

*16.72 Overview of
Modernization Plans*

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and Astronautics*



Focus is the OEP 35 airports

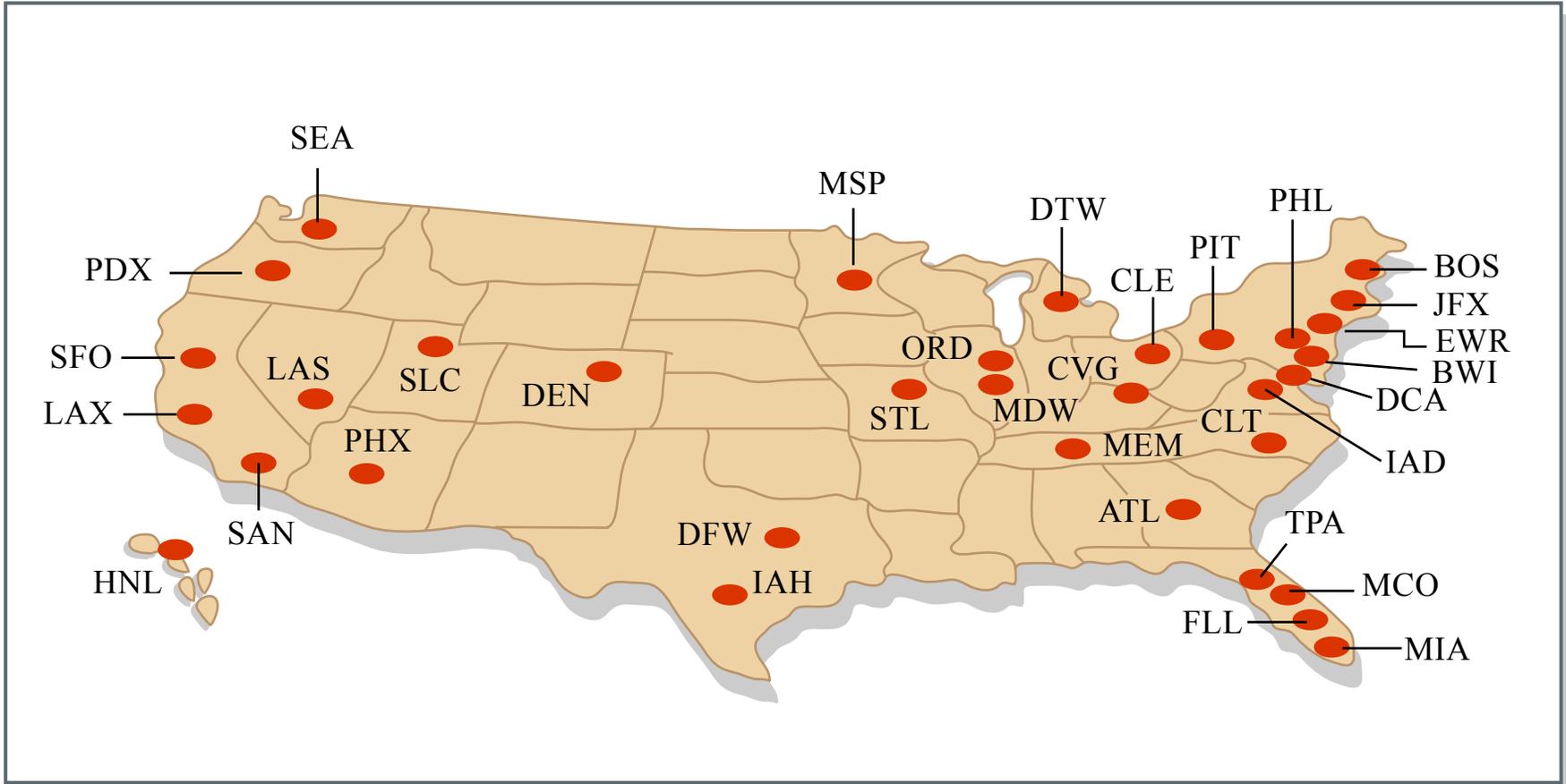


Figure by MIT OCW.

More? Oakland Burbank Long Beach John Wayne-Orange County Tucson Albuquerque San Antonio Houston Hobby Palm Beach

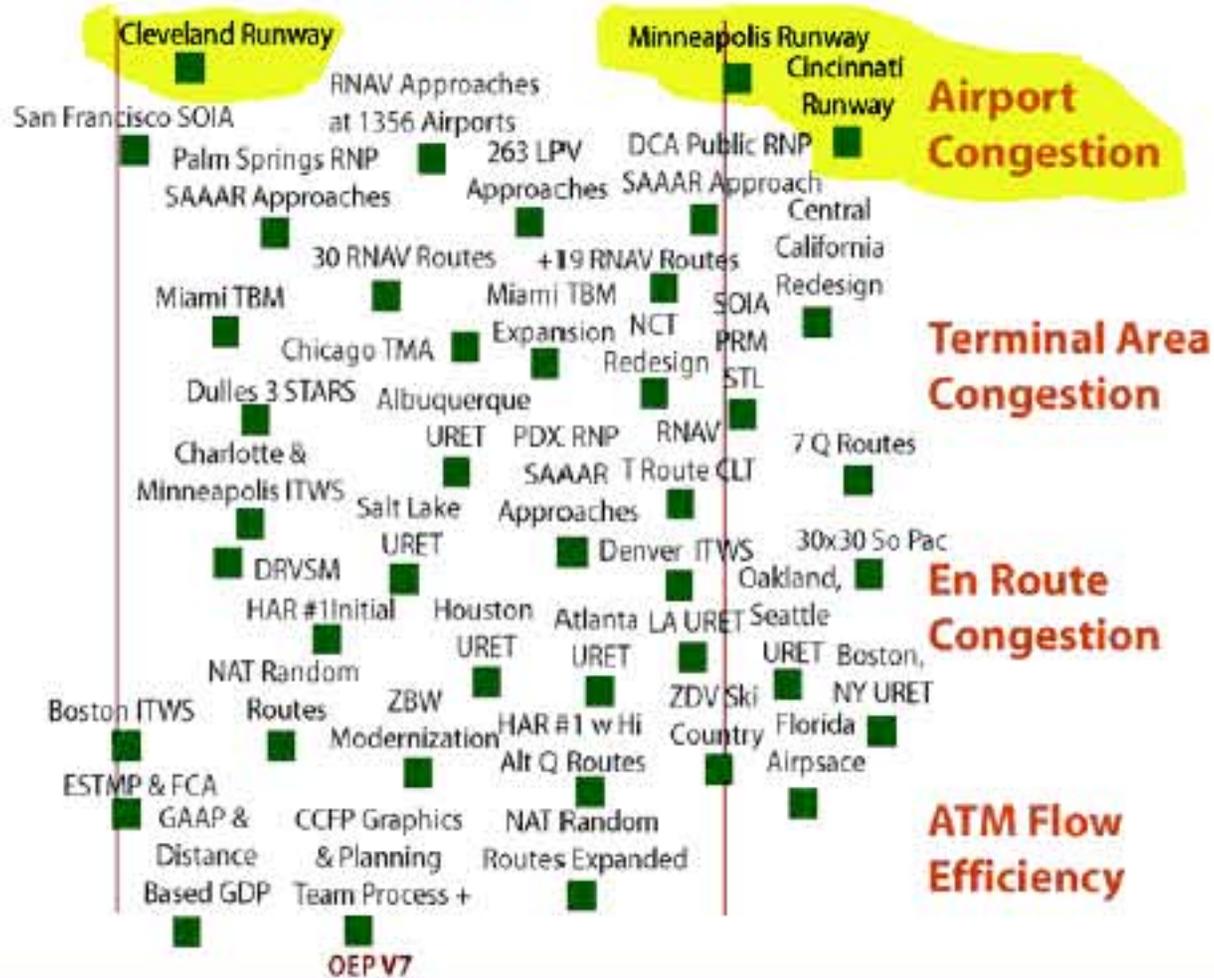


Core Solution Sets with hard commitments

Sampling of OEP Core Programs/Initiatives

- 30-30
 - Airspace
Redesign
 - CCFP
 - CDM
 - ITWS
 - Runways
 - RNP Public
SAAAR
 - RVSM
 - TMA
 - URET
 - Wake
-

FY 2005



OEP Commitments: New and Extended Runways

Completed: Phoenix, Detroit, Denver, Miami, Cleveland, Houston, Orlando, Minneapolis, Cincinnati

FY06: St. Louis, Atlanta

Future: Boston, Philadelphia extension, Los Angeles, Seattle

Benefits through FY06:

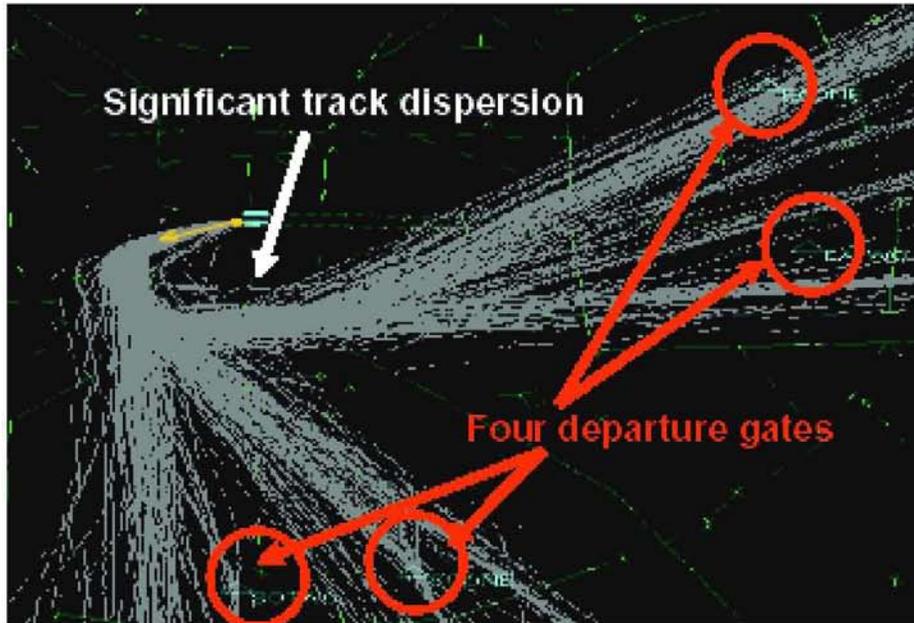
- Capacity increase to accommodate about 1.6 million more annual operations.
- Decrease average delay per operation at these airports by approx. 5 minutes.



