GBAS Activities

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GNSS Operational Implementation

E Operations Workshop
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THE MIND IS LIKE A PARACHUTE
IT WORKS BEST WHEN IT IS OPEN

GNSS TEAM HONEYWELL, FEDEX, RNP OFFICE, AVN, AFS, MEMPHIS TRACON
Project Memphis-Revalidation

• **OBJECTIVE** – Land 267 A/C in 2hrs 45 min
• **Government Industry Partnership Testbed**
  – Increase Capacity (High Density Arr/Dep Periods)
  – Establish Agile Air Traffic Terminal Operations (Flexibility, Trajectory Operations)
  – Protect the Environment (Low Power Arrivals/Minimum Ground Taxi)
  – Enhance Situational Awareness (ADS-B, CTAS, Map Displays)
  – Minimize Weather Impacts (AOC Operations)
Existing Memphis Corner Posts
FedEx Arrivals (night push)
FedEx TAP Flight Tests at Memphis

• Two Phases
  – Phase 1 (Complete)
    • Performed 3 TAPS to 3 Different Runways From 1 Cornerpost
  – Phase 2
    • Continue Flight Testing Other TAPS/CDA/metering/RTAF/environmental
    • Multiple Approaches and Multiple Aircraft

• Three Areas
  – En route: GPRS
  – Terminal Area: TAP
  – Surface navigation: Control Taxi Speed and Path

• Purpose
  – Technical Viability
  – Crew Flyability
  – Operator Benefits
  – Environmental Benefits
  – Surface Movement Applications

• TAP Flight Tests Use Red Label TAP Capable Rockwell GNLU-930 MMR and Updated Z-12 Trething System
Memphis Prototype Procedures
Continued Work

• Test Procedures Were Based on Desired and Existing Vectored Paths

• Memphis ATC Participated in Development
  – Initial Design Approach Only Considered Feeding a Single Runway End From a Single Cornerpost at a Time

• Integration of Multiple Simultaneous Feeds Has Proven More Difficult
  – Current ATC Required Separation is 3 miles Laterally and 1000 Feet Vertically

• Testing Will Also Characterize the Procedure Timing
  – Expected Time of the Procedure Will Be Compared to the Achieved Time, and the Timing FTE Will Be Quantified
GBAS Flight Evaluation Approach

• PHASE 1
  – Conduct Single Aircraft Flight Tests To Quantify User Benefits For Time and Fuel Savings On Single RNP Path Applications

• PHASE 2
  – Integrate Multiple Aircraft and Conduct Flight Tests To Determine ATC Impacts and Benefits

• PHASE 3
  – Integrate With Automation Enhancements To Identify Needed Coordination Points Between Industry and Government

• PHASE 4
  – Finalize Aircraft, Avionics, Pilot, ATC and Government Changes As Needed Through Regulation, Policy Or Implementation Changes
GBAS Flight Testing Concepts

• **TAP/RNP Approaches**
  – No Radar Vectors
  – Low Power TAP (CDA but with deceleration points)
  – Missed Approach*****
    • FAS Only
    • Turns
    • Straight Other Than FAS
  – Auto-Coupled Curved Turns
  – Environmental
  – Long Curved To Decision Height
  – Path Merging
  – Land Long – closely spaced/wake turbulence
  – Dynamic Downwind/Shortened

• **TAP/RNP Departures**
  – Low Viz/4D (a,c,d,e,g approach tasks)

• **TAP/RNP – 4D/RTA Approaches (Flex Applications)**
  – Merging – multiple runways/closely spaced
  – Sequencing, Spacing, Timing Starting at altitude
GBAS Flight Testing Concepts (cont.)

• **Aircrew Training/Workload/Safety**  
  – FMS Reload vs GBAS Re-tune
• **Airspace Design**  
  – Non-Ground Based Cornerposts
• **Surface Movement**  
  – Map vs Non-Map (nav display)
• **Adjacent Airport FAS**  
  – NPA
• **Procedure/Airport Oddities**  
  – Juneau NW Channel Approach
• **Database**
• **Critical Area Capacity Enhancements**  
  – “GBAS Performance”
• **Highest Availability of Low RNP Value**
• **LAAS Provides “BEST” Navigation Values**
NGATS TASK

• Optimizing Aircraft Sequencing and Spacing in the Terminal Area Airspace to Increase Airport Capacity and Reduce Fuel Burn and Emissions and Noise Reductions on Developed Terminal Paths

• Illustrate Increases in Airport Throughput By Demonstrating How Currently-Available Technologies That Exploit the Advances in Communication, Navigation and Surveillance (CNS) Systems, Optimize Aircraft Flight Tracks, Sequencing, and Timing in the Terminal Area Airspace
Relevance to NGATS CONOPS

