

# Implementing NextGen

Next Generation Air Transportation System



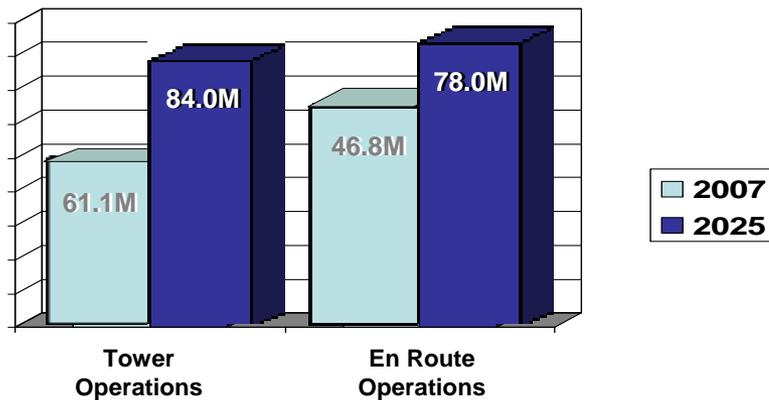
**Presented By:**  
**Date:**

**Ann Tedford**  
**September 2008**

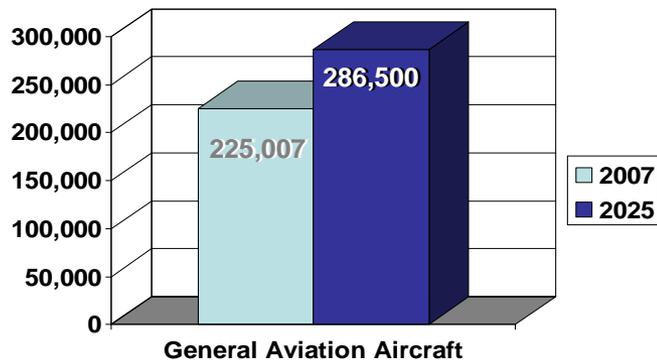


Federal Aviation  
Administration

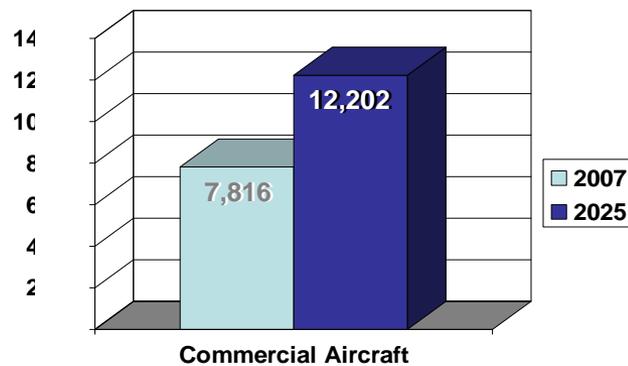
# The Need for NextGen...Growing Demand



*Operations*



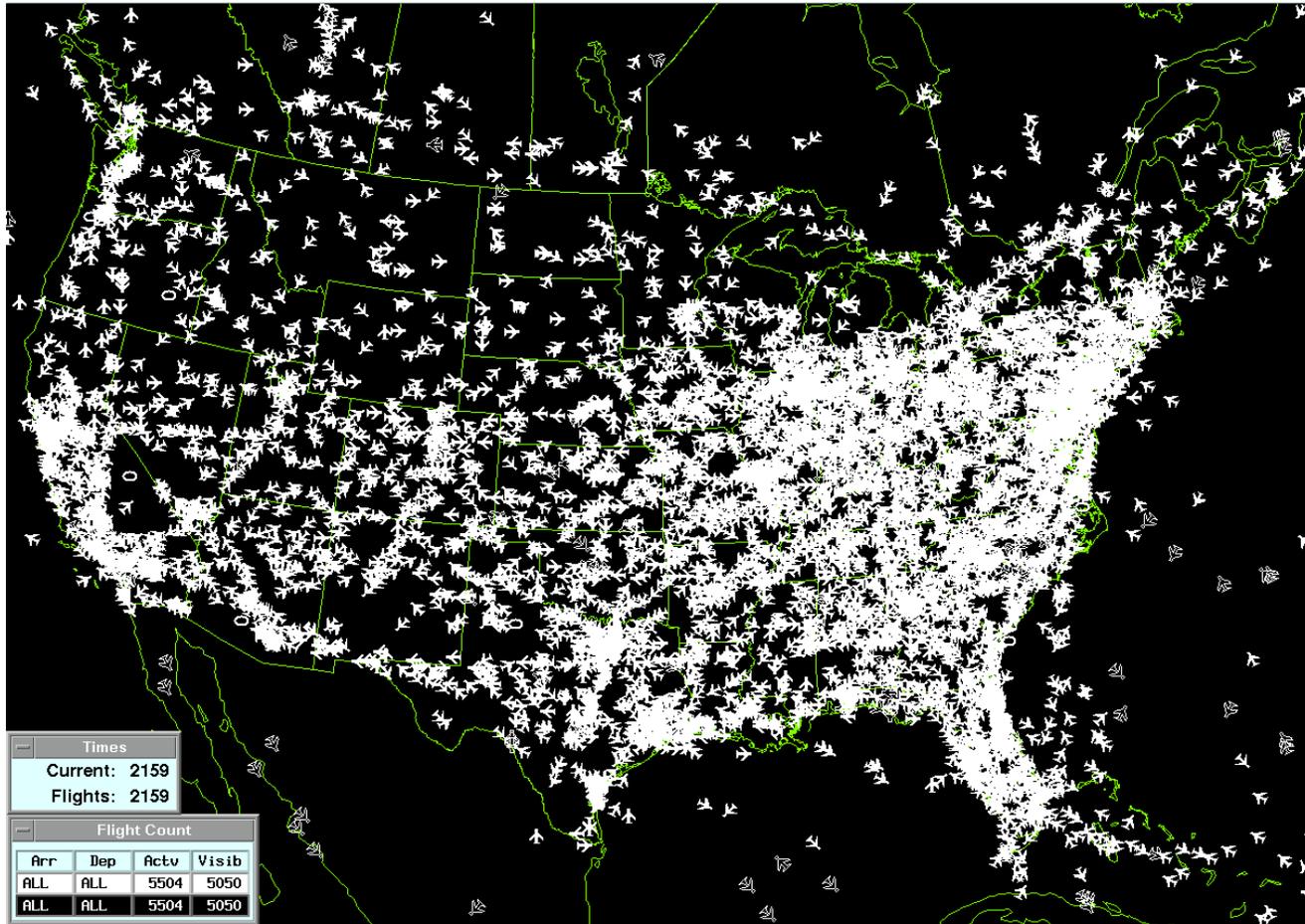
*General Aviation*



*Commercial Aviation*

\* FAA 2008-2025 Forecast

# Our National Airspace System in the Air



Peak aircraft traffic over the US

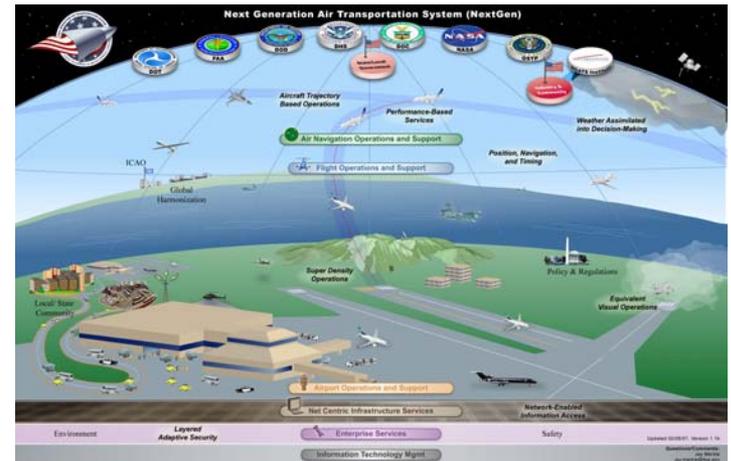
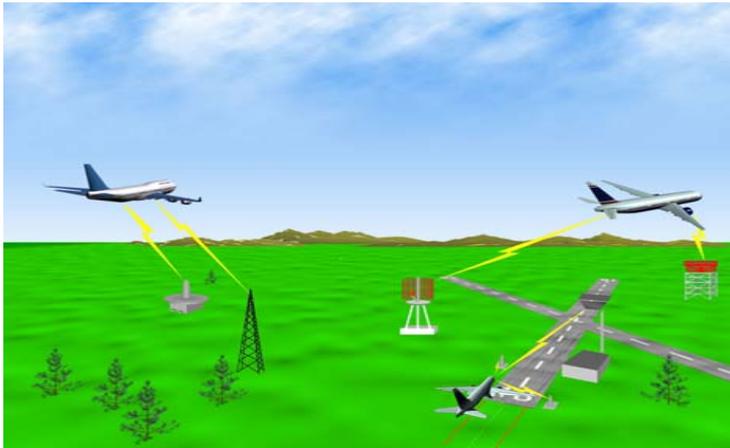
# NextGen: Improving Service Delivery

## Today's NAS

- Ground-based Navigation and Surveillance
- Air Traffic Control Communications By Voice
- Disconnected Information Systems
- Air Traffic "Control"
- Fragmented Weather Forecasting
- Airport Operations Limited By Visibility Conditions
- Forensic Safety Systems

## NextGen

- Satellite-based Navigation and Surveillance
- Clearance Trajectories and Routine Information Sent Digitally
- Information More Readily Accessible
- Air Traffic "Management"
- Forecasts Embedded into Decisions
- Operations Continue Into Lower Visibility Conditions
- Prognostic Safety Systems



# NextGen Integration and Implementation



## Joint Planning and Development Office (JPDO)

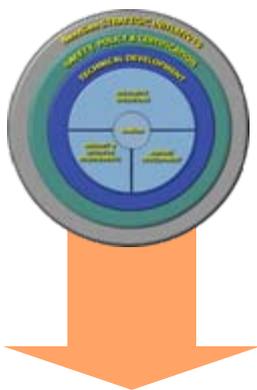
Seven US Government Departments and Agencies

System users and manufacturers included

Nine Government and Industry working groups

Defined the *NextGen Vision* and Concept of Operations for 2025

Addresses cross-agency needs, issues, and concerns



## FAA's Integration & Implementation Office

*Integrates* and *manages* the work required to implement each operational capability, including:

- Research
- Technical requirements
- ATC equipment
- Aircraft avionics
- Airspace redesign
- Procedures
- Rulemaking
- Certification