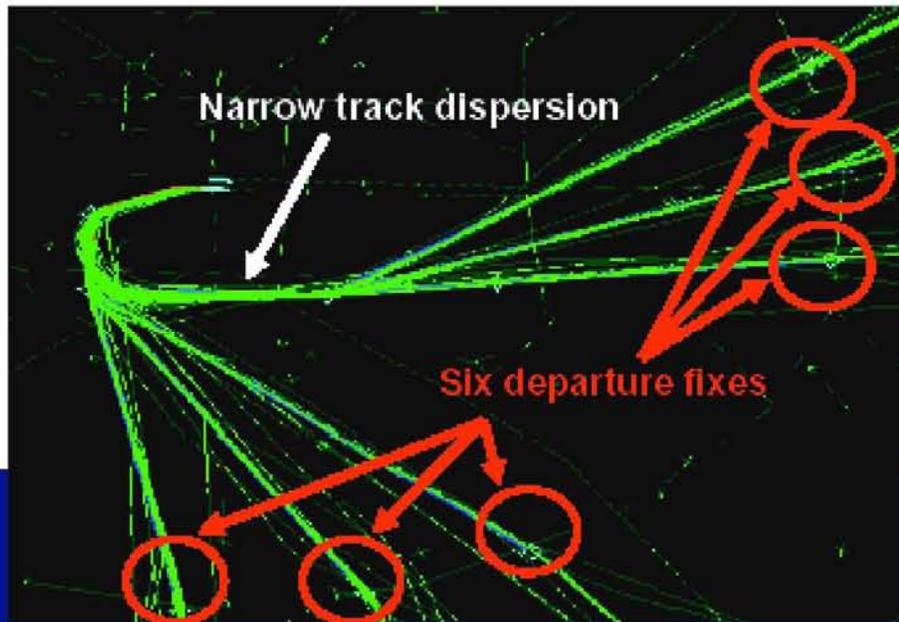
Atlanta Runway 10/28 opening June 06



Before RNAV



After RNAV



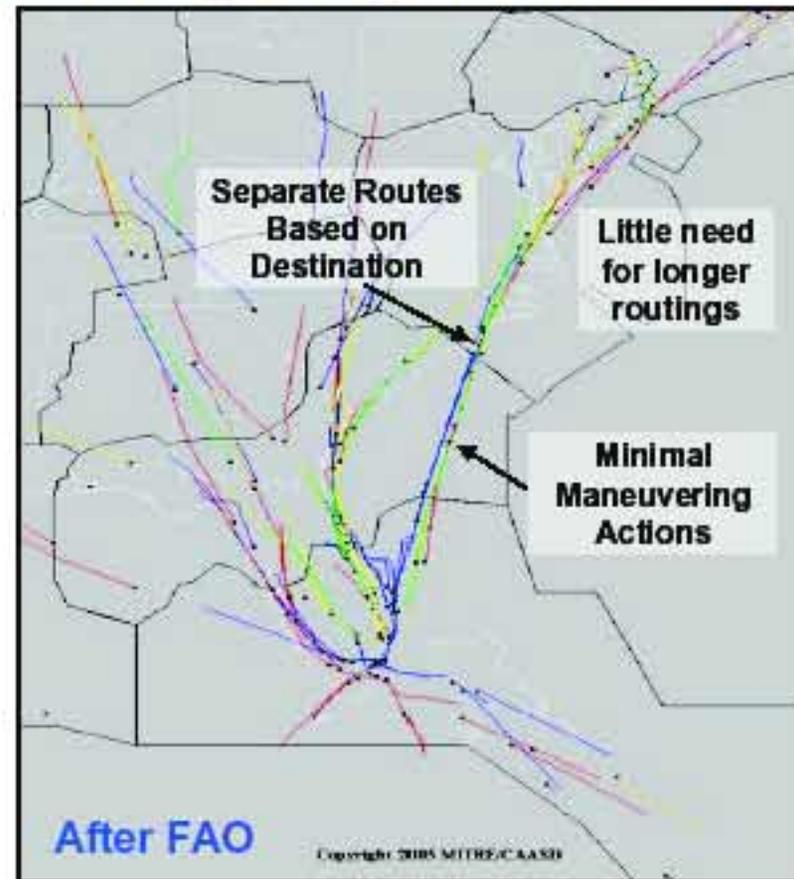
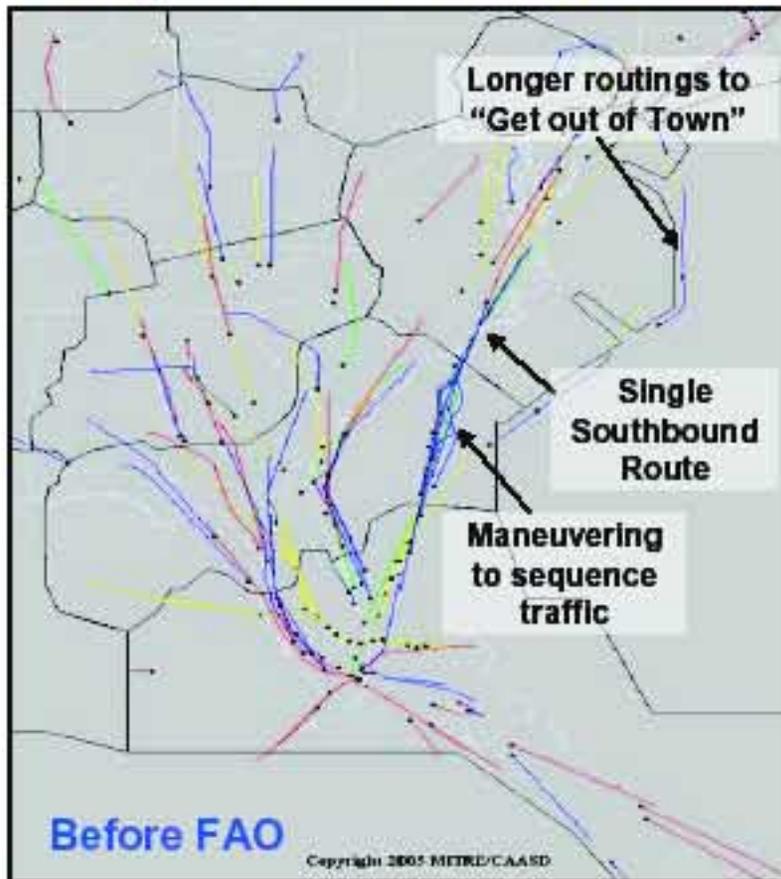
RNAV Standard Instrument Departure Procedures (SIDs)

Hartsfield – Jackson Atlanta International Airport
Atlanta, Georgia, USA

Annual airline savings:

- \$10M from reduced taxi time
- \$4M from reduced flying distance on arrivals
- \$1M from earlier climb achievement
- \$1M from reduced flying distance on departures.

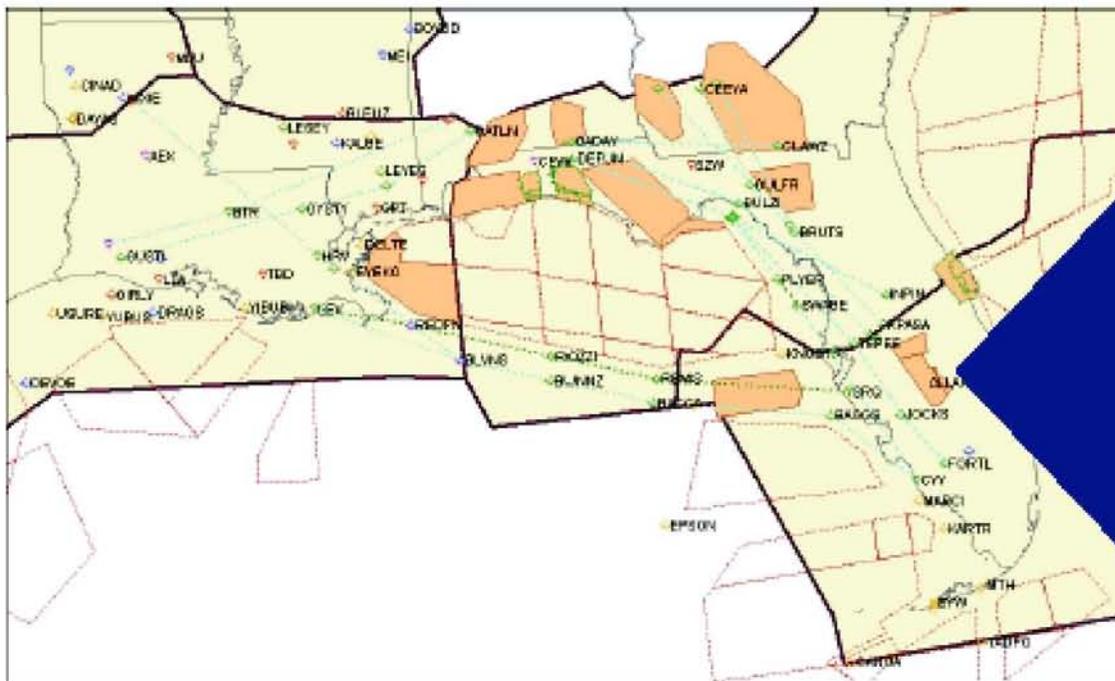
Florida Airspace Optimization: Comparison 2004/2005 Thanksgiving Traffic



These two snapshots illustrates traffic flows to FLL, PBI, MIA, SUA & BCT from 1600 to 1730Z on Thanksgiving Wednesday, first for 2004 and then for 2005

OEP Commitments: Airspace Redesign

High Altitude Redesign (HAR) Phase 1 with Q-Routes:



Florida Q-Routes

Benefits:

- Reduces flight distances between applicable city pairs by as much as 20 miles.
- Conservatively saves \$7M annually.



OEP Commitments: Decision Support Tools

User Request Evaluation Tool (URET)

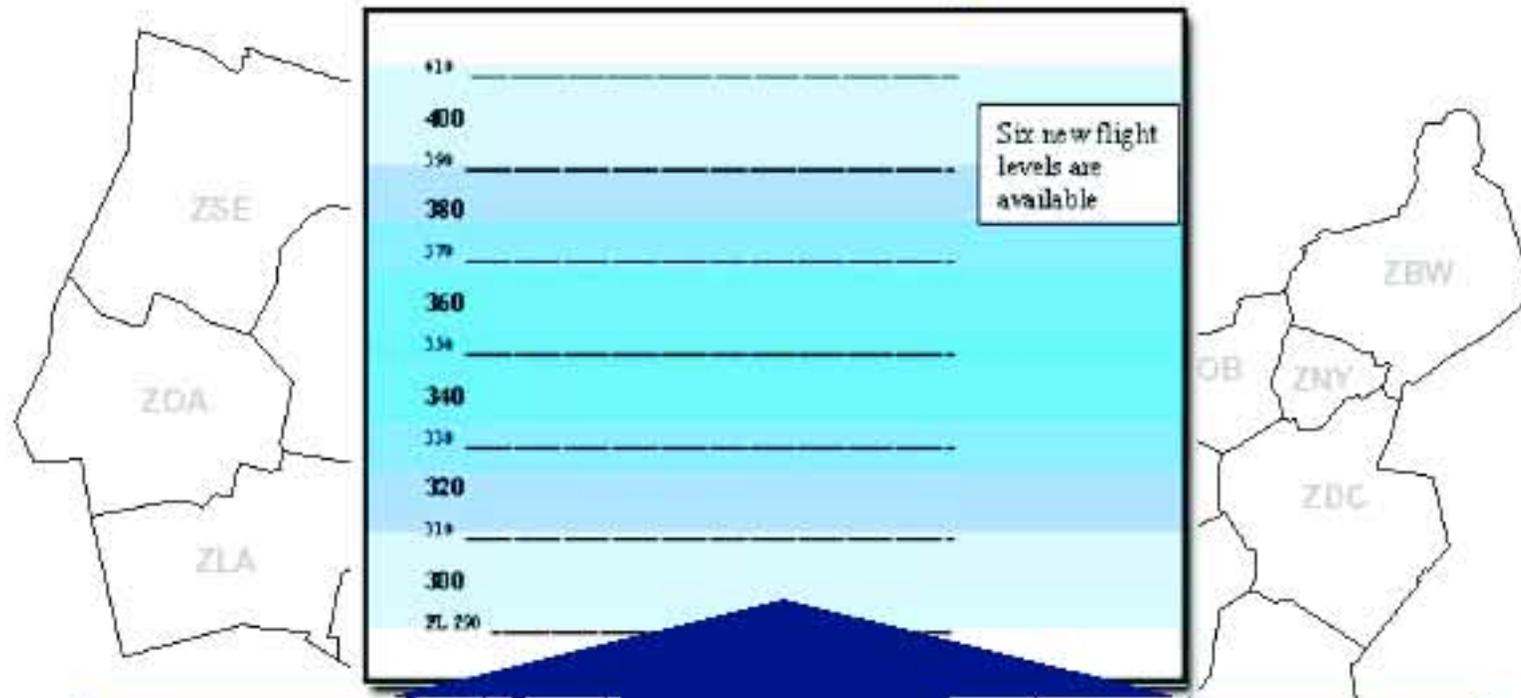
Pilots may request changes to their flight plans while en route to take advantage of more fuel-efficient altitudes and wind-optimal routes, which can save time and money. URET helps controllers determine whether these changes can be accommodated.

