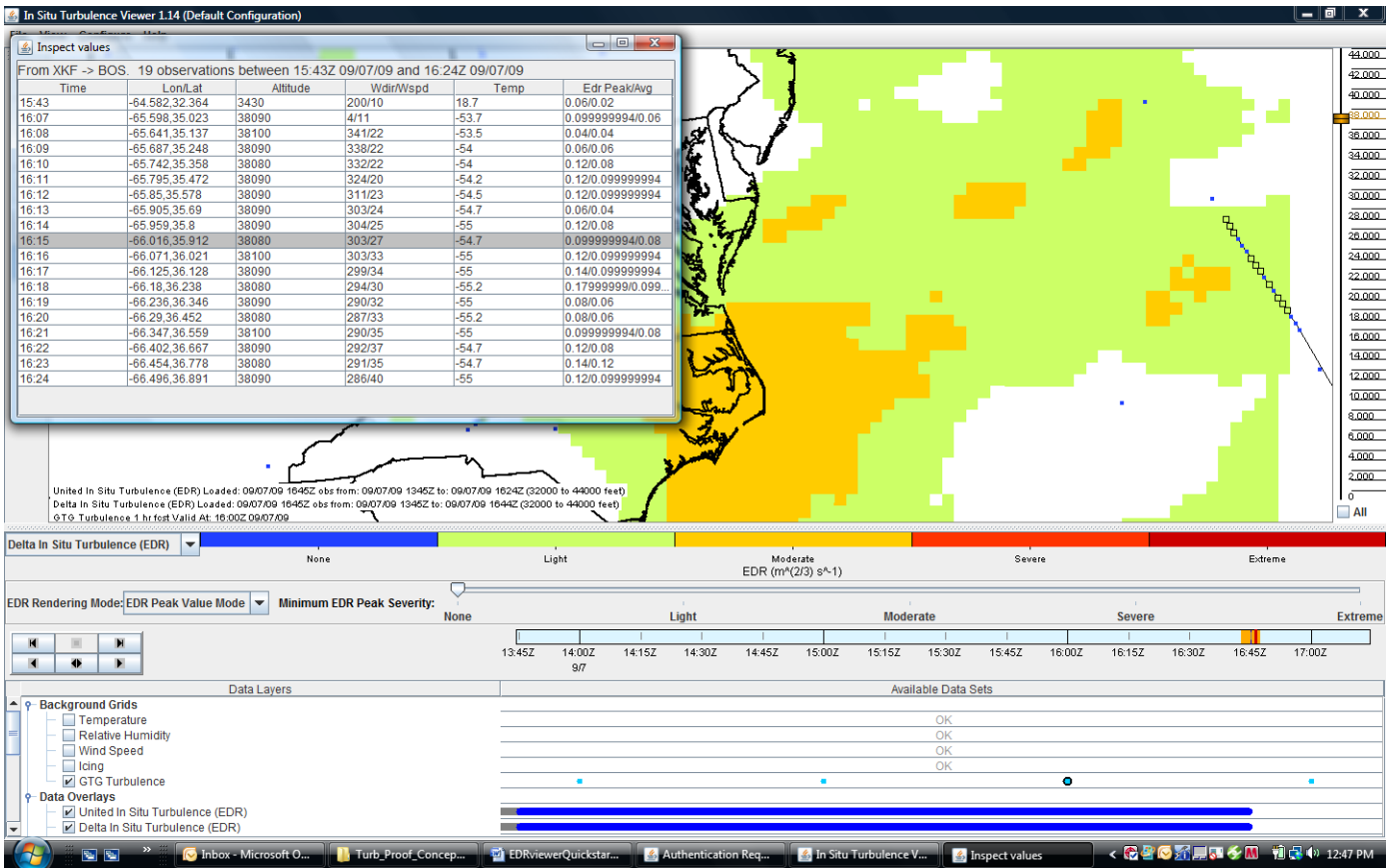
Tool for Dispatcher & Crew



EDR Flt Path vs. Fcst



EDR Viewer Summary



Air Traffic Organization



Federal Aviation
Administration

NextGen Demonstrations

*Presented to: NBAA Conference
By: Minh Nguyen, Ph.D*

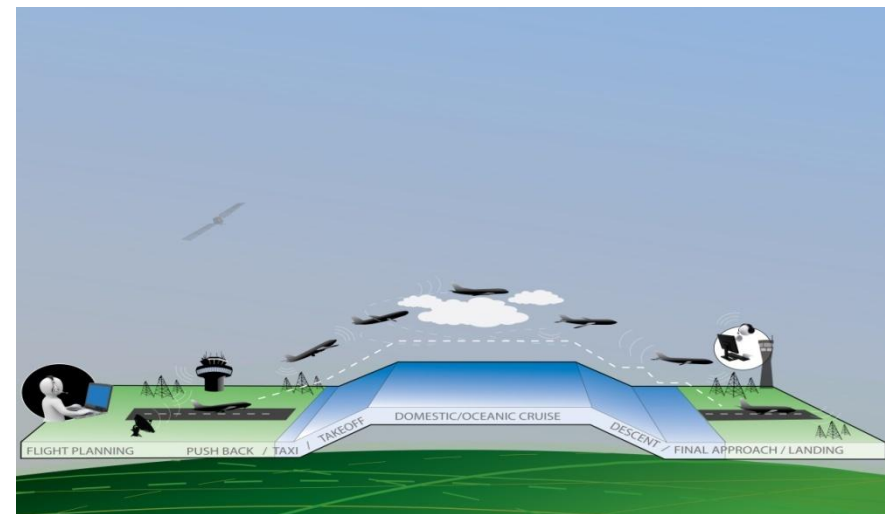
Advanced Technology Development and Prototyping
Group (AJP-67)

October 22, 2009



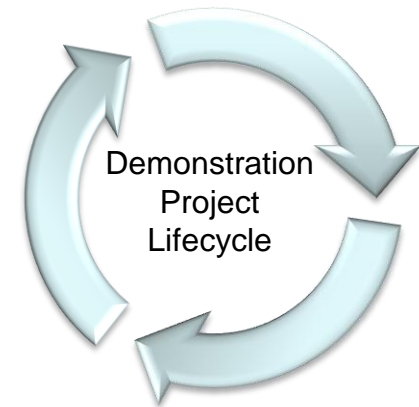
Purpose of NextGen Demonstrations

- ❖ Prove concept feasibility and support both validation and fast-time modeling
- ❖ Identify performance requirements
- ❖ Develop and refine operational concepts
- ❖ Collect data to support business case and investment decisions
- ❖ Provide early user benefits
- ❖ Promote industry involvement



NextGen Demonstration Objectives

- ❖ Clear Entry/Exit Criteria
- ❖ Demonstration Project Plan
- ❖ Identify environment, platform/systems, stakeholders and partners
- ❖ Target Decision Point(s)
- ❖ Funding Report