Operational Capabilities

# Next Generation Air Transportation System (NextGen)



Environment

**Layered Adaptive Security**

**Enterprise Services**

Safety

**Information Technology Mgmt**

Updated 02/06/07, Version 1.1b

Questions/Comments:  
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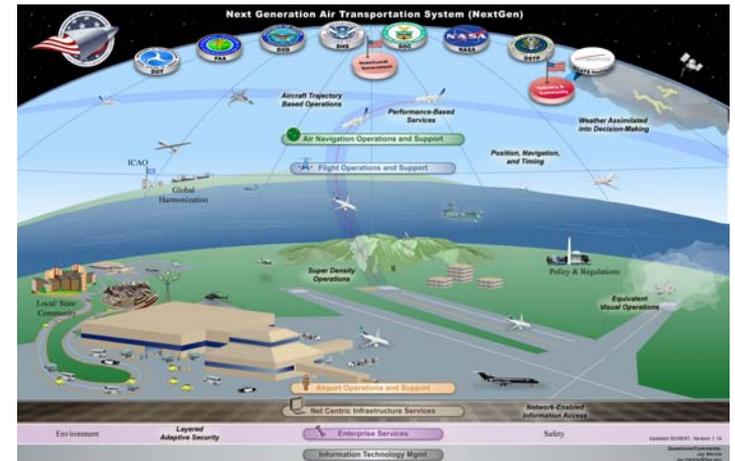
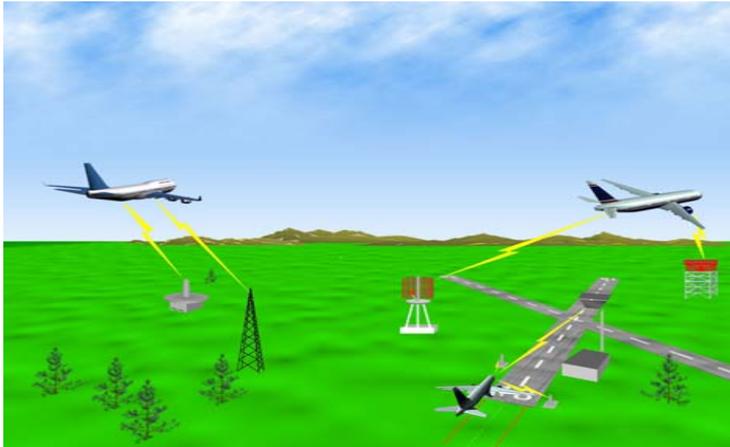
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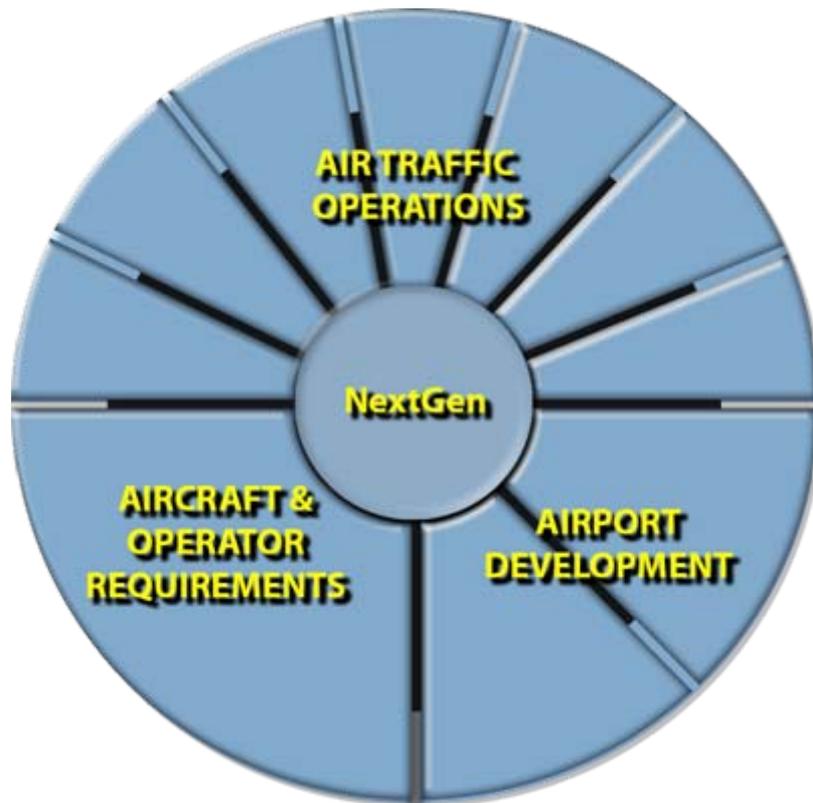
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# FAA's NextGen Implementation Plan

*Our focus is on integration and execution*



## **Airport Development**

- OEP Airports
- OEP Metro Areas

## **Air Traffic Operations**

- Initiate Trajectory-based Operations
- Increase Arrivals and Departures at High Density Airports
- Increase Flexibility in the Terminal Environment
- Improve Collaborative Air Traffic Management
- Reduce Weather Impact
- Improve Safety, Security and Environmental Performance
- Transform Facilities

## **Aircraft & Operator Requirements**

- Avionics

# FY 08 Accomplishments

## Aircraft Performance Based Mechanisms

### Area Navigation (RNAV) & Required Navigation Performance (RNP).

RNAV enables aircraft with specified operational performance requirements to fly more cost-effective automated trajectories. RNP introduces the requirement for onboard performance monitoring and alerting. Aircraft and controller performance increases are being realized. In Atlanta, for example, RNAV/RNP procedures have helped increase ATC productivity by 20-30%, which leads to as many as 10 additional departures per hour. Delta has estimated \$36M savings annually at that location.

- Introduced 64 published routes and procedures.
- Accelerated implementation at four high priority airports: Dallas-Ft.Worth, Chicago O'Hare, Houston's Bush Intercontinental, and New York's John F. Kennedy.