Benefits:

As of December 2005, all URET sites saved over 70 million route miles and over \$450 million in fuel.



OEP Commitments: Domestic Reduced Vertical Separation

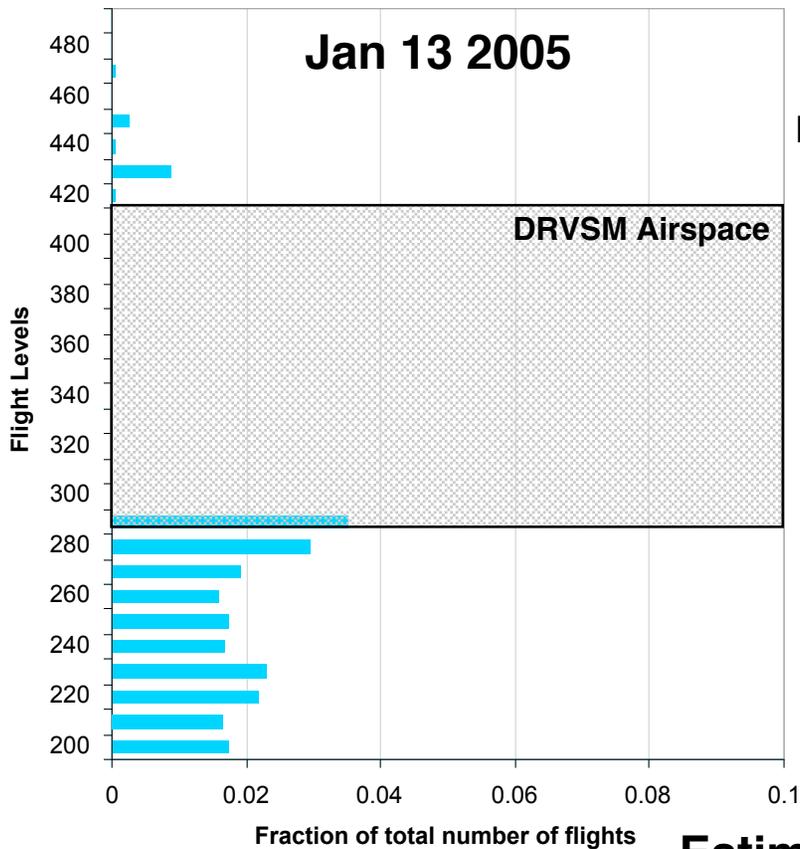


Annual airline savings:

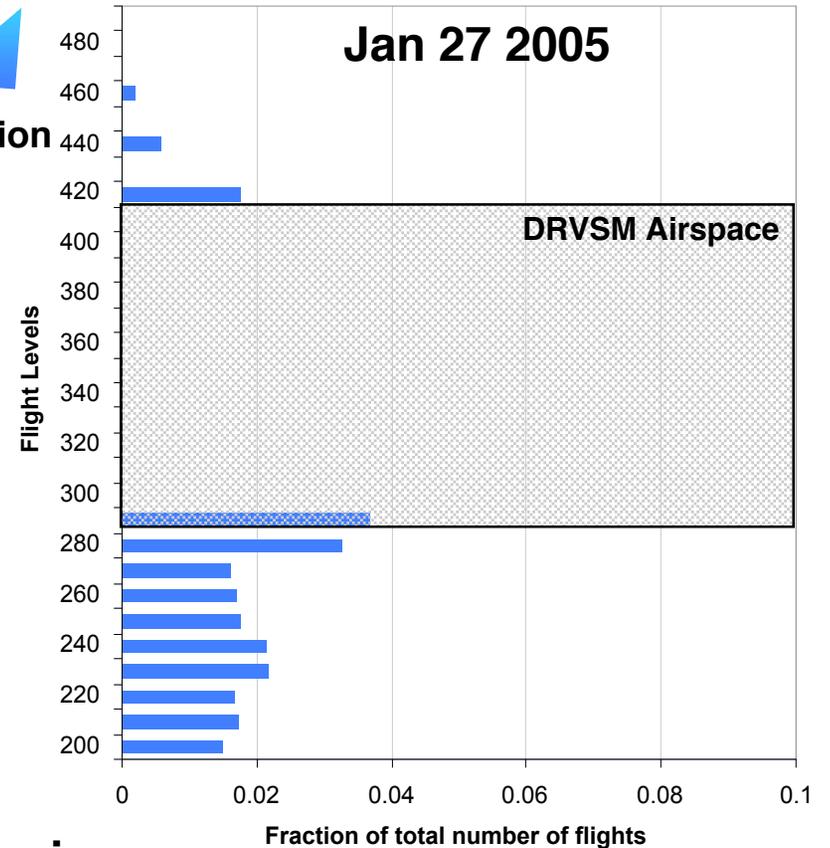
A first year fuel savings of \$393 million has been calculated for the domestic US due to DRVSM.



Implementation of DRVSM



DRVSM Transition
Jan 20 2005



Estimated Fuel Savings:

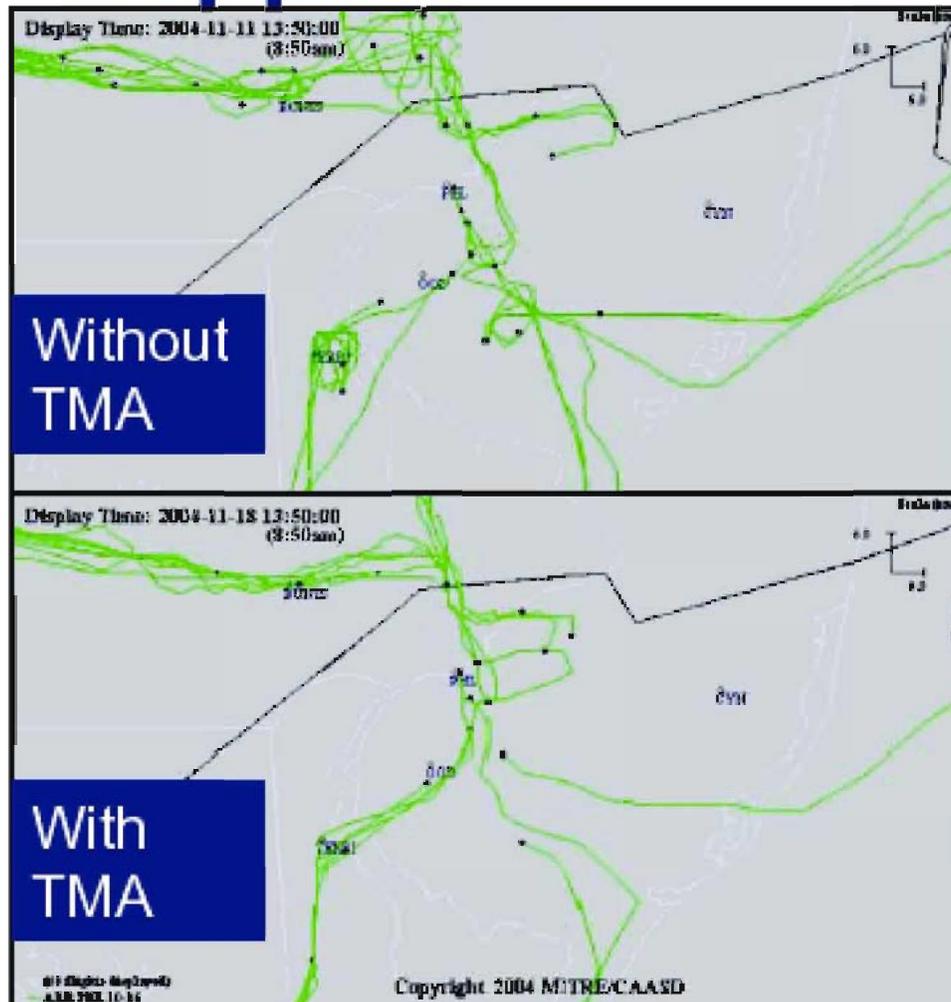
≈ 400 m\$ in 2005

≈ 5.3 B\$ from January 2005 to January 2016

Data source: FAA Cost Benefit Analysis published in the 61304 Federal Register / Vol. 68, No. 207 / Monday, October 27, 2003 / Rules and Regulations: 14 CFR Parts 11 and 91: Reduced Vertical Separation Minimum in Domestic United States Airspace; Final Rule

Note: The fuel saving benefits were based on 2003 fuel price forecast

OEP Commitments: Decision Support Tools



Traffic Management Advisor

Analyzes all arrival aircraft flight plans, weather data and local airport operating procedures and recommends the most efficient arrival sequence. Allows time-based metering.