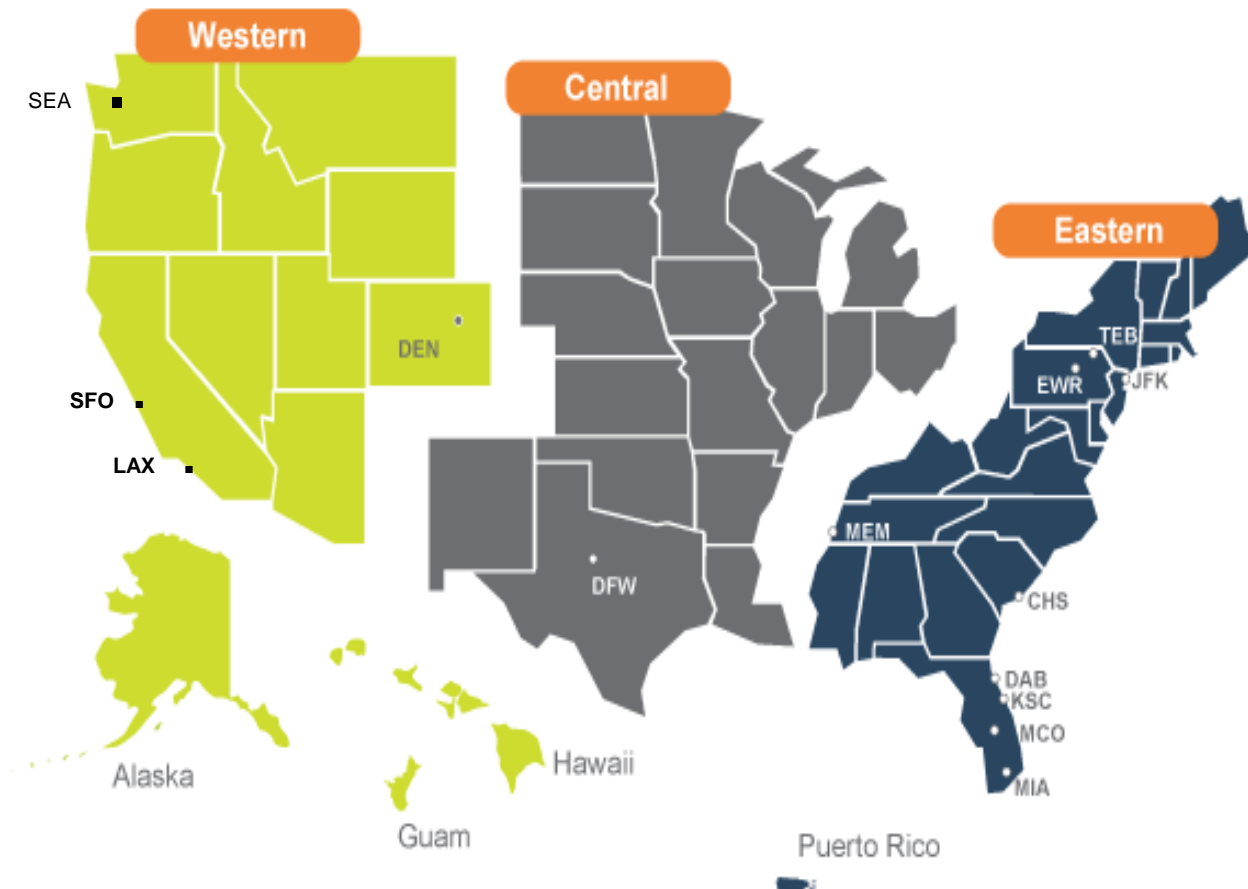
24 – 30 months

Demonstration Selection Process

Recommended Actions to Support NextGen:

- ❖ Establish a small group to propose demonstration projects. This “Demonstration Group” will be composed of representatives from each of the planning organizations (AJP, AJE, AJR, AJT and AJW)
- ❖ Look ahead 12–18 months or more. Focus on decisions requiring community buy-in in 4–5 years
- ❖ Link organizational needs and decisions related to implementations/investments
- ❖ Engage in proactive planning
- ❖ Support global harmonization across NextGen

FY09/10 Demonstration Locations



- Surface Management MEM, JFK, MCO
- Tailored Arrival: MIA, LAX, SFO
- 3D PAM: DEN
- Oceanic: MIA
- 4D FMS: TBD
- UAS: KSC, WJHTC
- Staffed NextGen Tower: DFW
- GBAS: EWR, TEB
- CSPO: TBD
- Wake: SEA
- CDA: MIA, CHS, ATL
- Flight Object: DAB
- Test Bed: DAB

NextGen Test Bed



Initiative:

- Establish real-world evaluation and demonstration environments for NextGen technologies and capabilities
- Identify and evaluate communications, navigation and surveillance solutions for the advancement of the National Airspace System (NAS)

Benefits:

- Provide NextGen rapid prototyping capability
- Integrate technologies from flight domains to allow multi-domain demonstrations
- Integrate and validate new & emerging technologies into existing or planned NAS enhancements
- Allow governed access for industry users, government, and academia
- Foster government – industry partnerships

Partners:

- Embry-Riddle Aeronautical University and ERAU industry partners
- MITRE Corporation

Schedule:

- Establishing contractual agreements with partners
- Preparing Draft Test Bed Concept of Operations
- Preparing Technology Governance documentation
- Coordinating with Test Bed stakeholders

Status:

- EC approval for Test Bed project (July 7, 2009)
- Project Level Agreement (PLA) signed Aug 13, 2009
- FY09 Test Bed Program Plan completed (Aug 15, 2009)

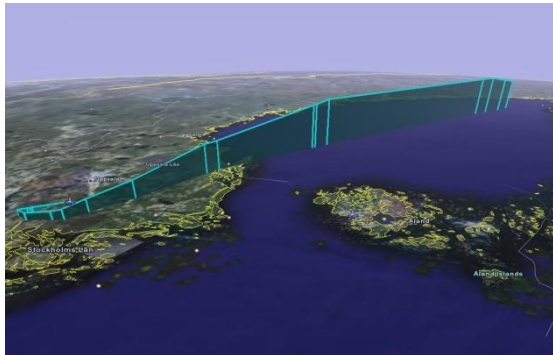
Test Bed Goals

- Build a microcosm of future integrated NAS environment
 - ATC Infrastructure / Airport / Aircraft
- Simulation environment to mirror test environment
 - Should determine “Gate-to-Gate improvement targets”
- Large scale between three geographic locations
 - Focus on Gate-to-Gate Trajectory Based Operation (TBO) testing between city pairs to validate simulations
- Alignment of NextGen programs to support test bed build out and build “layers” of potential “leave behind” capability
- Create “open” test bed environment to allow industrial base to innovate new ideas / capabilities – and allow FAA to focus them

Test Bed Benefits

- Integrate individual domains within the same facility space.
- Allow end-to-end (multi-domain) demonstrations.
- Allow NAS demonstration initiatives fostering government / industry partnerships:
 - Leverage on Centers of Excellence (CoE):
 - Embry-Riddle Aeronautical University.
 - ERAU OTA Consortium Industry Members.
- Support demonstration of NextGen components and interaction with existing and arising NAS systems.
- Assist incremental migration of NextGen components.
- Support integrated demonstrations to validate large scale modeling and simulation efforts.
- Allow for potential human-in-the-loop demonstrations
- Act as open development platform to analyze feasibility of new technologies.