**Wide Area Augmentation System (WAAS) Localizer Performance with Vertical Guidance (LPV) approaches** give equipped aircraft a lower cost space-based, ILS-like approach option to runways with published LPV minimums.

- Integrated nine international reference stations.
- Deployed two new geostationary satellites.



- Published over 325 LPV approaches.
- Aug 08 – the number of LPV approaches expected to surpass the number of ILS approaches.

**Optimized Profile Descent (OPD).** These arrivals (also known as Continuous Descent Arrivals, or CDAs) provide the operator the ability to fly the aircraft's optimal vertical profile with a continuous descent. The FAA is currently designing, modeling, evaluating, and demonstrating procedures that accommodate OPD at several facilities in an effort to reduce noise and emissions, as well as increase fuel efficiency (estimated to be 100M gallons annually if implemented nationwide).

- Implemented one Standard Terminal Arrival Procedure (STAR) at Los Angeles that accommodates OPD (used by 25% of LAX traffic). Expected to implement two more STARS in July 2008 that will increase OPD availability to 50% of LAX traffic.
- Designed one STAR OPD procedure for San Diego, expected to be published in Nov 2008, that will be available to 50% of the traffic.
- RNAV STAR procedures designed for optimum profiles are available at six OEP airports.

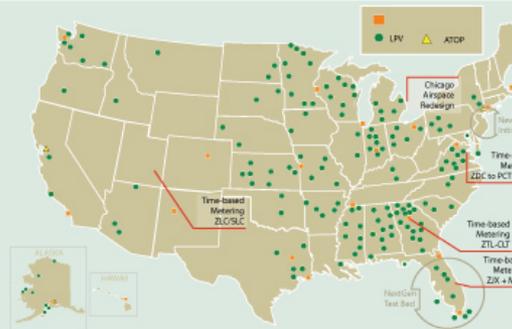
## Airspace Capacity

**Airspace Design and Improvement.** Refining airspace design and procedures that increase use of air traffic management automation are part of our efforts to enhance system capacity, user efficiency and safety.

- Time-based Metering Procedures – four En Route centers.
- Initial Traffic Flow Management – Modernization (TFM-M).
- Airspace Redesign – Chicago.
- Airspace Redesign – New York New Jersey.
- Airspace Redesign – Houston.
- Adaptive Compression tool for the Airspace Flow Program (AFP).
- Advanced Technologies and Oceanic Procedures (ATOP) for the West Atlantic Route System, the Atlantic portion of Miami Oceanic, and the San Juan flight information region.

**New York Initiatives.** The FAA instituted a special office to focus attention on the airspace around New York. Partnering with industry, the FAA convened an Aviation Rulemaking Committee (ARC) that resulted in more than 70 recommended initiatives aimed at reducing delays here.

- De-conflict Newark arrivals over SHAFF intersection.



- Simultaneous Visual Approaches to Runway 4L/R at Newark.
- Enhanced procedures for Caribbean arrivals.
- New procedures to allow arrivals to Runway 29, while landing Runway 4R at Newark.
- Simultaneous Approaches to Runways 31L/R at JFK.
- Accessing J134/J149 from ELIOT Intersection.

**Improved ILS Runway Visual Range (RVR) Landing Capabilities.** Due to advances in aircraft equipage and improvements in ILS ground system performance, the FAA was able to safely reduce landing visibility minimums, enhancing capacity and reducing the number of aircraft diversions.

- Reduced the required approach RVR from 2400 to 1800 feet for properly equipped aircraft (271 approaches at 190 airports).
- Authorized Category (CAT) II approach minimums to runways with CAT I ILSs that meet CAT II ILS performance criteria for properly equipped aircraft (three complete and 37 in progress).
- Reduced the minimum RVR required for takeoff on runways without centerline lighting from 1600 to 1000 feet (370 runways at 99 airports).
- Harmonized FAA takeoff minimums with European Joint Aviation Authority standards, reducing the RVR minimums required for takeoff from 600 to 500 feet.