Performance-Based Navigation

Area Navigation (RNAV) and Required Navigation Performance (RNP)

Presented to: RTCA Spring Symposium

By: Michael A. Cirillo

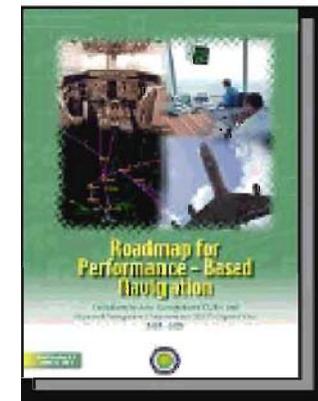
Vice President System Operations

Date: May 23, 2006



FAA's Roadmap

- Collaborative effort among aviation industry stakeholders
 - Performance-based Operations Aviation Rulemaking Committee (PARC)
- Three Planning Horizons (updated version)
 - Near-term 2003 to 2006 (2006 to 2010)
 - Mid-term 2007 to 2012 (2011 to 2015)
 - Far-term 2013 to 2020 (2016 to 2025)
- Harmonization considerations
- Focuses on operational capabilities in:
 - En route domain
 - RNAV Q-Routes
 - RNAV T-Routes
 - Terminal domain
 - RNAV Standard Terminal Arrivals (STARs)
 - RNAV Standard Instrument Departures (SIDs)
 - Approach domain
 - RNP Special Aircraft and Aircrew Authorization Required (SAAAR)
 - RNP Parallel Approach Transition



Update Planned for Summer
2006

Draft Roadmap Milestones (in Industry Coordination)

Near Term (2006-2010)

- ⇒ **En Route**
 - RNP-2 Q Routes
 - RNP-1 in selected areas high altitude
 - GPS Direct and RNAV T Routes
 - Lower MEAs on routes based on GPS
- Mandate RNAV above FL350
- ⇒ **Terminal**
 - RNAV SIDs/STARs at OEP Airports
 - Controller Tools for Merging and Spacing
 - RNP-2/1 SIDs/STARs in busy terminal areas
- ⇒ **Approach**
 - Complete Standards for Performance-based Approaches
 - Initial sites for Basic RNP
 - 25 RNP SAAAR per year
 - 300 LPV per year
 - Standards for closely spaced parallel and converging approaches (e.g., enhanced surveillance)

Mid Term (2011-2015)

- ⇒ **En Route**
 - RNP-2/1 Q Routes and Airspace
 - GPS Direct and RNAV T Routes
 - Lower MEAs
- Mandate RNP above FL290
- Mandate RNAV above FL180 and for arriving/departing at OEP Airports
- ⇒ **Terminal**
 - RNP 2/1 and RNAV SIDs/STARs
 - Merging and Spacing with Time of Arrival Control
- ⇒ **Approach**
 - Hundreds of Basic RNP, RNP SAAAR, and LPV per year
 - Standards for closely spaced parallel and converging approaches (e.g., improved surveillance)

Far Term (2016-2025)

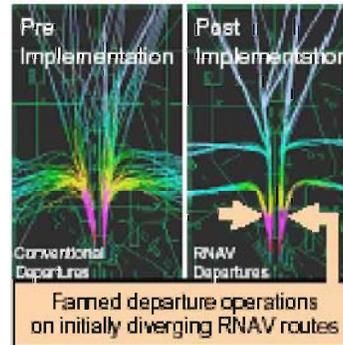
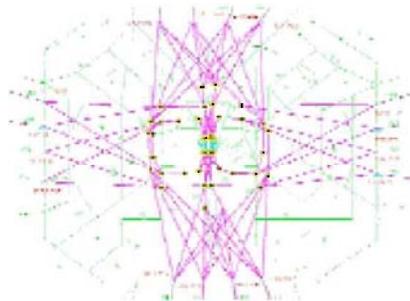
- ⇒ **Performance-based NAS Operations**
 - Optimized Airspace and procedures based on Required System Performance
 - 4D Trajectory Management
 - Delegation of separation tasks
- Mandate RNP in busy en route and terminal airspace
- Explore need for 4D, data link, and enhanced surveillance capability mandates



Benefits of RNAV SID Operations

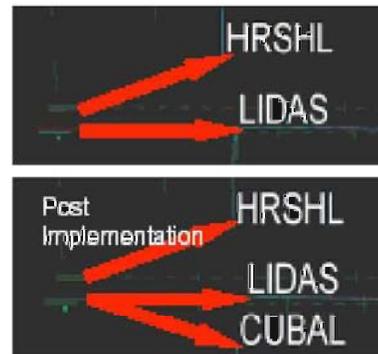
RNAV SID Procedures → Operational Change → Operational Benefits

DFW



- **Implemented 16 SIDs in 2005**
 - Approx 85% of 990 daily IFR departures are RNAV capable
- **Anticipated Benefits**
 - Structured “lanes” to en route airspace
 - Over 3,700 routine daily pilot/controller voice transmissions eliminated (40% reduction)
 - Validated estimates **-\$8.5M** annual benefits
 - Realized from delay and capacity benefits
 - Up to **~\$13M** with 100% RNAV

ATL



- **Implemented 13 SIDs and 4 STARs in 2005**
 - Publishing revised procedures in April 2006 (16 SIDs and 3 STARs) to support new runway and maximized efficiency
- **Anticipated Benefits**
 - Initial model estimates suggest departure delay reduction benefits that compare or likely exceed those at DFW
 - Earlier climb to en route altitudes enables reduced fuel burn
 - Reduced track distances enable fuel savings
 - Carriers predict annual savings from \$15-30M with revised procedures

Applications of RNP SAAAR Criteria

| Parallel Operations | Converging Operations | Adjacent Airport Operations | Single Runway Access |
|--|--|--|--|
| | | | |
| 10 to 15 Top Airports | 15 to 20 Top Airports | 10 to 15 Top Airports | Several hundred runway ends |
| Arrival capacity gains up to 60% over single runway operations | Arrival capacity gains up to 50% over single runway operations | Increased arrival and departure rates for adjacent airports involved | Approach minimums lower than existing minima |

SAAAR – Special Aircraft and Aircrew Authorization Required

Third Party Procedure Development

Enabling Criteria and Guidance

- AC 90-100 U.S. Terminal and En Route Area Navigation (RNAV) Operations
 - Airworthiness, Operational Approval, Operating Procedures, and Training guidance for RNAV Departure Procedures, RNAV Standard Terminal Arrivals, and RNAV routes
 - Currently in revision by FAA and Industry team to incorporate lessons learned and harmonize with international developments
- Order 8260.52 United States Standard for Required Navigation Performance (RNP) Approach Procedure with Special Aircraft and Aircrew Authorization Required (SAAAR)
 - Written for approach procedure designers to develop public RNP SAAAR instrument approach procedures
- Notice 8000.300 RNP SAAAR
 - This document outlines the operational approval process for special (non-14CFR Part 97) RNP SAAAR operations and addresses the implementation of special aircraft and aircrew authorization requirements similar to current ILS Category II/III approvals
- AC 90-101 Approval for RNP procedures with Special Aircraft and Aircrew Authorization Required (SAAAR)
 - Airworthiness, Operational Approval, Operating Procedures, and Training guidance for RNP SAAAR Instrument Approach Procedures
- AC 20-153 Acceptance of Data Processes and Associated Navigation Databases
 - How to evaluate whether data processes comply with the requirements of RTCA/DO-200A, Standards for Processing Aeronautical Data
 - How to obtain a Letter of Acceptance (LOA) from the Federal Aviation Administration (FAA)
 - How to define the aeronautical data quality requirements when obtaining airworthiness approval of new equipment or installations where the function of the equipment is dependent on an updateable database.



International Harmonization

- ICAO RNP Special Operations Requirements Study Group is primary forum for harmonization
 - Members include Australia, Brazil, Canada, EUROCONTROL, France, Japan, United Kingdom, United States, IATA, ICCAIA, IFALPA
 - Rewriting ICAO Doc 9613, *Manual on RNP* (to be renamed *Performance-Based Navigation Manual*)
 - Agreed on globally consistent definitions of RNAV and RNP
 - Agreed on “ICAO RNAV” – harmonized Europe’s P-RNAV and US RNAV
 - Performance-Based Navigation Implementation considerations & guidance
 - Publication planned for Fall 2006



ADS-B Plan

Proposed Schedule: Segments 1, 2, 3, 4

- **Segment 1 (2007 – 2010):**
 - Begin Avionics Equipage: FY 2007
 - Expand TIS-B / FIS-B Infrastructure: FY 2007 – FY 2010
 - Additional Aircraft to Aircraft Requirements Definition: FY 2007 – FY 2010
 - ADS-B “Out” Notice of Proposed Rulemaking (NPRM) Issued: FY 2007 / 2008
 - Begin Initial Aircraft to Aircraft Application Deployment: FY 2008
 - Targeted ADS-B Infrastructure Deployment: FY 2010

- **Segment 2 (2010 – 2014):**
 - ADS-B “Out” Final Rule Published: FY 2010
 - Continue Initial Aircraft to Aircraft Application Deployment: FY 2010 – FY 2014
 - Additional Aircraft to Aircraft Application Deployment: FY 2010 – FY 2014
 - Additional Aircraft to Aircraft Requirements Definition: FY 2010 – FY 2014
 - Complete TIS-B / FIS-B Deployment: FY 2012
 - Complete ADS-B NAS Wide Infrastructure Deployment: FY 2013
 - Complete 40% Avionics: FY 2014

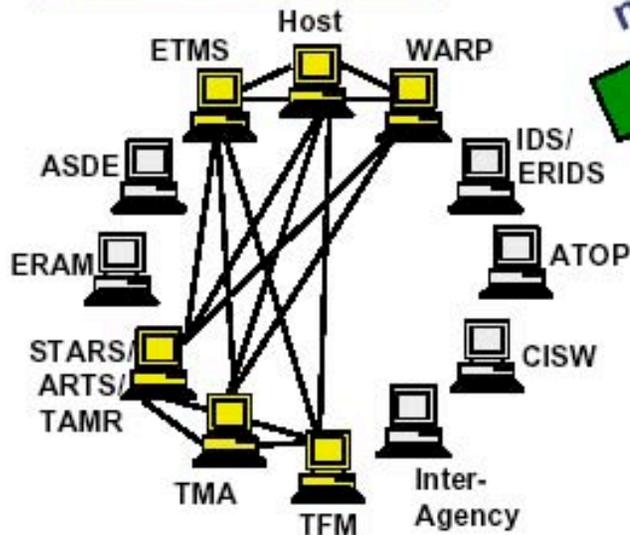
- **Segment 3 (2015 – 2020):**
 - Additional Aircraft to Aircraft Requirements Definition: FY 2015 – FY 2020
 - Additional Aircraft to Aircraft Application Deployment: FY 2015 – FY 2020
 - Targeted Removal of Legacy Surveillance: FY 2018 – FY 2020
 - Complete 100% Avionics: FY 2020
 - Complete Initial Aircraft to Aircraft Application Deployment: FY 2020

- **Segment 4 (2021 – 2025):**
 - Complete Removal of Targeted Legacy Surveillance: FY 2023
 - Complete Targeted Removal of TIS-B: FY 2025
 - Complete Additional Aircraft to Aircraft Application Deployment: FY 2025