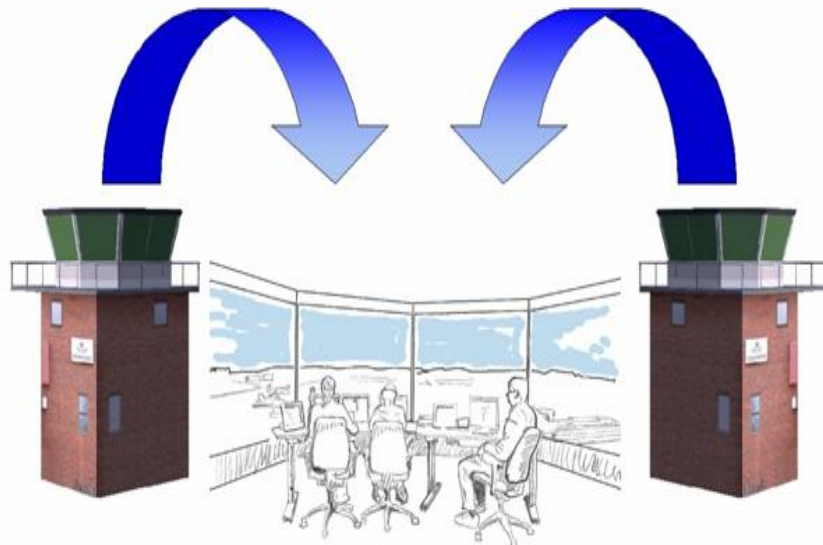
Demonstrations: International Air Traffic Interoperability



- **Initiative:** Series of demonstration projects aimed to assist the FAA in validation of 4D Trajectory Based Operations and Performance Based Air Traffic Management alternatives that promote safe, economical, and environmentally friendly ATM innovations
- **Benefit:**
 - Global harmonization of ATC infrastructure and advancement
 - Reduce environmental impact
- **Partners:** Boeing, Airbus, Air France, Air Europa, American, Delta, Qantas, United, Lufthansa, New Zealand, Airways New Zealand, Airservices Australia, Nav Portugal
- **Schedule:**
 - Conduct integrated oceanic/arrival operational trials in Atlantic from June-October 09
 - Conduct 6 months of ADS-C ops trials in Pacific starting early 2010
 - Conduct Gate-to-Gate demonstration flight(s) early CY 10
- **Status:**
 - ASPIRE flight 3 flown by UAL from Sydney to SFO in Nov 08
 - ADS-C ITP demonstration plan delivered Apr 09
 - Completed Oceanic optimization trials June-Sept 09
 - Web-Enabled CTP Concept of Operations delivered Apr 09

Demonstrations:

Staffed NextGen Towers (SNT)



- **Initiative:** SNT provides surface and tower services without the requirement for direct visual observation by ATC personnel from an airport tower cab
- **Benefits:**
 - Improves service during inclement weather and at night
 - Expands services to a significantly larger number of airports
 - Extends air traffic management tower services when towers close
 - Increases IFR throughput
 - Provides runway incursion awareness and prevention and the ability to see new runways obstructed from view of the tower cab
 - Provides flexible staffing through collocation
 - Reduces infrastructure operating and maintenance costs and tower construction
- **Partners:** ATO-Terminal, DFW, MIT Lincoln Labs
- **Schedule:**
 - Initial Field Demonstration Test Plan – Aug 2009
 - Initial Metrics Data Collection Plan – Sept 2009
 - Field Demonstration – Sept 2010/ Jan 2011
- **Status:**
 - Approved Research Mgmt Plan – Apr 2009
 - Field Site Final Selection – Mar 2009
 - DFW Kickoff meeting – Aug 2009
 - Test NCP Document – Dec 2009
 - Final Field Demonstration Test Plan – May 2010
 - Field Demo Test Procedures – July 2010

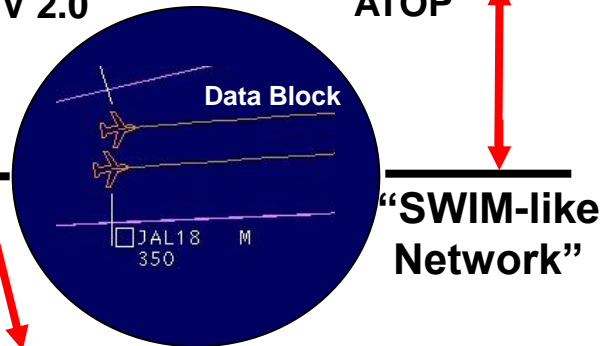
Demonstrations: International Flight Data Object



ERAM V 2.0



ATOP



Nav Portugal Santa Maria (Adacel Systems)

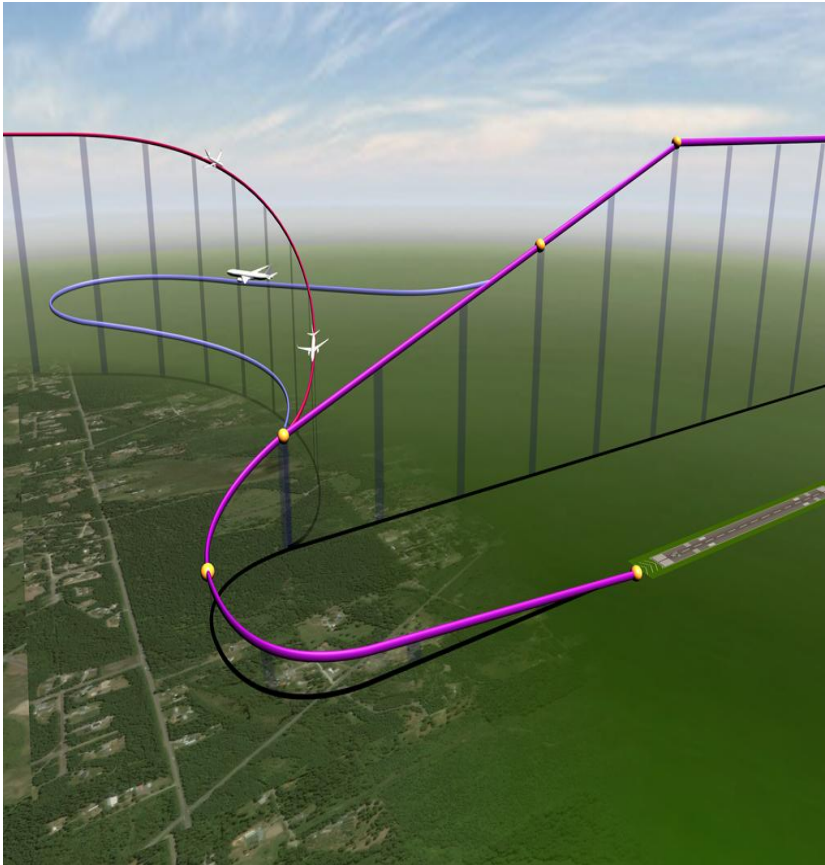
- **Initiative:** Integrated “disparate” domestic and foreign ATC systems through use of a common “SWIM-like” enabled “Flight Data Object”
- **Benefits:** Helps define requirements and ConOps for common data object across automation platforms
- **Partners:** “SWIM Alliance” partners (Lockheed Martin, Computer Sciences Corp, Boeing, Harris), Adacel, Nav Portugal, Nat UK
- **Schedule:**
 - Fall CY-09 (Oct / Nov) Laboratory Demonstration – Extend Flight Data Object to include Surface TBO, Scheduled for Nov. 17
- **Status:**
 - Proof of concept lab demo completed Mar 09