## Airport Capacity

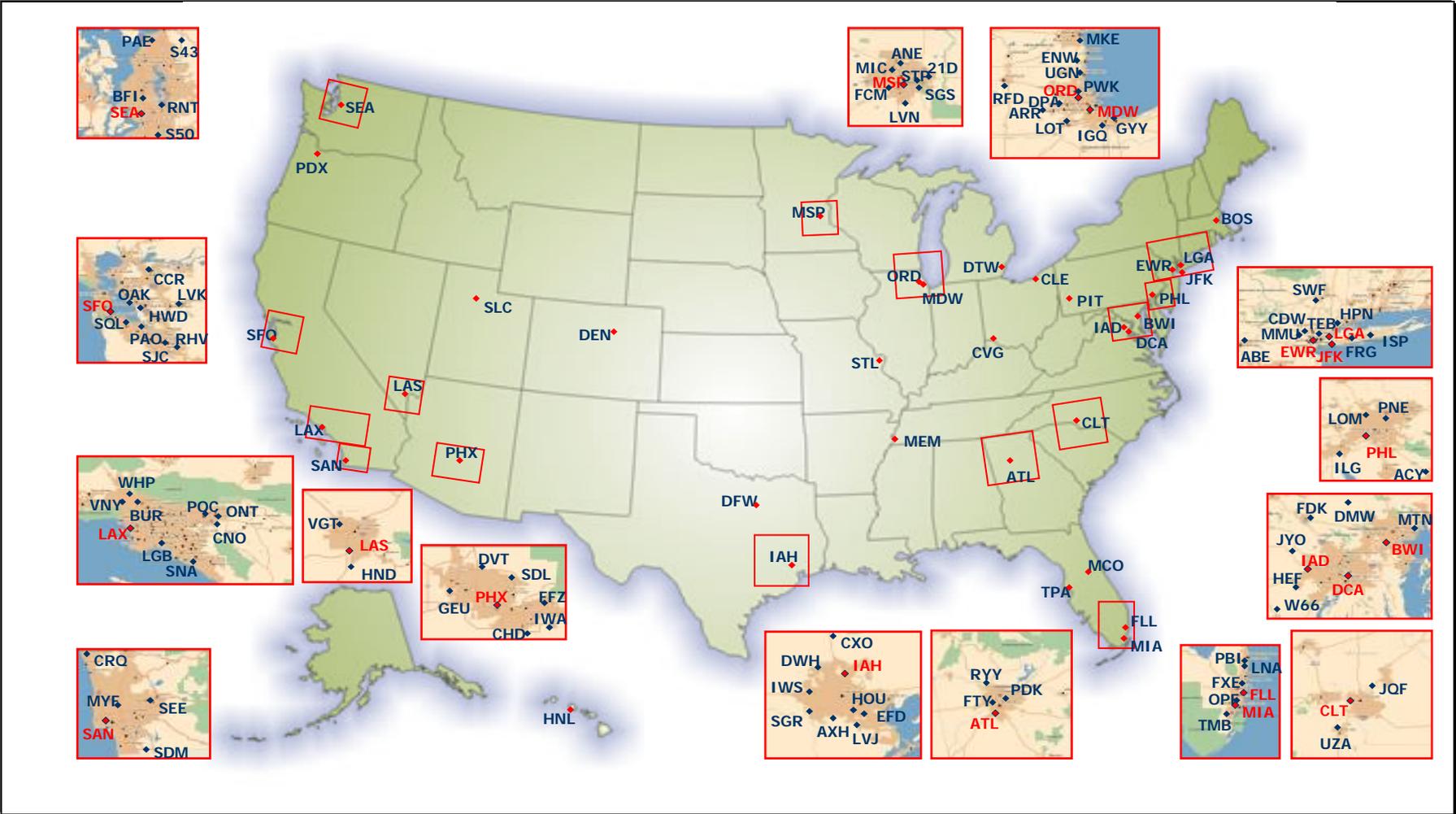
The largest capacity improvements for airports, building new runways and taxiways, require significant lead time (10-15 years) and substantial investment. NextGen technologies will allow greater design flexibility with closer simultaneous landing separations. Surface automation technology will improve situational awareness for all operators as well as lead to greater surface movement efficiencies.



- New Center Taxiway at Los Angeles, completing the airport's south airfield reconfiguration project that increases safety
- Airport Surface Detection Equipment – Model X (ASDE-X) declared operational at four sites this year to date. This enhanced surface surveillance provided by the 12 total deployed ASDE-X systems has reduced airport delays by one million minutes nationwide.

# FAA's NextGen Implementation Plan

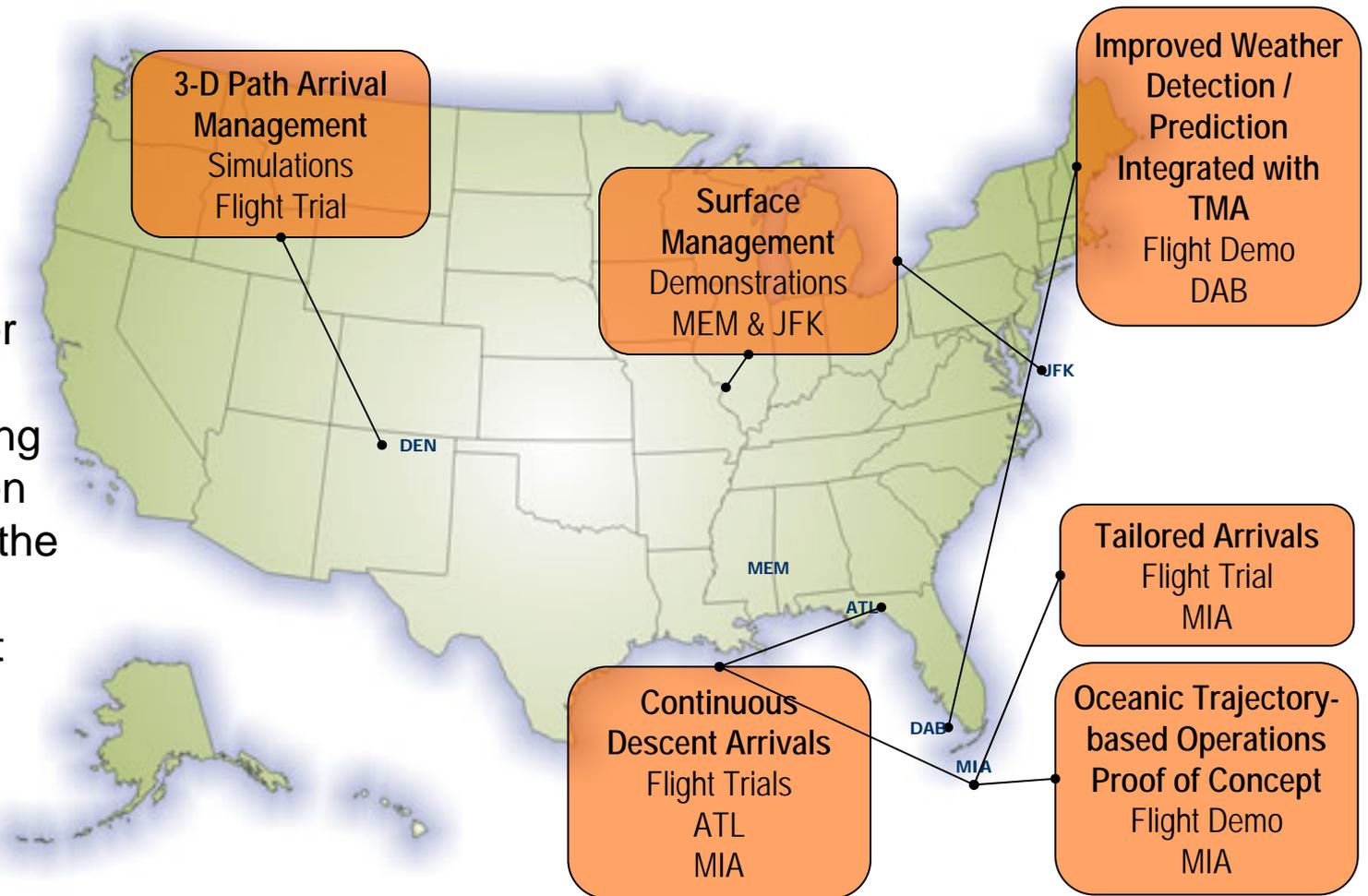
*Identifying solutions for tomorrow's trouble spots*