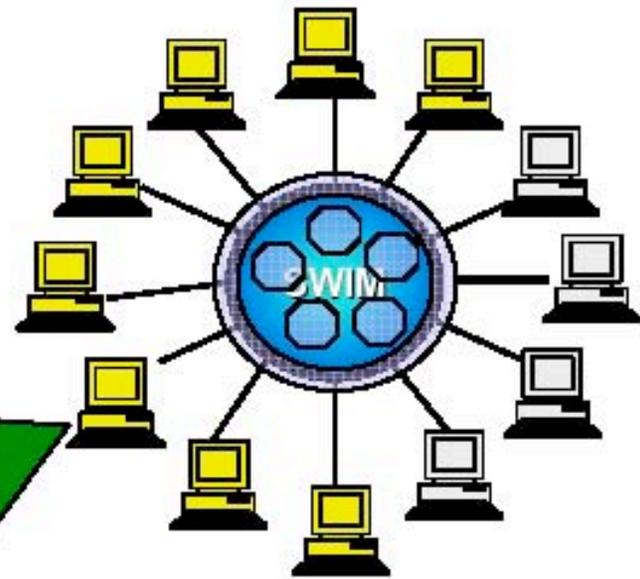


System Wide Information Management

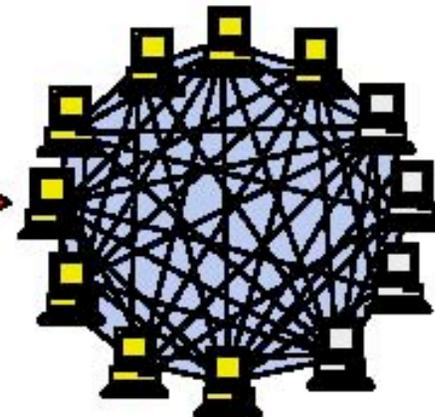
Today's Paradigm



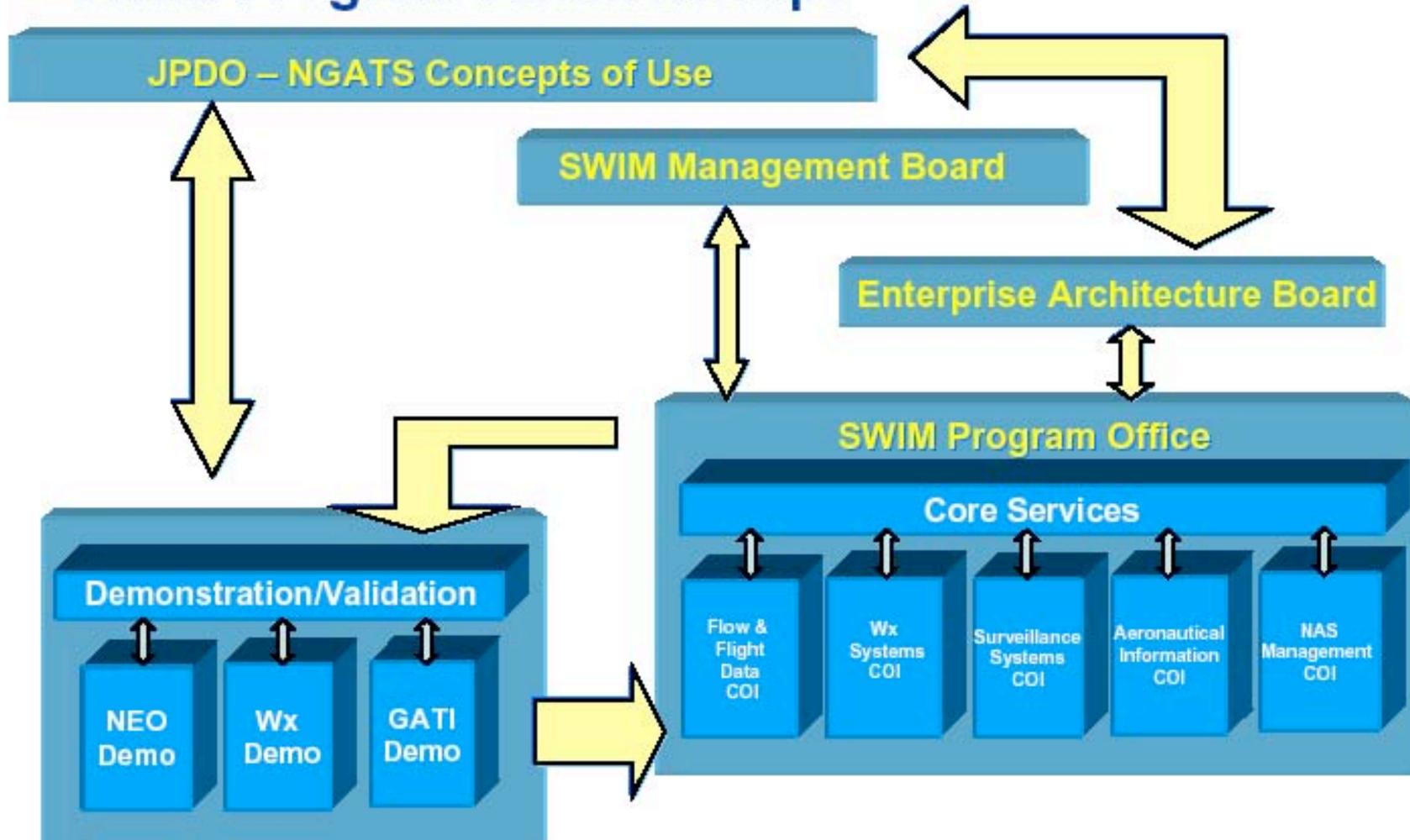
Enterprise management



Business as usual



SWIM Program Relationships



2025 NGATS Concept

Operating Principles

- "It's about the users..."
- System-wide transformation
- Prognostic approach to safety assessment
- Globally harmonized
- Environmentally compatible to enable continued growth

Key Capabilities

- Net-Enabled Information Access
- Performance-Based Services
- Weather-Assimilated Decision Making
- Layered, Adaptive Security
- Broad-Area Precision Navigation
- Trajectory-Based Aircraft Operations
- "Equivalent Visual" Operations
- "Super Density" Operations



NGATS Snapshot

Next Generation Air Transportation System
Joint Planning and Development Office

Guiding Principles

- System-wide transformation
- Prognostic approach to risk management
- Globally harmonized
- Environmentally friendly to foster continued growth

Key Capabilities

- Net-Enabled Information Access
- Performance-Based Services
- Weather-Assimilated Decision Making
- Layered, Adaptive Security
- Broad-Area Precision Navigation
- Trajectory-Based Aircraft Operations
 - Dynamic Use Airspace
- "Equivalent Visual" Operations
- "Super Density" Operations



Objectives:

- **Retain US leadership in global aviation**
- **Expand capacity by at least 3X**
- **Ensure current level of safety**
- **Protect the environment**
- **Ensure our national defense**
- **Secure the nation**



Net-Enabled Information Access

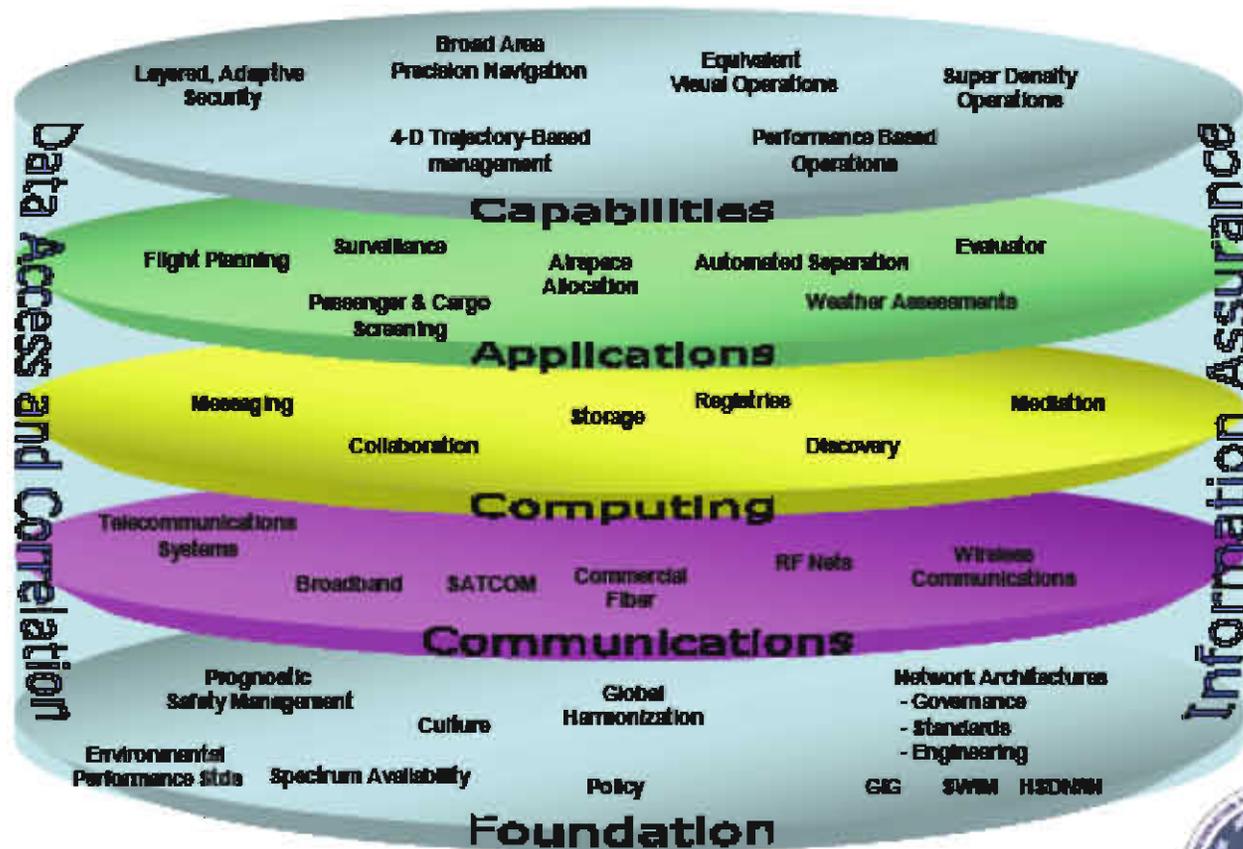
Global secure access, information handled according to "communities of interest"



- **"Shared Situation Awareness"**
 - Ø Real-time free-flow of info from private, commercial, & government sources, integrated internationally
 - Ø Tailored, responsive and secure
 - Ø Push/pull processes
 - Ø Common awareness of day-to-day ops, events, crises
- **Aircraft are integral "nodes" in network**
- **Integrated cooperative air traffic and non-cooperative national security surveillance**



Information Sharing: Foundation to Capabilities



Performance-Based Services

Service levels designed to capability performance

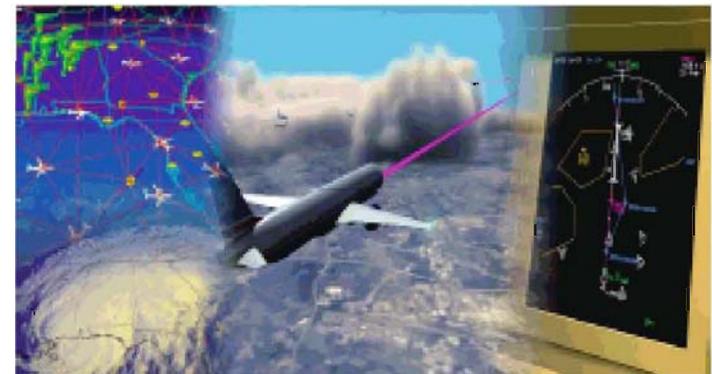
- **Multiple service levels aligned with specified user performance thresholds**
 - ∅ Provides choice to users depending on needs
 - ∅ Required Communication, Navigation and Surveillance performance
 - ∅ Environmental performance criteria
 - ∅ Security parameters, etc.
- **Services flexible to varying situations/needs**
 - ∅ Varies from area to area, in terms of airspace and "air portal" surfaces
 - ∅ Varies with time as needs dictate
 - ∅ Preference established based on user capability/equipage/training/security etc.
- **Performance-based approach used to analyze risks (safety, security, environment, etc) instead of "equipment-based" approaches**
- **Service guarantees let users align performance with needs**
 - ∅ Developed cooperatively by service providers and their users
 - ∅ Opens opportunities trans-nationally, globally