Demonstrations: Unmanned Aircraft System (UAS)



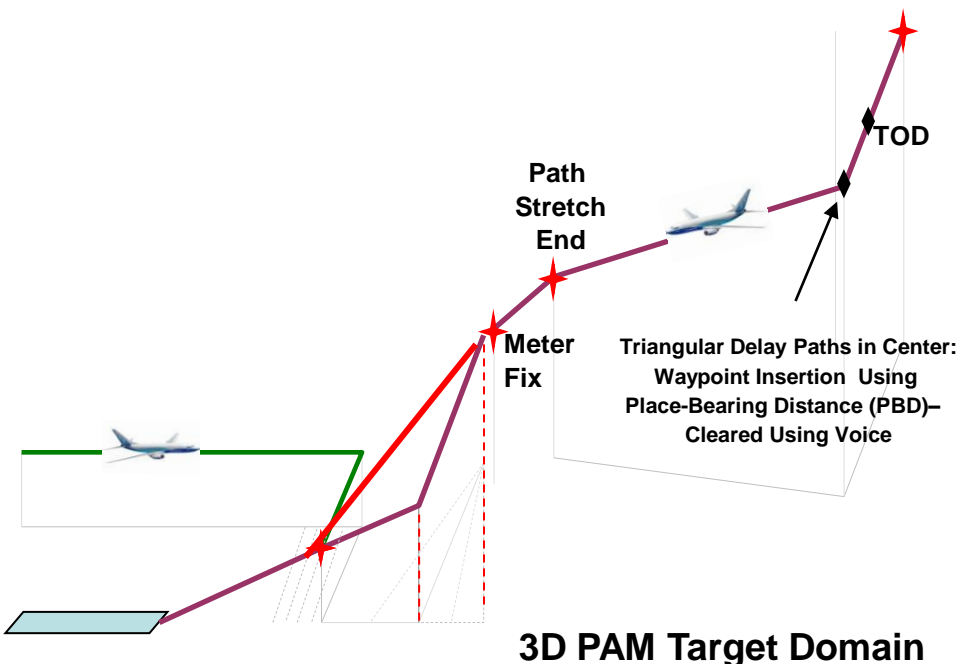
- **Initiative:**
 - Utilize advanced capabilities of UAS community for exploring future 4D Trajectory Based Concepts
 - Examine potential concepts for wide-spread, safe integration of UAS into future NextGen environment
- **Benefits:**
 - Contribute to evaluation of safety case for UAS operation in the NAS.
 - Evaluation of NextGen enabling TBO technologies
- **Partners:** AAI, General Atomics, GE Aviation
- **Schedule:**
 - UAS OTA with Embry-Riddle Aeronautical University awarded September 17, 2009
 - Two additional Flight Tests in 4th quarter CY 2009 (Cherry Pt. / 4DT FMS Coupled)
 - UAS TIM planned November 2009
- **Status:**
 - UAS “Shadow” Baseline Flight Test completed July 09
 - Developed Cooperative Research and Development Agreement (CRDA) with AAI, General Atomics, and GE Aviation
 - Integrated and prioritized UAS Plan drafted (awaiting final signatures)

Demonstrations: Continuous Descent Arrivals (CDA)



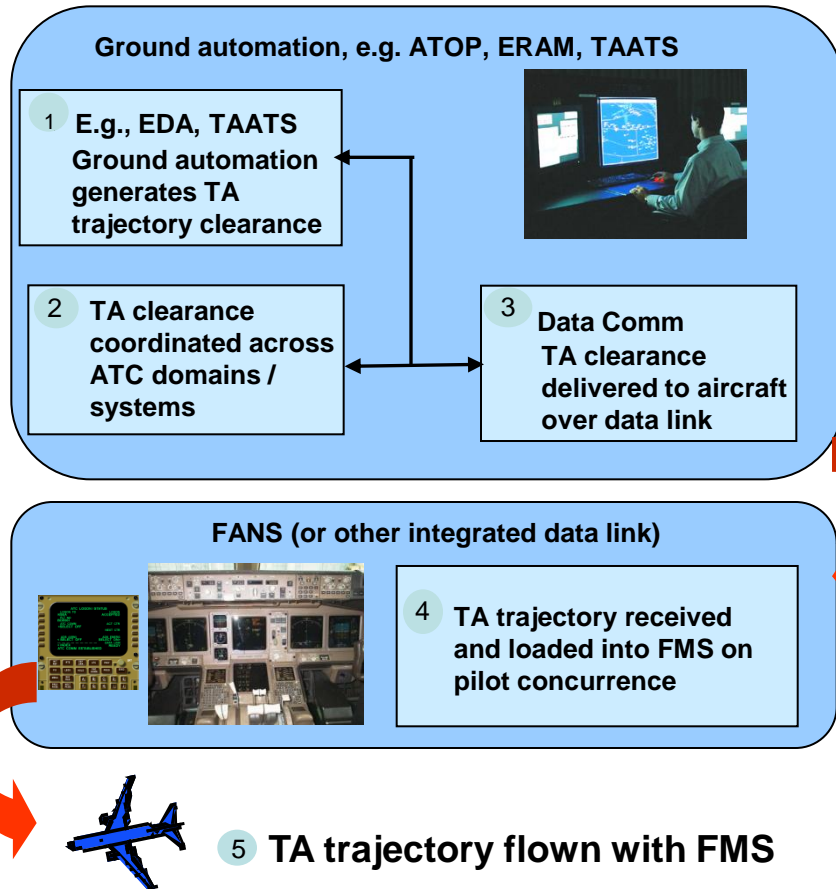
- **Initiative:** Uses Area Navigation (RNAV) / Required Navigation Performance (RNP) arrivals with optimized vertical profile
- **Benefit:**
 - Approximately 200 to 400 LBS of fuel per arrival
 - Reduced noise and emissions
- **Partners:** American Air Lines, Delta, US Air Force Mobility Command (AMC), International Air Carriers, Georgia Tech, MITRE
- **Schedule:**
 - Demonstration flights by AMC at CHS in Sept 09
 - Publish CHS OPD procedures for public use in FY-10
 - Publish ATL OPD procedures for public use in Feb 2010
- **Status:**
 - ATL Flight Tests: May 5 -16th, 11 partial/full CDAs conducted (Delta)
 - MIA Flight Tests: May 5-19th, 10 partial/full CDAs conducted (American)
 - CHS Flight Test: Fly draft procedures in C-17
 - Delta simulations in Dec 08
 - C-17 simulation in Mar 09
 - Prioritized list of recommended airports for CDA implementation – Apr 09
 - Results indicate approximately 335-800 Lbs per flight savings