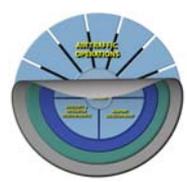


# FAA's NextGen Implementation Plan

## Flight trials

This summer  
FAA is  
demonstrating  
vital NextGen  
concepts in the  
operational  
environment

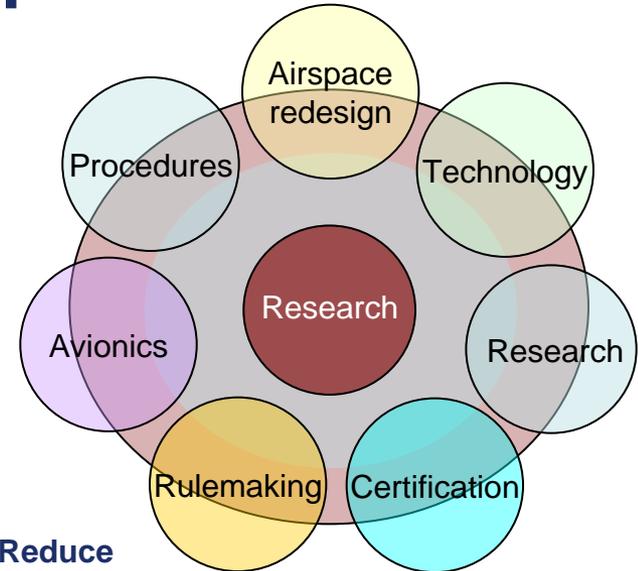




# Air Traffic Operations Domain

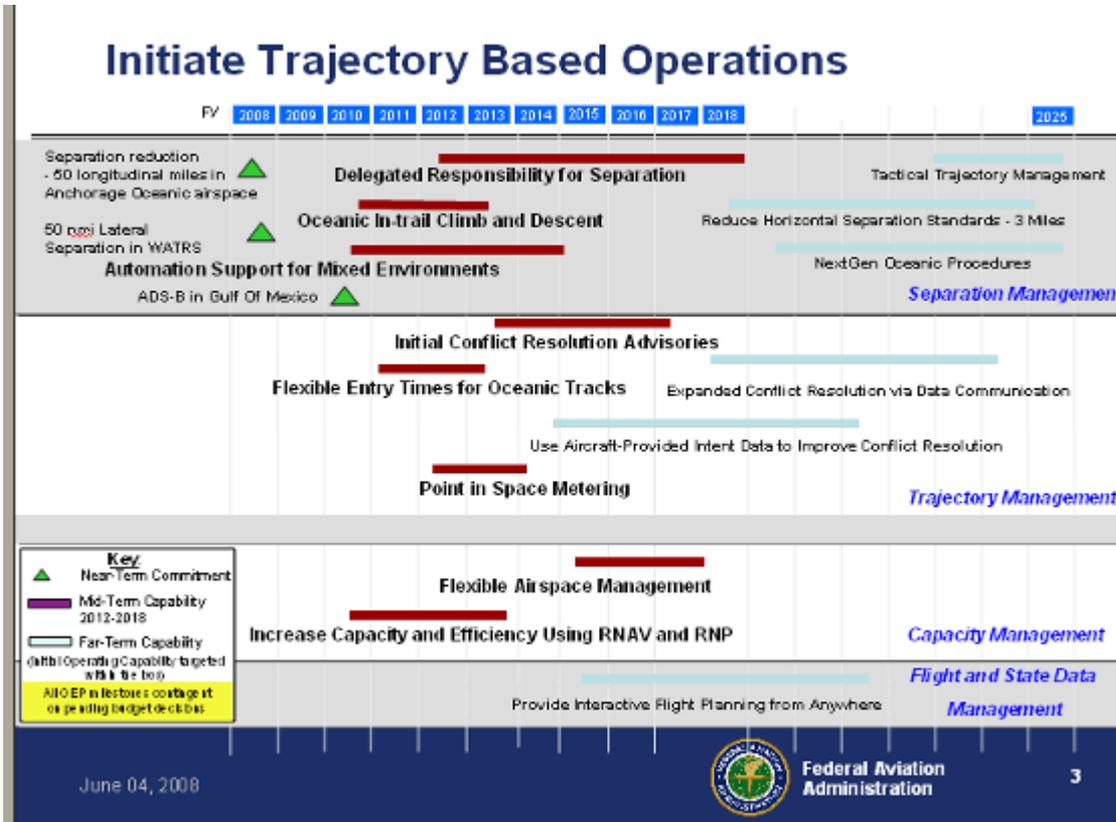
A solution set is a portfolio of *capabilities*