Weather Assimilated into Decisions

Common weather picture across NGATS

- Fuse global weather observations and forecasts into single database, dynamically update as needed
 - ∅ Tens of 1000's of sensors (airborne & ground) feed 100's of forecast models
- Learning automation accounts for weather and its uncertainties in managing aircraft trajectories
- Identify hazardous weather real-time
- Assimilated into NGATS "decision loops"
 - ∅ Total integration via machine-to-machine
 - ∅ Critical decision system time scales using both probabilistic and deterministic weather info
 - ∅ Optimized to maximize available weather-favorable airspace
 - ∅ Terminal weather impacts including ground/ramp ops and adaptability due to wind shift changes



Layered, Adaptive Security

Move people/goods expeditiously from "curb-to-curb" while ensuring protection from foreign & domestic threats



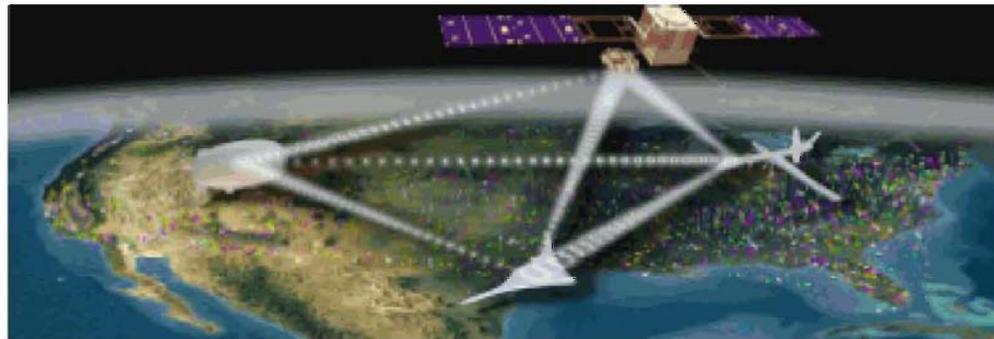
- **Adaptive Security for People, Cargo, Airports and Aircraft**
- **Risk Assessment-Driven Evaluation and Response**
- **Positive Identification for People and Cargo**
- **Preventive Threat Detection and Mitigation**



Broad-Area Precision Navigation

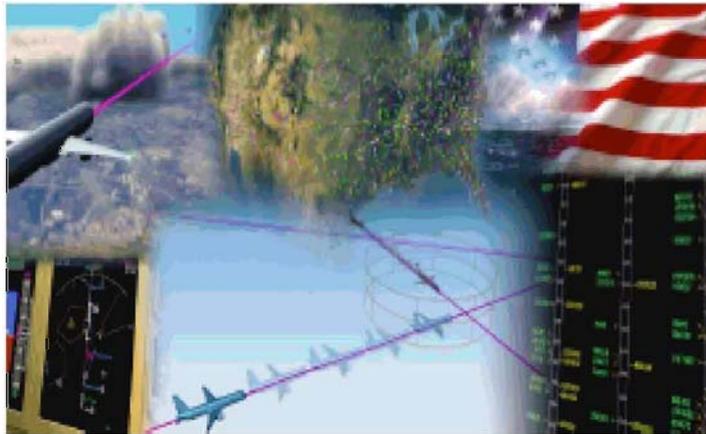
Large area precision enables flexibility

- **Navigation performance sufficient to enable precision approaches (CAT-I/II/III)**
 - Ø Minimal/zero ground-based aids at any "air portal"
 - Ø "Air portal"-specific, vice runway-specific
- **Broad-Area to Global Availability of Nav Services**
 - Ø Meeting appropriate requirements for accuracy, integrity and continuity
- **Reduction/elimination of legacy systems & procedures**



Aircraft Trajectory-Based Operations

Adjust airspace configuration to meet user needs

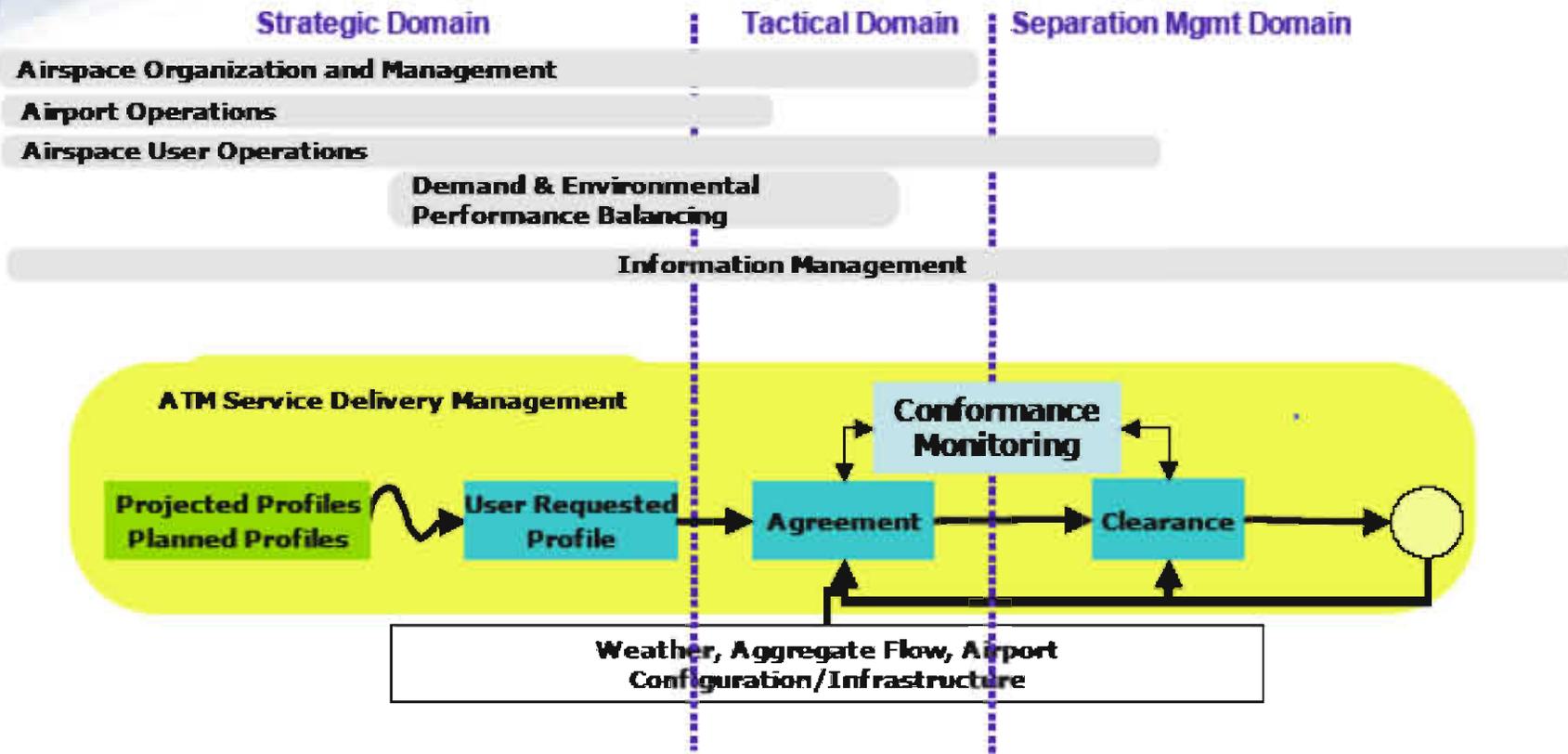


- 4D trajectories (including taxi and roll-out) are basis for planning and execution
- Machine-based trajectory analysis and separation assurance
- Includes environmental performance throughout all phases of aircraft operations
- Airspace configuration driven by: DoD/DHS requirements, domestic & international user needs, requirements for special-use airspace, safety, environment, overall efficiency
- Airspace reconfigurable during day of operations
- Users "contract" for airspace access and service



Aircraft Trajectory-Based Operations: Management-by-Trajectory

Next Generation Air Transportation System
Joint Industry and Government Effort



Key Issues are functional allocation between:

- Ø Automation and humans
- Ø Aircraft operators and service provider



Aircraft Trajectory-Based Operations: *National Dynamic Airspace*

- **Freedom from static geospatial constraints**
- **Airspace configured/allocated as a resource to meet demand**
 - Ø Temporal implementation of high-density, high demand corridors, etc
 - Ø Creates options for service provider operations
 - Ø Environmental parameters integral to allocation
- **Single mechanism for implementing Special Use Airspace, TFR's, etc**
 - Ø Maximizes airspace access to all
 - Ø Defense, Homeland Security needs are prioritized



Aircraft Trajectory-Based Operations: "Evaluator"



- Integrates/communicates weather, security, defense, environmental, safety, international considerations, other information
- Users "post"/update desired 4D trajectories in common system that continuously evaluates mutual compatibility
- Predicts potential "over demand" situations, in multiple "capacity dimensions"—traffic density, environmental, security, etc.
- Works across all time horizons from days/weeks/months prior to flight up to separation management (20 minutes or less)
- Supports distributed decision-making environment where players have clear, agreed-upon roles and interactions



Equivalent Visual Operations

Increasing capacity from today's non-visual conditions

- Aircraft perform **"equivalent visual"** operations in non-visual conditions (achieve "VFR capacity" under these conditions)
- ATM provider delegates **"maintain separation"** responsibility to aircraft operators
 - ∅ Requires timely, high fidelity information on nearby aircraft, weather, etc
- **System-wide availability** at all air portals
 - ∅ With appropriately capable "landside" (including security)
- **Greater predictability of operations** at busy airports, including ground operations