• Key Capabilities
  – Network-Enabled Info Access
  – Performance-Based Services
  – Wx Assimilated into Decision-Making
  – Layered, Adaptive Security
  – Broad Area Precision Navigation
  – Aircraft Trajectory-Based Ops
  – Equivalent Visual Operations
  – Super Density Ops

• NextGen Goals and Objectives
  – US Leadership in Global Aviation
  – Safety
  – Ensure National Defense
  – Expand Capacity
  – Protect the Environment
  – Secure the Nation
TASKS

• **Develop a Terminal Area Test-bed at a Major Airport Where Flight Trials Can Be Conducted**
  – Phase I Development
    • Identification and Preparation of Test-bed Site
    • Development of Prototype Terminal Area Path Procedures
    • Flight Profiles and Procedures
    • Data Collection Formats and Analysis Approach
    • Avionics Installation Configuration and Approvals
    • Development of the Engineering Models to Support Flight Trials

• **Conduct Integrated Flight Trials to Demonstrate the Operational Objectives Defined in the Program Plan**
  – Phase II Execution
    • Bench testing
    • Avionics installation
    • Flight trials
    • Data analysis
    • Final report
Sub-Tasks

1. Coordinate with airline, industry, academia, and airport personnel to reach agreement with the project objectives and understand air traffic controllers’ national and local constraints.
   • Task Lead - ISI

2. Develop different formulations and cognitive engineering models to support the terminal area airspace issues and operations, and develop report.
   • Task Lead - GT

3. Develop mathematical and cognitive engineering models of the operations at an airport, that can be used in future JPDO work related to airport operations. Provide feasible concept for optimizing the sequencing and timing of aircraft in the terminal area airspace to increase airport throughput and reduce fuel burn emissions.
   • Task Lead - GT

4. Integrate prototype decision support tool with the surveillance tool methodology and required flight operations
   • Task Lead - ISI

5. Develop continuous descent approach TAP procedures and integrate a prototype two-way Real-time Communication Systems.
   • Task Lead - ISI
Technology

- Operational GBAS Ground System
- GBAS Equipped Aircraft
- Truthing System
- Two-Way Communications Capability
- Performance Based Terminal Area Procedures (TAP)
- Sequencing and Timing Optimization
Scenarios

- **Sequence**
  1. Same Direction, Set Sequence
  2. Split Direction, Set Sequence
  3. Split Directions, Sequence Changed to Increase Throughput

- **Where Possible the Order of the Aircraft Will Be Alternated (big vs. small) Using Two of the Four Cornerposts**
Aircraft Installations

• Aircraft – 7 Potential
  – 2 FedEx B-727’s
  – AVN Flight Inspection (Learjet 60)
  – Navcanada (CRJ)
  – USAF (Learjet 35)
  – FAATC (Global Express 5000)
  – FAA HQ (Gulfstream and Citation)

• Installation Package
  – Dual Function Antenna (GPS and two-way data), Knee Board/SA Display, Data Collection, Satellite Transceiver, Power (if required), Cables
Project Milestones

- Project Plan – 11/30/07
- Weather Models for Optimization Software – 12/21/07
- Final TAP Procedures – 12/31/07*
- Report on Cognitive Models and Sequencing Concepts – 1/31/08
- Installation Approval – All aircraft 1/15/08
- Operational procedures – 2/15/08
  - Pilot/Controller Procedures Approved
- Optimization Model – 2/29/08
- Flight Test – March 2008

*Not in accordance with Contract
Phase II

• **Phase 2 Activities**
  – Integration of the Hardware and Software Into Identified Platforms – Jan 08
  – Bench Testing – Jan 08
  – Avionics Installation – Mar 08
  – Flight Trials – Mar 08
  – Data Analysis – Apr/May 08
  – Final Report – July 08

• **Requires 1 Jan 08 Start Date for Phase II**
  – Contracts, Funding, etc.
TAP Approaches

- Finalized by 31 Dec
- Requires Buy-in From All Players
  - Fedex
  - ATC
  - AFS
- Significant Coordination Process
NEWARK PROPOSED CONCEPT OF OPERATIONS

ENROUTE
• Free Flight With Passing Lanes
• Weather Diversion Capability
• Conflict Resolution – Problems Are Predicted And Resolved Strategically
• Time Based Metering Used To Manipulate Traffic Constricted Cornerposts

PLANNED TRANSITION DESCENT
• Automation Assists With Sequencing, Timing, Merging, And Spacing
• Cornerpost Flow Management
NEWARK PROPOSED CONCEPT OF OPERATIONS

**TERMINAL**
- Automated High Precision RNP Operations With Preplanned Route Structures

**LANDING**
- Closely Spaced Parallel Operations
- Planned Taxi Transition And Surface Movement
- Category 1-2-3 Landing Operations
# NEWARK CONCEPT