Demonstrations: 3D Path Arrival Management (3D PAM)



- **Initiative:** Deliver aircraft from TOD to a meter fix efficiently and predictably. The concept is an initial attempt at 4D trajectory operations in the arrival domain. The project includes the development of a new automation support tool
- **Benefit:** Move from controller-based to Trajectory Management using automation for fuel and emissions saving with reduced controller work load
- **Partners:** NASA Ames, Boeing, Sensis, Continental, AAL
- **Schedule:**
 - FY10 Flight Deck and ATC Human-in-the-Loop Simulation (HITLS)
 - 3D PAM Flight Demonstration – Nov. 13, 2009
 - Technology Transition Activities FY10
- **Status:**
 - Integrated ATC / Flight Deck Simulation completed September 18, 2008
 - HITL #1 (Basic 3D PAM Demo) completed April 2009
 - Denver flight trials completed September 2009

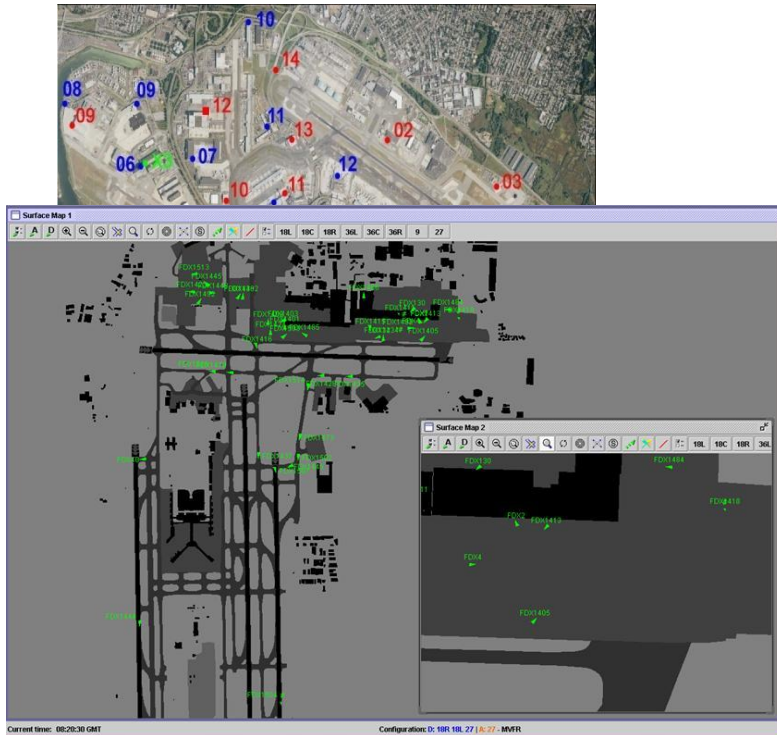
Demonstrations: Tailored Arrivals (TAs)



- **Initiative:** Integrate automation tools and Data Comm to provide cleared trajectory path, which is uplinked to the aircraft and flown by Flight Management System (FMS) *
- **Benefits:**
 - 400/600 LBS of fuel reduction per arrival in end-state
 - Reduced fuel burn and environmental footprint
- **Partners:** NASA Ames, Boeing, Sensis, American Air Lines & Foreign Carriers
- **Schedule:**
 - Continued trials of initial TAs at MIA, and SFO with collection and analysis of fuel saving data
 - TA Implementation Activities FY10
 - LAX TA profiles in development with live flight trials planned in FY10
- **Status:**
 - Since December 2007 – over 1933 complete and partial TAs at SFO (Both B-777 & B-747)
 - As of May 09 estimate 220,000 gals of total fuel saved or about 100 – 130 gallons per flight
 - Flight Trials resumed in MIA in Jun 09
 - Four check flights on 3/9/09 at LAX with Qantas reporting fuel savings of 115 gals (B747) over typical arrival

* Supporting Atlantic Interoperability Initiative to Reduce Emissions (AIRE)

Demonstrations: Surface Management at John F. Kennedy (JFK) Memphis (MEM) & Orlando (MCO)



- **Initiative:** Leverage FAA investment in surface detection equipment (ASDE-X) to support new decision support tools
- **Benefits:**
 - Collaborative planning at airport
 - Reduced fuel burn and environmental footprint
- **Partners:** Airport Authorities, FedEx, Delta
- **Schedule:**
 - MEM Surface Decision Support System
 - Working group formed to evaluate benefits / future enhancements
 - Flight Operations Surface Application (FOSA) interface concept development ongoing (i.e., data sharing interface) – estimated completion Nov 09
 - FOSA and Collaborative Departure Queue Management demo in Nov 09
 - MCO Surface Decision Support System
 - Field evaluations begin Nov 09
 - Collaborative Departure Queue Management demonstration begins Mar 10
 - Ongoing Coordination with ATO-T and SysOps – Implementation now part of Tower Flight Data Manager program
- **STATUS:**
 - JFK Commercial Ramp Surveillance System complete late 08
 - Feeds to ATC, Airline Ramp Towers and TSA
 - MEM initial Surface Decision Support System demonstrated in FedEx Ramp Tower in Sept 09
 - Completed MOU with FedEx for joint development of surface data exchange in June 09
 - MCO Surface Decision Support System operational in Oct 09

Demonstrations:

4-D Flight Management System (4-D FMS)



Initiative:

- Demonstrate operational capabilities and potential benefits of 4 Dimensional (4-D) Flight Management Systems in Trajectory Based Operations (TBO).
- Aid in defining “required RTA performance” of 4 Dimensional (4-D) Flight Management Systems in trajectory prediction, negotiation, and guidance.

Benefits:

- Reduce controller workload and improved productivity
- Enhance reliability, repeatability and predictability of operations, leading to increased throughput.
- Improve efficiency and flexibility by increasing use of operator-preferred trajectories NAS-wide, at all altitudes.