Super Density Operations

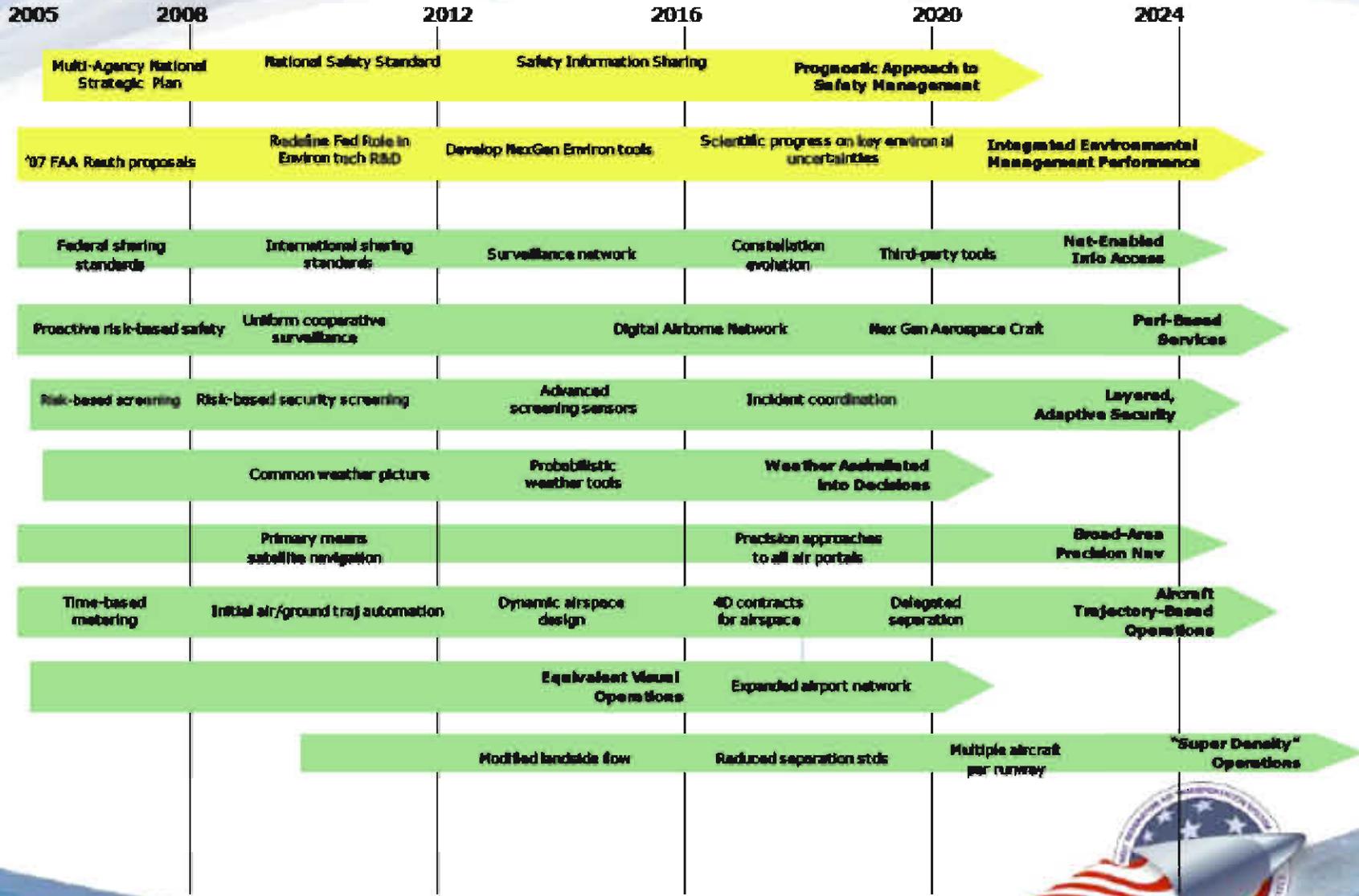
Peak performance for the busiest airports

- **Maximized, environmentally acceptable runway capacity**
 - Ø Reduced arrival/departure spacing
 - Ø Equivalent Visual capability
 - Ø Predictable detection/integration of wake vortex hazards
- **Reduce Runway Occupancy Time**
 - Ø Aircraft energy management during rollout coupled with optimum turnoff selection
 - Ø Situational awareness of “nearby” surface traffic and intent for high-speed turnoff
- **Simultaneous operations on single runway**
 - Ø Multiple aircraft operate on single runway when sufficient “separation” exists
 - Ø High-update rate surveillance info available to all aircraft
- **Incorporates required environmental performance during all operations**
- **Airport “landside” (including security) sized accordingly**



Migration Roadmap

Next Generation Air Transportation System
Joint Industry and Government Effort



NGATS Operational Improvements and Benefits

1. **Broad Area and Precision Navigation ▶ Access and capacity**
2. **Airspace Access and Management ▶ Capacity**
3. **4D Trajectory Based ATM ▶ Capacity and efficiency**
4. **Reduced Separation between Aircraft ▶ Capacity**
5. **Flight Deck Situational Awareness and Delegation ▶ Capacity and safety**
6. **ATM Decision Support ▶ Capacity**
7. **Improved Weather Data and Dissemination ▶ Capacity and safety**
8. **Reduced Cost to Deliver ATM services ▶ Cost**
9. **Greatly Expanded Airport Network and Improved Terminals ▶ Capacity**

For more detail see Operational Improvement Roadmap in the Tech Hanger section of JPDO Website www.jpdo.aero

NGATS Evolution

ATM Research

FY05 & Earlier

- 4DT & "Flight Object"
- Space Based NAV
- RNP/RNAV
- ADS-B/CDTI
- Decision Support Tools

FY06 – FY11

- 4DT Management
- RTSP & Levels of Service
- Equivalent Visual Ops (CDTI)
- Roles of Pilots & Controllers

FY12 – FY17

- Safety Case for Super Density Operations
- 4DT on Surface
- Right Sizing of Facilities

FY18 & Later

- Research for Beyond NGATS

Building NGATS

Establish NGATS Infrastructure

Segments: 0, 1, & 2

Develop: 06-11

Implement: 08-13

- Deploy critical infrastructure for NGATS operations
 - ADS-B, DL, RNP, NEO
- Policy: Establish aircraft equipage rules
 - NAS wide (ADS-B "OUT", NAV)
 - Airspace/Route access based on RTSP (CDTI, DL, Lower RNP)
- Commercial fleet equips for NGATS
- Capacity benefits realized by those equipped and the system

Primary NGATS Operations

Segments: 3, 4, & 5

Develop: 12-17

Implement: 14-19

- Equipage of all aircraft completed for NGATS
- Airspace/Route access and Level of Service based on RTSP
- Most of NGATS capacity gains realized
 - 4DT Management (Runway-to-Runway)
 - VMC rates achieved in IMC
 - Delegation to flight deck for self-separation, merging, and passing

NGATS Super Density Operations

Segments: 6 & 7

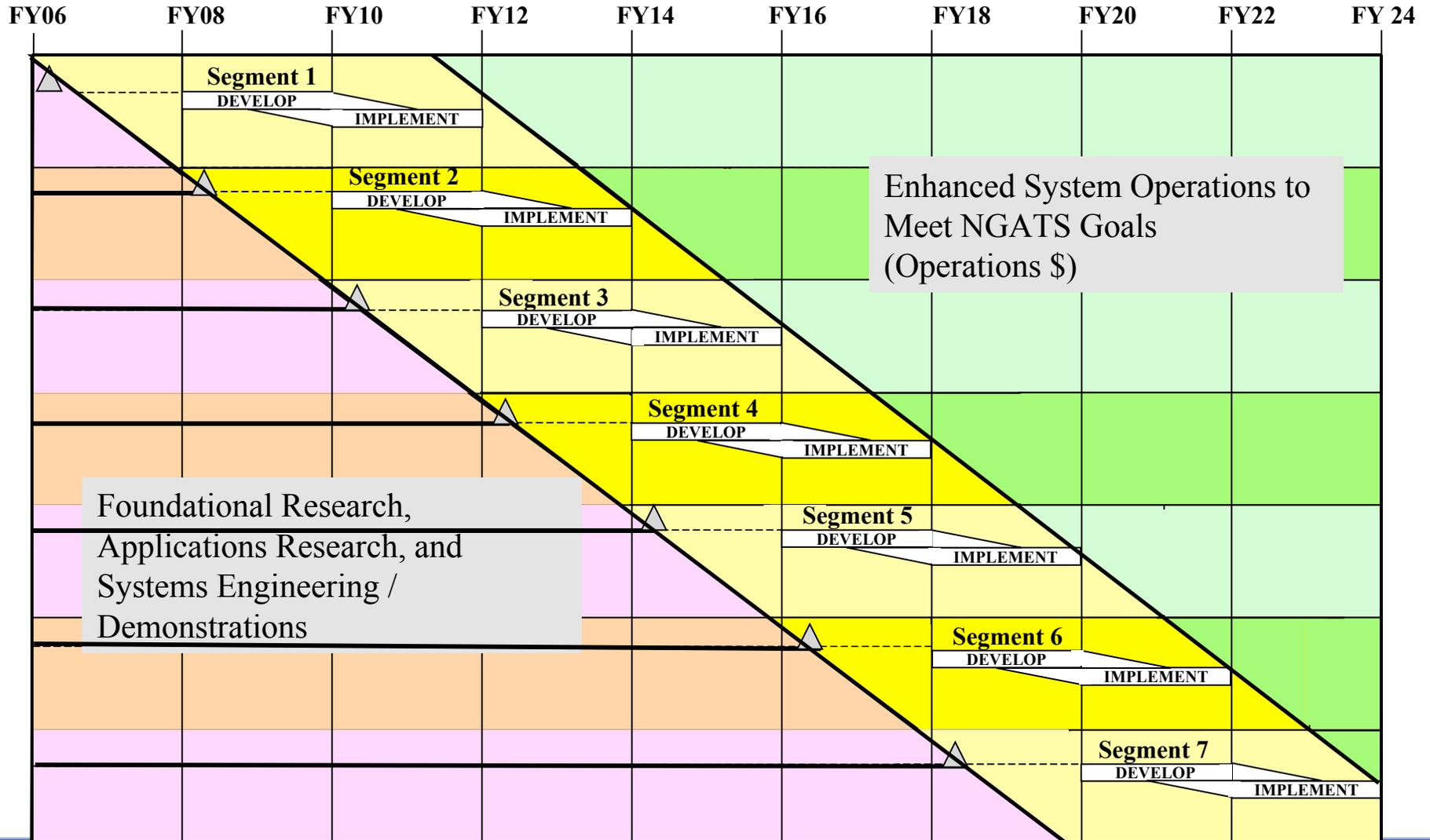
Develop: 18-21

Implement: 20-23

- Airports network expanded
- Capacities of congested airports further increased
 - 4DT Management (Gate-to-Gate)
 - Reduced Runway Lateral Spacing
- Complete reduction of facilities and NAV & surveillance infrastructure



Transition to NGATS



Source: John Scardina JPDO



Broad Area and Precision Navigation

| Segment | Operational Improvement |
|---------|---|
| 1 | _ RNAV is made available for general aviation by certifying portable GPS/WAA units for VFR use |
| 2 | _ RNP routes are available to/from all runways at OEP airports |
| 3 | _ CAT I/II approaches are available at all runway ends throughout the NAS without ground augmentation _ Area navigation routes with lower RNP are available NAS-wide |
| 5 | _ RNP routes are available to/from all runways at top 100 airports _ CAT III approaches are available where needed, with augmentation |
| 6 | _ RNP routes are available to/from all desired airports |



Airspace Access and Management

| Segment | Operational Improvement |
|---------|--|
| 1 | <ul style="list-style-type: none">– RTSP serves as the basis for airspace and route access and level of service– General aviation corridors are established in Class B airspace to ensure efficient and safe movement of aircraft |
| 2 | <ul style="list-style-type: none">– Systems and airspace policies are in place that increase civilian access to SUA and flow restricted airspace |
| 4 | <ul style="list-style-type: none">– Arrival/departure terminal airspace boundaries in large metro-area are dynamically configured to meet flow requirements |
| 5 | <ul style="list-style-type: none">– Air-ground data communication (addressable and broadcast) is used to support improved access to SUA and flow restricted airspace– All airspace is dynamically configured to meet flow requirements |