## TERMINAL AREA
- TMA
- CONFLICT RESOLUTION
- COLLABORATIVE ATM
- OPTIMUM RUNWAY ASSIGNMENTS
- TIME BASED METERING

## SURFACE AREA
- SURFACE MANAGEMENT ADVISORY
- OPTIMUM TAXIWAY ASSIGNMENTS
- SPACING AND SEQUENCING

## PROCEDURES
- TERMINAL PROCEDURES
  - ADS-B SURVEILLANCE
  - LAAS GUIDANCE
  - RNAV/RNP
  - TAP/CDA
  - AIRSPACE REDESIGN

## AIRCRAFT
- AIRCRAFT EQUIPPAGE
- GNSS APPLICATIONS
- CTAS
- DATA LINKING
- DATA MESSAGING
PROJECT NEWARK - OPERATIONAL VALIDATION

• Government/Industry Partnership NEXTGEN Testbed
• Increase Capacity (High Density Arr/Dep Periods)
  – Establish An Agile Air Traffic Terminal Operations (Flexibility, Trajectory Operations)
  – Protect The Environment (Low Power Arrival/Minimum Ground Taxi)
  – Enhance Situational Awareness (ADS-B, CTAS, Map Displays)
  – Minimize Weather Impacts (AOC Operations)
NEWARK AIRSPACE CORNERPOSTS

• **WEST ARRIVAL**
  – Traffic From Midwest Through PA (Supports South Flow)

• **NORTH ARRIVAL**
  – Traffic From Northeast and North (Supports South Flow)

• **OCEAN ARRIVAL**
  – Northeast and Transatlantic (Supports North Flow)

• **SOUTH ARRIVAL**
  – South and Midwest (Supports North Flow)
CONGA LINE MENTALITY

• RNAV Should Not Be a Method To Force Aircraft To Accurately Follow a Single Line on Arrivals, But it Can Be a Method To Accurately Know Where an Aircraft Will Be
• Current FAA Concept Is To Align Aircraft Up In Arrival Lines As Far As 200-300 Miles
• Inefficiencies Are Created By Having a B-777 Follow An ATR-42
• CDA’s Are Precluded Because Of Inadequate Sequencing, Merging, Spacing, and Timing
POTENTIAL SOLUTIONS

• Arrival Paths Based On Operation Need and Not Existing Ground Based Structure
• Unrestricted Climbs – Cruise Climb – Flight Idle Descents
• Eliminate Radar Vectoring
• Benefits That Could Be Achieved
  – Significant Fuel Savings and Payload Increases
  – Significant Reduction In Terminal Airspace Conflicts
  – Reduced Airspace Congestion
  – Reduced Terminal Arrival and Departure Delays
  – Reduced Air Pollution/Emissions
  – Reduced Noise Pollution
CURRENT ISSUES OR CONCERNS

- FAA Management Support
- User Community Vocal Support
- Funding
- Limited Operational Testing
- Reluctance Of Other FAA Elements To Conduct Joint Tests
- Limited Personnel Resources
- Conflicting Schedules and Priorities Between The Three Major Players In The GBAS Effort
- **NEED TOVALIDATE OPERATIONAL PLANS AND OBJECTIVES!**
GBAS Implementation Issues

- Terminal Path Definitions (Procedures/Airspace Design)
- Charting
- Flight Inspection Recurrent Requirements
- Existing ATC Procedures
- ATC ARTTC to TRACON Transition Methodology
- Uplinking and Database
- Mixed Equipage Applications
- Green Procedure Applications
- Control Of International System/Procedure Definitions
- Siting Definitions vs. Operator’s Requirements
- NOTAMs (Runway vs. Airport)
- Concept Of Operations
- Data Collection and Analysis
- Flyability
CONCLUSION

• Today’s Scenario Will Not Support a 25% Traffic Increase
• An Operational Concept and New Set of Capabilities Has Been Demonstrated To Provide Significant User Benefits
• These Capabilities Take a Major Step Forward To NEXTGEN Desired Capabilities
• Ground Based Structure Does Not Support Further Increases Nor Needed Efficiencies
STANDARD DISCLAIMERS

• I CAN NOT BE ACCOUNTABLE FOR WHAT I SAY IF MY MOUTH OVERLOADS MY BRAIN

• THE OIT TEAM SILENTLY DISAVOWS ALL WHAT I SAY UNLESS THEY HAVE PRIOR APPROVAL
DISCUSSION AND QUESTIONS

TOTAL EFFORT IS CLOSE AND SUCCESS IS CLOSER

IF YOU DON’T KNOW THE DESTINATION ANY ROAD WILL GET YOU SOMEWHERE