Implementation of a *capability* depends on a variety of activities carried out across FAA's lines of business



# NextGen Implementation Timelines

## Portfolio – Operational Level Descriptions



### Separation Management

**Separation between aircraft, airspace and terrain**

*Conflict Management*

### Trajectory Management

**Provide the most efficient “flow” of aircraft**

*Traffic Synchronization*

### Flow Contingency Management

**Manage demand with flow exceed capacity (Strategic Flow)**

*Demand Capacity Balancing*

### Capacity Management

**Airspace Design and Management**

*Airspace Organization and Management*

### Flight and State Data

**Safe and Efficient Flight Planning and Execution**

*Information Management*

# Initiate Trajectory-Based Operations

- **Air Traffic Control transitions to *traffic management by trajectory* and aircraft fly negotiated trajectories**
- ***Aircraft are equipped to fully participate***
- **Pilot, controller and aircraft *roles and responsibilities & procedures changed* to support requirements**
- **System enhancements support traffic management *improvements in airspace with mixed equipage aircraft operations***

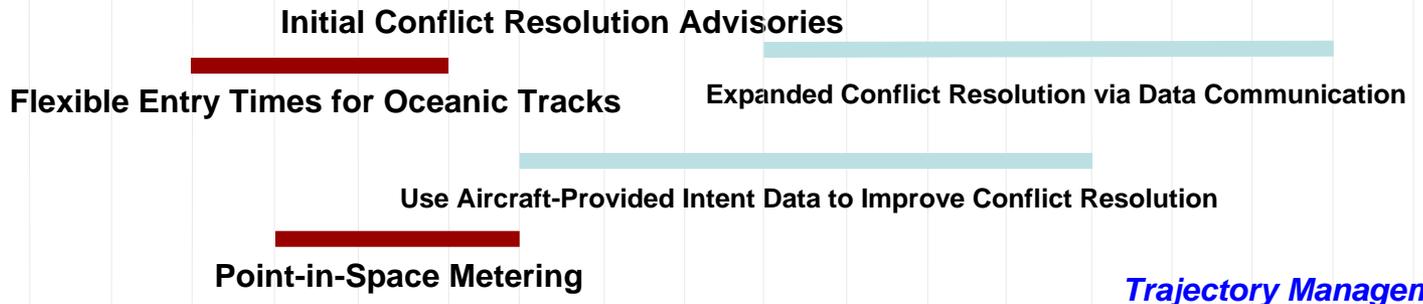
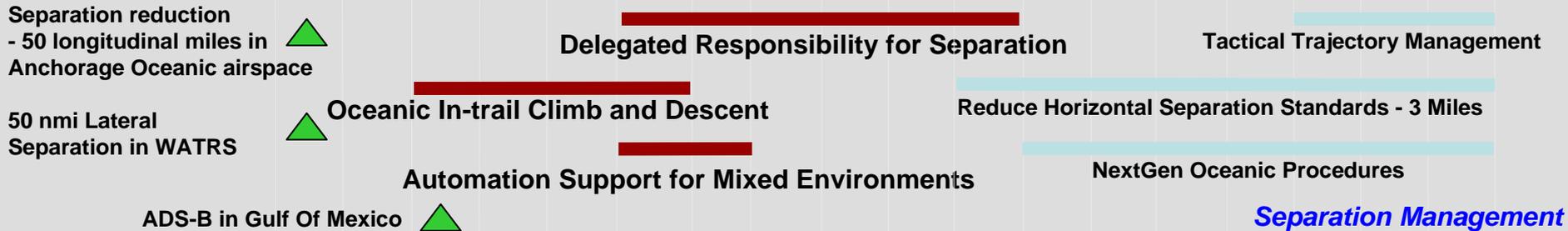


## Benefits

- Accommodate the enroute demand growth by optimizing enroute capacity
- Reduce the impact of congestion and weather on system capacity
- Increase the efficiency for each flight reducing user cost and the flight's impact on the environment

# Initiate Trajectory Based Operations

FY 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2025



**Key:**

- Near-Term Commitment
- Mid-Term Capability 2012-2018
- Far-Term Capability (Initial Operating Capability targeted within the box)

All OEP milestones contingent on pending budget decisions



# Increase Flexibility in the Terminal Environment

- Provide *capabilities* to address the needs of airports with lower demand
- Supports *more efficient* use of airspace and ground assets
- Provides *increased situational awareness* to service provider and pilot



## Benefits

- Increase the use of secondary airports to meet growing demand in metro areas
- Improve safety through increased situational awareness for both pilot and controller
  - Cockpit displays
  - Coded taxi-routes with conformance monitoring
- Increase the environmental performance through lower emission procedures
- Maintain capacity in lower visibility operations

# Increase Flexibility in the Terminal Environment

FY 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2025

STL Revised Wake Separation Standards



WTMD: Wind-Based Wake Procedures

Separation Management

WAAS 200-foot minima



GBAS Precision Approaches

Provide Situation to Pilots, Service Providers and Vehicle Operators for All Weather Operations