4D Trajectory Management

| Segment | Operational Improvement |
|---------|--|
| 1 | <ul style="list-style-type: none">_ Flight planning is based on 4D trajectories for commercial aircraft that fly in high altitude airspace_ Trajectories are available with variable separation to accommodate special classes of aircraft (e.g., UAS, A380) |
| 2 | <ul style="list-style-type: none">_ Flight planning is based on 4D trajectories for all aircraft that fly in high altitude airspace |
| 3 | <ul style="list-style-type: none">_ All aircraft in high altitude airspace are managed by 4D trajectories, with trajectories exchanged via data communications |
| 4 | <ul style="list-style-type: none">_ Management by 4D trajectories is expanded to additional airspace, with trajectories exchanged via data communications |
| 5 | <ul style="list-style-type: none">_ All aircraft departing from or arriving at OEP airports file 4D runway-to-runway trajectories_ Trajectory management is enhanced by auto negotiation with properly equipped aircraft |
| 6 | <ul style="list-style-type: none">_ All aircraft departing from or arriving at OEP airports will file 4D gate-to-gate trajectories |

Source: John Scardina JPDO



Reduced Separation between Aircraft

| Segment | Operational Improvement |
|---------|--|
| 1 | <ul style="list-style-type: none"> _ 3-mile and 5-mile separation procedures are applied to new airspace based on RSP _ RSP standards are established for surface operations (control off glass) |
| 2 | <ul style="list-style-type: none"> _ Oceanic longitudinal and lateral spacing is reduced to 15 X 15 nm by use of RNP, ADS and data communications |
| 3 | <ul style="list-style-type: none"> _ Lateral separation requirements are reduced for converging and parallel runway operations based on use of RTSP, CDTI and ADS-B |
| 4 | <ul style="list-style-type: none"> _ Procedures based on RTSP for less than 3 mile separation are implemented _ Longitudinal arrival and departure spacing are dynamically adjusted at OEP airports, based on ground-based wake vortex detection and prediction |
| 5 | <ul style="list-style-type: none"> _ 5 mile separation procedures are used in some oceanic airspace via enhanced CNS and CDTI (lower RTSP) _ Multiple runway occupancy procedures for single runway arrivals are available at all OEP airports |
| 6 | <ul style="list-style-type: none"> _ Reduced arrival spacing (with altitude offset) is allowed for very closely spaced parallel runways at OEP airports _ Multiple runway occupancy procedures for single runway departures are available at all OEP airports |
| 7 | <ul style="list-style-type: none"> _ Reduced arrival spacing (co-altitude) is allowed for very closely spaced parallel runways at appropriate OEP airports |

Source: John Scardina JPDO



Flight Deck Situational Awareness and Delegation

| Segment | Operational Improvement |
|---------|---|
| 1 | <ul style="list-style-type: none"> <li data-bbox="405 444 1923 503">_ Oceanic pair-wise maneuvers (in-trail climbs, descents and passing maneuvers) are enabled through the use of ADS-B, CDTI and satellite-based communications <li data-bbox="405 529 1692 561">_ Increased use of visual approaches is supported by ADS-B and CDTI-aided visual separation (CAVS) <li data-bbox="405 587 1539 620">_ Self-spacing at near VFR levels on single runway approaches is enabled by CDTI, ADS-B <li data-bbox="405 646 1524 678">_ Departures rates in reduced visibility/ceilings are increased by use of ADS-B and CAVS |
| 2 | <ul style="list-style-type: none"> <li data-bbox="405 703 1854 761">_ Self spacing, merging and passing in en route airspace is allowed under certain conditions in certain airspace via CDTI, ADS-B |
| 3 | <ul style="list-style-type: none"> <li data-bbox="405 794 1835 852">_ Aircraft and ground vehicle movement on the airport surface in low visibility conditions is guided by moving map displays, CDTI, and ADS-B at OEP airports. |
| 5 | <ul style="list-style-type: none"> <li data-bbox="405 885 1902 943">_ Aircraft-to-aircraft separation is delegated to the flight deck in some oceanic airspace via CDTI and improved CNS and oceanic automation <li data-bbox="405 969 1892 1027">_ High density en route corridors (tubes) are in use and are characterized by parallel tracks and delegation of separation responsibility to the flight deck via CDTI and ADS-B <li data-bbox="405 1053 1682 1086">_ Self-spacing with CDTI/ADS-B coupled with sequencing automation is in use at non-towered airports <li data-bbox="405 1112 1919 1170">_ Aircraft and ground vehicle movement on the airport surface in zero/zero visibility conditions is guided by moving map displays, CDTI, and ADS-B at OEP airports. |
| 6 | <ul style="list-style-type: none"> <li data-bbox="405 1205 1835 1263">_ Aircraft and ground vehicle movement on the airport surface in low visibility conditions is guided by moving map displays, CDTI, and ADS-B at all desired airports |
| 7 | <ul style="list-style-type: none"> <li data-bbox="405 1295 1919 1354">_ Aircraft and ground vehicle movement on the airport surface in zero/zero visibility conditions is guided by moving map displays, CDTI, and ADS-B at all desired airports |

Source: John Scardina JPDO



ATM Decision Support

| Segment | Operational Improvement |
|---------|--|
| 2 | <ul style="list-style-type: none"> _ Departure Management incorporates surface traffic information reduces the time to develop and execute Traffic Management Initiatives (TMIs) and increases the predictability of departure times _ Probabilistic weather information is incorporated into 4D trajectory flight planning decision support tools |
| 3 | <ul style="list-style-type: none"> _ Timely and accurate weather information is available to all automated decision support tools _ Arrival scheduling and sequencing tools are used to flow aircraft from en route airspace to individual arrival runways at all OEP airports _ A Surface Management System is available at all OEP airports that uses automation, ADS-B, CDTI/aircraft moving map displays, and data linked taxi instruction prior to pushback _ RTSP-based TMI allow “multiple TMI what-if analysis” and are incorporated into TFM automation |
| 4 | <ul style="list-style-type: none"> _ Time-based and metered RNP routes are assigned by Decision Support Tools (DSTs) for aircraft arriving/departing at all OEP airports _ A Surface Management System is available at all OEP airports that is used to generate data linked taxi instructions prior to final approach _ Flight Operations Center (FOC) automation and net-centric data-sharing mechanisms are implemented with service providers to allow flight planning feedback and negotiatio mechanism |
| 5 | <ul style="list-style-type: none"> _ Integrated Arrival/Surface/Departure Manager improves decision making and flow management _ Time-based surface traffic management is used at all OEP airports |
| 6 | <ul style="list-style-type: none"> _ Time-based and metered RNP routes are assigned by DSTs for aircraft arriving/departing at the top 100 airports |

Source: John Scardina JPDO



Improved Weather Data and Dissemination

| Segment | Operational Improvement |
|---------|--|
| 1 | <ul style="list-style-type: none"> _ Improved and automated upper-air wind and weather observations allow more accurate flight planning _ In-flight icing and turbulence forecasts are improved due to additional data from aircraft-based weather sensors _ New transoceanic weather products (e.g., convection, volcanic ash, in-flight icing, clear air turbulence, and convection-induced turbulence) are available _ Improved airport weather sensors support improved airport operations |
| 2 | <ul style="list-style-type: none"> _ A single national weather virtual database ensures a common aviation weather picture. This common picture enables improved NGATS decision making and leads to improved recovery from disruption _ Digital weather information are broadcast to the flight deck via UAT FIS-B |
| 3 | <ul style="list-style-type: none"> _ Robust network-centric disseminates weather information to users _ Enhanced Echo Top mosaic and forecast are available that facilitate over-the-top routing _ Improved weather forecasts are provided to minimize the predicted volume of airspace impacted by weather |
| 4 | <ul style="list-style-type: none"> _ Runway reconfiguration forecasts are improved through new sensors and improved forecast products _ Advisories, in-flight weather information, and alerts are immediately available to all system users (controller, pilots, airline operation centers, and airport operations managers) via net-centric architecture |
| 5 | <ul style="list-style-type: none"> _ A depiction of hazardous weather impacting the NAS is available to all users _ Hazardous weather information and alerts (particularly wind shear and microbursts) are provided to pilots and controllers by an Automatic Hazardous Weather Alert Notification System using voice circuits, ground based transceivers, and air-ground data communication |

Source: John Scardina JPDO



Reduced Cost to Deliver ATM Services

| Segment | Operational Improvement |
|---------|---|
| 1 | <ul style="list-style-type: none"> _ A decision is made regarding backup systems for surveillance and navigation _ NDB ground-based navigation aids are shut down |
| 2 | <ul style="list-style-type: none"> _ NAS-wide transition to ADS-B for air/ground surveillance is completed |
| 3 | <ul style="list-style-type: none"> _ VOR/DME ground-based navigation network is reduced to minimize sustainment costs and to reduce reliance on terrestrial-based systems |
| 4 | <ul style="list-style-type: none"> _ Arrival/departure terminal airspace boundaries and sectors in large metro-area are dynamically configured to increase resource efficiency and balance capacity with demand |
| 5 | <ul style="list-style-type: none"> _ En route airspace is dynamically reconfigured during the day within a facility to increase resource efficiency and balance capacity with demand _ Tower functions at all but high capacity airports are remoted (virtual towers) _ Terminal facilities are combined and reduced to 30-55 facilities |
| 7 | <ul style="list-style-type: none"> _ En route and terminal facilities are combined and reduced to 15 ground service delivery facilities _ ILS is shut down at all but CAT III approach locations |

Source: John Scardina JPDO



Significant Transformation

Trajectory-Based Operations

NGATS Capability

- All operators share flight intent information via four dimensional trajectories (4DTs); the level of specificity varies according to overall system needs to handle demand
 - Automation manages greater amounts of information on overall demand and forecast conditions and better incorporates probabilistic data to reduce the likelihood of overly conservative decisions
 - Metering, Controlled Time of Arrival (CTA) exchange, and more flight-specific adjustments increase overall throughput and operator efficiency
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Significant Transformation

Performance-Based Operations and Services

Collaborative Traffic Flow Management (ANSP and Flight Operators)

NGATS Capability

- Regulatory definition of operational requirements in performance terms rather than specific technology/equipment enables private sector innovation
 - ANSP service levels aligned with aircraft performance capabilities, allowing aircraft operators to realize the full benefits enabled by their equipment capability
 - Focus is on allocating NAS assets to maximize capacity to meet user demand
 - Integrated strategic and tactical flow management (TFM) with more agile management of TFM to capitalize on evolving conditions exists
 - Better decision support increases ability to use capacity in presence of uncertainty
-



| Significant Transformation | NGATS Capability |
|---------------------------------------|--|
| Allocation of Airspace | <ul style="list-style-type: none">• Airspace allocation is flexible over different time horizons to meet demand, and flexible over different geographic and vertical boundaries. Airspace restrictions for aircraft capability are applied only when needed• Changes to airspace configuration are provided dynamically to flight crews so that maximum trajectory flexibility to utilize all available airspace |
| Separation Management | <ul style="list-style-type: none">• Separation provision, both airborne or by the ANSP, relies heavily on automation support, allowing reduced and performance-based separation standards for different airspace categories• 4DTs of many aircraft following similar routes may be aligned to nearly eliminate conflicts• Trajectory changes required for separation assurance are communicated via digital communications |
| Weather/Automation Integration | <ul style="list-style-type: none">• Enhanced probabilistic forecasting coupled with network-enabled operations and decision support tools predict best options and facilitate 4DT planning and execution for minimal weather disruption |