Partners: Embry Riddle Aeronautical University, General Electric, and Partners in ERAU Aviation Consortium, Mitre, Lincoln Labs

Schedule:

- Developing project plan version 1
- Selecting partner airlines

Status:

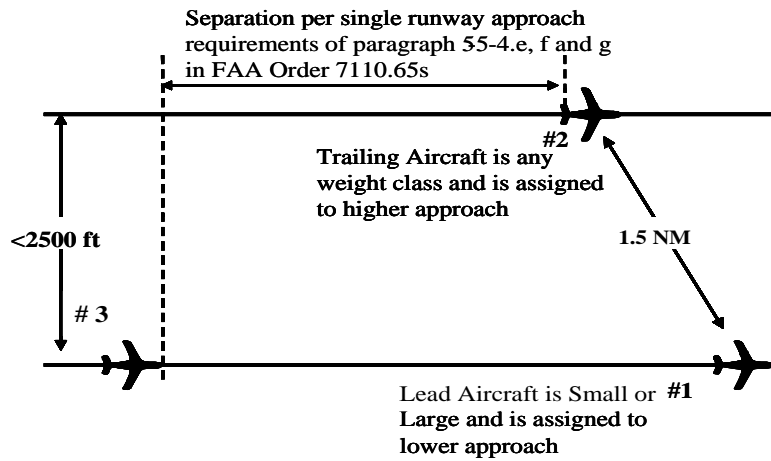
- Held Technical Interchange meeting to vet concept with stakeholders on Oct. 7
- Airport Selection Rationale white paper, in support of future demos, distributed to AT on Sept. 3

Wake Turbulence

Research Program



Parallel Dependent ILS/MLS Approaches



- **Initiative:** Safely change wake turbulence separation standards where possible to improve capacity
 - Start with procedural solutions
 - Add technology and complexity as science and engineering mature
 - Deliver more complex solutions to more difficult problems as NextGen infrastructure matures
- **Benefits:**
 - Improves airport capacity and efficiency
 - Improved safety through wake turbulence separation and mitigation
- **Partners:** AFS, DOT Volpe, MITRE, Continental Air Lines, United Air Lines
- **Schedule:**
 - Wake re-categorization from ICAO 3 categories to 6 proposed
 - ADS-B wake avoidance strategies
 - Wake turbulence mitigation for departure (WTMD)
- **Status:**
 - Approved FAA Order 7110.308 1.5nm dependent ILS approaches to runways spaced less than 2500'
 - B757 Safety risk Management Document (SRMD) eliminates heavy 757
 - Wake separation assessment of A380

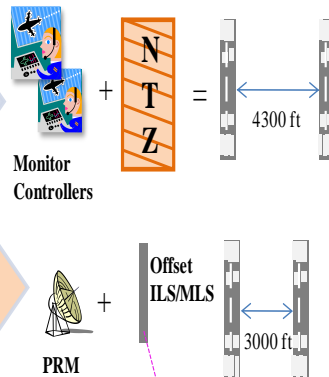
Closely Spaced Parallel Runway Operations (CSPO)

Simultaneous Independent

(Higher IMC throughput)

Applies to runways with centerlines spaced 4300 ft apart or greater

With monitoring controllers, an offset ILS/MLS course, and a high update radar, runway spacing can be reduced to 3000 ft. With no course offset, the reduction in spacing is limited to 3400 ft

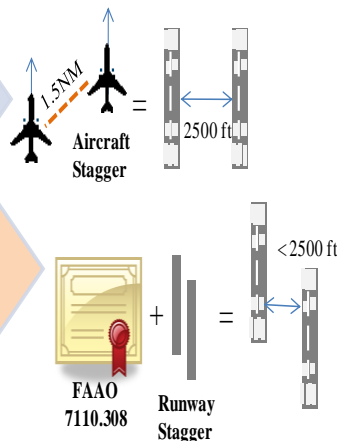


Dependent

(Lower IMC throughput)

Applies to runways with centerlines spaced 2500 ft apart or greater

Under FAA Order, centerline separations < 2500 ft are allowed at five US airport; FAA wants to expand this operation to additional airports



Initiative: This program will investigate a number of CSPO *enabling activities* to permit revised runway spacing standards and the use of advanced technology and performance-based procedures in the near to mid-term, eventually leading to the development of new airport design standards in the far term.

Benefit: Maintain airport/runway capacity in lower visibility conditions, Improved NAS efficiency (reduce delay), Decreased user operational costs, Decreased emissions, Higher quality of surveillance without fundamental changes in current procedures, and Instantaneous awareness for both Pilot and Controller of blundering aircraft

Partners: NASA Langley

Schedule:

- FY09 1st Human in the Loop (HITL) test
 - Dual-ILS with 4.8 sec radar refresh
- FY10 – FY13 HITLs every 2nd and 4th Quarter

Status:

- Conducted 1st HITL July 2009
- Currently analyzing data from HITL

Demonstrations: Ground Based Augmentation System (GBAS)



- **Initiative**
 - Demonstrate the use of Performance Based Navigation technology to improve arrival rates at airports
- **Benefit**
 - Additional throughput to maximize airport efficiency
 - Reduced fuel consumption and lower noise and emissions
 - Improved airport access
- **Partners**
 - NY Port Authority, Continental and NetJets
- **Schedule**
 - GBAS installation complete at EWR – Dec 2009
 - First Revenue flight by Continental Airlines – March 2010
- **Status**
 - MOU signed – July 2009

NextGen Network Enabled Weather (NNEW)

Demonstrations

Friends/Partners in Aviation Weather

By: Tom Ryan, FAA Program Manager,
Co-Lead 4-D Weather Data Cube Team

Date: October 22, 2009

Overview

- Program description
- September 2009 IT Demonstration
- OWS-7
- NextGen Demonstrations

NNEW Program Description

A network-enabled, virtual, 4-Dimensional Weather Data Cube, established jointly with NOAA & DoD, which draws information from multi-agency sources, for aviation users.

- Key Themes:
 - An integrated and nationally consistent, common weather picture for observation, analysis, and forecast data available to all users
 - “Network Enabled”: Available, secured, real-time, information
 - “Virtual”: Repository with no single physical database or computer
 - Conceptually unified source distributed among multiple physical locations and suppliers
 - Purpose: Provide a source of weather information for operational decision making

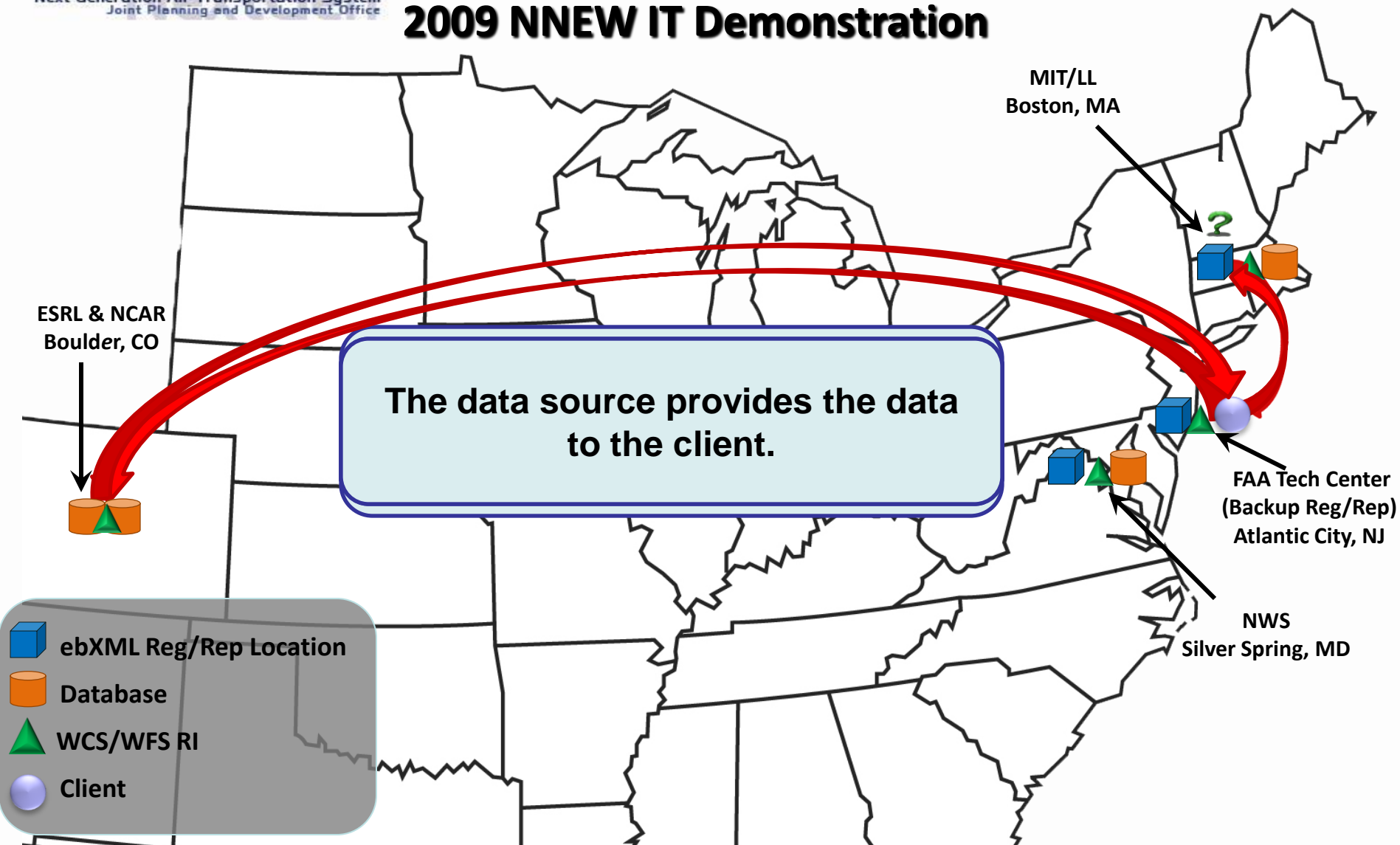
September 2009 IT Demonstration

- Registries/repositories at MIT/LL, NWS, & FAA Technical Center
- Databases at NCAR, ESRL, MIT/LL, & NWS/MDL
- OGC compliant, non-gridded data formats, mostly conforming to WXXM (being developed jointly with EUROCONTROL)
- Gridded data formatted using NetCDF-4 (allows for subsetting)
- Initial implementation of OGC Web Coverage & Web Feature Services

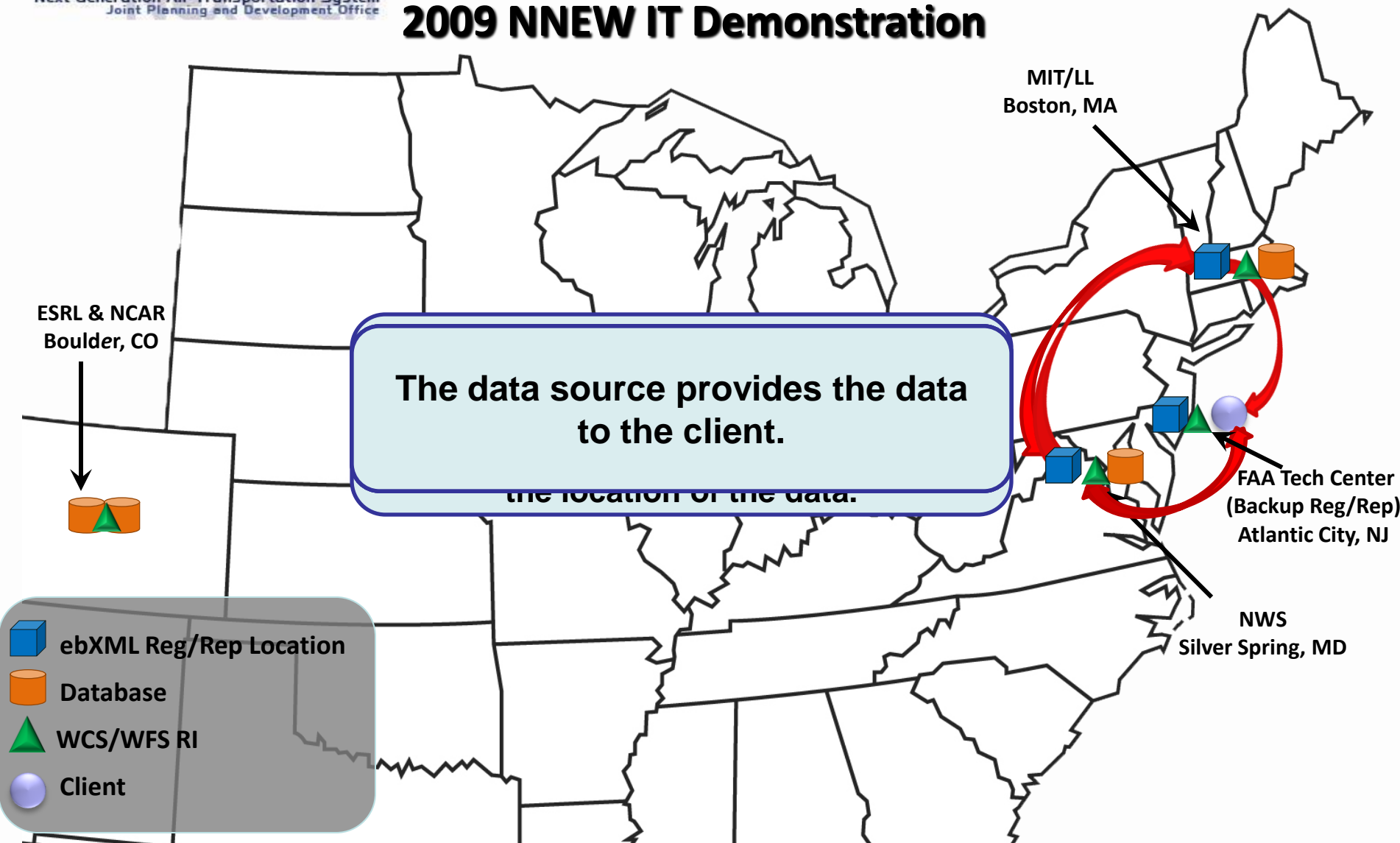
NNEW FY09 Demonstration Datasets

- NCAR
 - Current/Forecast Icing Severity, Potential, & SLDs (CIP/FIP)
 - Ceiling & Visibility (C&V)
 - Turbulence (GTG)
 - RUC20 Air Temperature, Relative Humidity, & Wind Speed
 - PIREPs
- ESRL
 - Rapid-Refresh Model Air Temperature & Wind Speed
 - MDCRS
- MIT/LL
 - CIWS Echo Top & Vertically Integrated Liquid
 - Lightning Data
- NWS/MDL
 - NDFD Wind speed
 - LAMP Thunderstorm Probabilities

2009 NNEW IT Demonstration

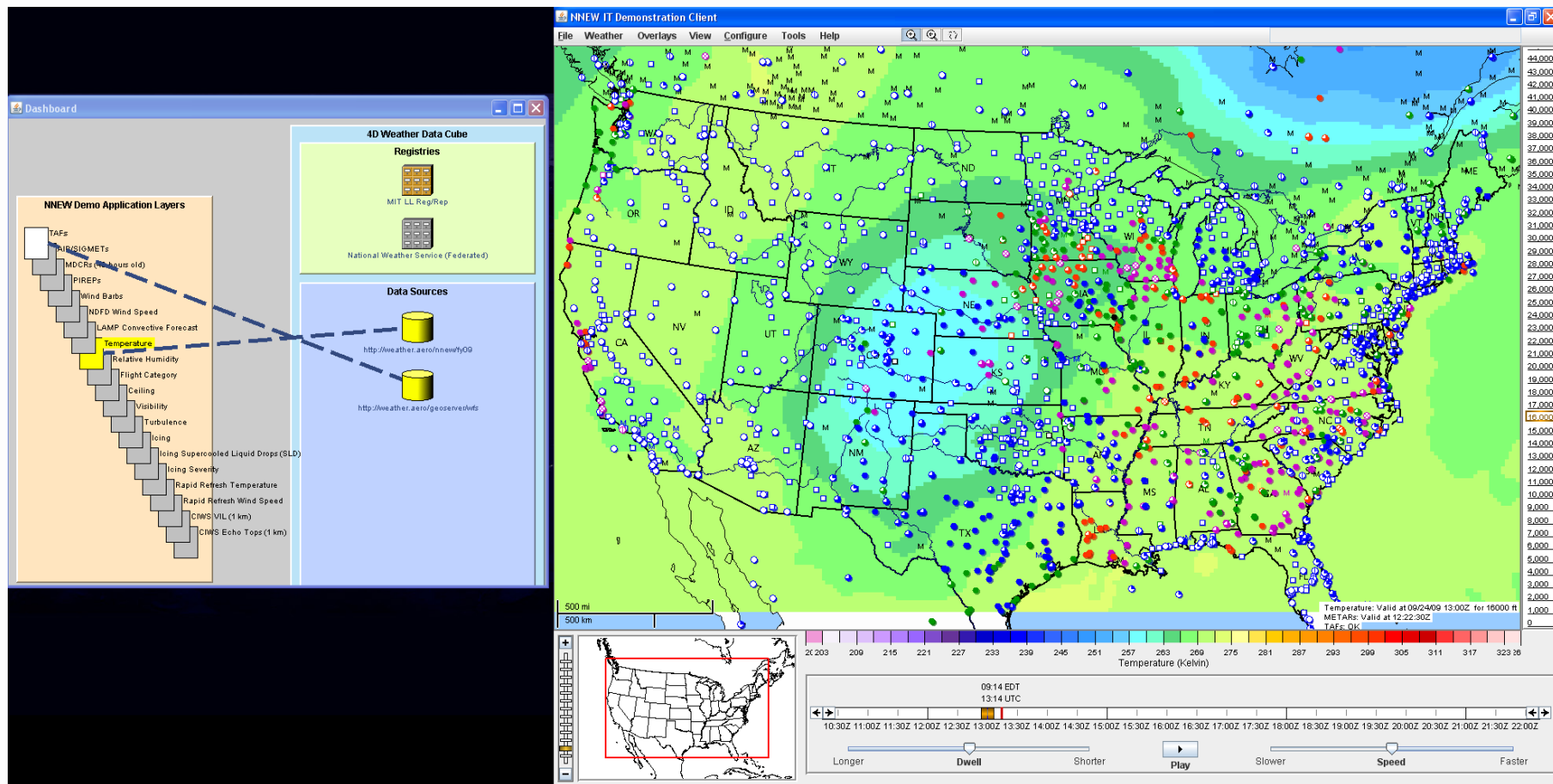


2009 NNEW IT Demonstration



2009 NNEW IT Demonstration Screen Shot

(<http://weather.aero/nnew/fy09/demo/>)



Data Access

- NNEW Data Access Information
 - Available at WIKI website
 - <https://wiki.ucar.edu/display/NNEWD/NNEW+FY+2009>
- The website includes information on all of the datasets
 - Each of the datasets and their service endpoints have associated metadata in the registry/repository
 - The NNEW repository implements the coming ebXML 4.0 specification.
 - Location: <http://ngenwww2.wx.ll.mit.edu:8080/wellgeo-ui-swing/4.4/jnlp/wellgeo-ui-swing.jnlp>

OGC Web Services, Phase 7 (OWS-7) Testbed

- **Develop and demonstrate the use of AIXM and WXXM in an Open Geospatial Consortium Web Services Environment**
 - Scenario will focus on ground usage of information and will also include preparation of data for upload on handheld Electronic Flight Bag devices
- **Increase industry adoption of AIXM and WXXM and support the operational use and validation of the standards**
 - Results of OWS-7 are expected to be contributed to the FAA SWIM program
- **WXXM will also be evaluated to demonstrate new weather concepts such as the 4-D Weather Data Cube**
 - User-oriented evaluation of WXXM to determine its efficiency as a mechanism for distributing information about probabilistic weather events

Open Geospatial Consortium

NextGen Demonstrations

- NNEW will support NextGen demonstrations
 - Participating in NextGen testbeds
 - Coordinating with appropriate I&I Solution Set Managers
 - Work with other developing NextGen capabilities (e.g., Flight Data Object, CATM)
 - Clear objectives will be established in writing
 - Deliverables will be part of the contractual agreements with industry partners



CENTER FOR ADVANCED AVIATION SYSTEM DEVELOPMENT (CAASD)

Review of FAA Weather or Weather-Related Products from an RTO Perspective

Matt Fronzak - MITRE/CAASD

October 22, 2009

Friends and Partners of Aviation Weather Meeting



CENTER FOR ADVANCED AVIATION SYSTEM DEVELOPMENT

MITRE