ADS-B Services to Secondary Airports

Limited Use CDAs: SDF, LAX, ATL



Use Optimized Profile Descent

Trajectory Management

RNAV SIDs and STARs



50

50

50

50

50

50

50

50

RNP Public SAAAR Approaches



25

50

50

50

50

50

50

50

LPV approaches



300

300

300

300

300

300

300

300

T Routes/ GPS MEAs



12

Capacity Management

**Key:**



Near-Term Commitment

Mid-Term Capability 2012-2018

Far-Term Capability (Initial Operating Capability targeted within the box)

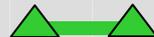
All OEP milestones contingent on pending budget decisions

Expanded Traffic Advisory Services Using Digital Traffic Data (Nationwide)



Provide Full Surface Situation Information

Increase ... By Using Vision Systems in Reduced Visibility Conditions



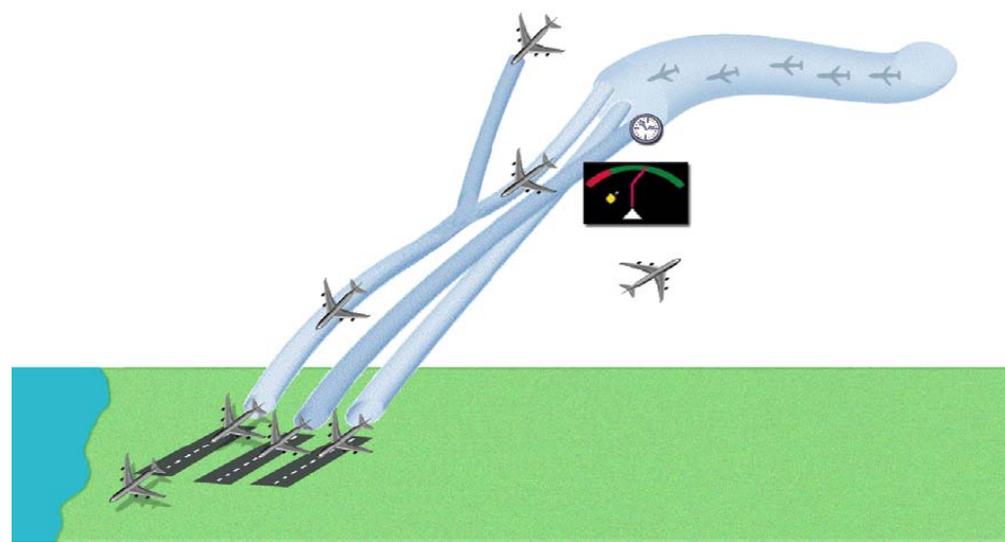
Enhanced Surface Traffic Operations

Flight and State Data Management



# Increase Arrivals/Departures at High Density Airports

- *Traffic flow management* will improve to increase arrivals and departures at airports where:
  - the demand for the runway capacity is high
  - Complex airspace and taxiing operations exist due to multiple runways, airport geometry, etc.
  - Airspace interference exists with airports in close proximity to each other
- Operations will require *higher performance navigation and communications capabilities*



## Benefits

### Maximum use of runway by:

- Getting the right *departure* aircraft in the right order to maximize throughput
- Getting the right *arrival* aircraft through the airspace to the runway to fill every landing opportunity
  - Expanding use of terminal procedures into transition airspace
  - Using 3-D RNAV/RNP criteria and procedures to “decouple” runways from shared flows
  - Improving the efficiency and delivery of aircraft in time-based metering by utilizing the aircraft’s capabilities

# Increase Arrivals/Departures at High Density Airports

FY 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2025



Delegated Responsibility for Horizontal Separation (FY 2012-2018)

*Separation Management*

Initial Surface Traffic Management (FY 2012-2014)

Wake Vortex Incorporated into Flow (FY 2015-2018)

*Trajectory Management*

Time Based Metering Using RNAV and RNP Route Assignments (FY 2012-2018)

Implement En Route Time Based Metering Procedures (FY 2008-2009)

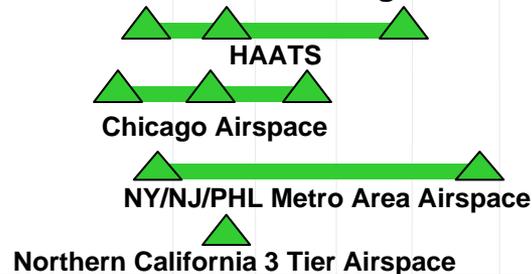
Optimize Runway Assignments (FY 2015-2018)

Use Data Messaging To Provide Flow and Taxi Assignments (FY 2015-2018)

Full Surface Traffic Management with Conformance Monitoring (FY 2015-2018)

Use Aircraft-Provided Intent Data to Improve Flow and Conflict Resolution (FY 2015-2018)

Integrated Arrival/Departure Airspace Management (FY 2012-2018)



*Capacity Management*

**Key:**

- ▲ Near-Term Commitment
- Mid-Term Capability 2012-2018
- Far-Term Capability (Initial Operating Capability targeted within the box)

All OEP milestones contingent on pending budget decisions



# Improve Collaborative ATM

- Accommodate *flight operator preferences* to the maximum extent possible
- Impose restrictions only when a real operational need exists
- *Adjust airspace* and other assets to satisfy forecasted demand, rather than constraining demand
- Maximize the operators' opportunities to resolve necessary constraints based on their own preferences



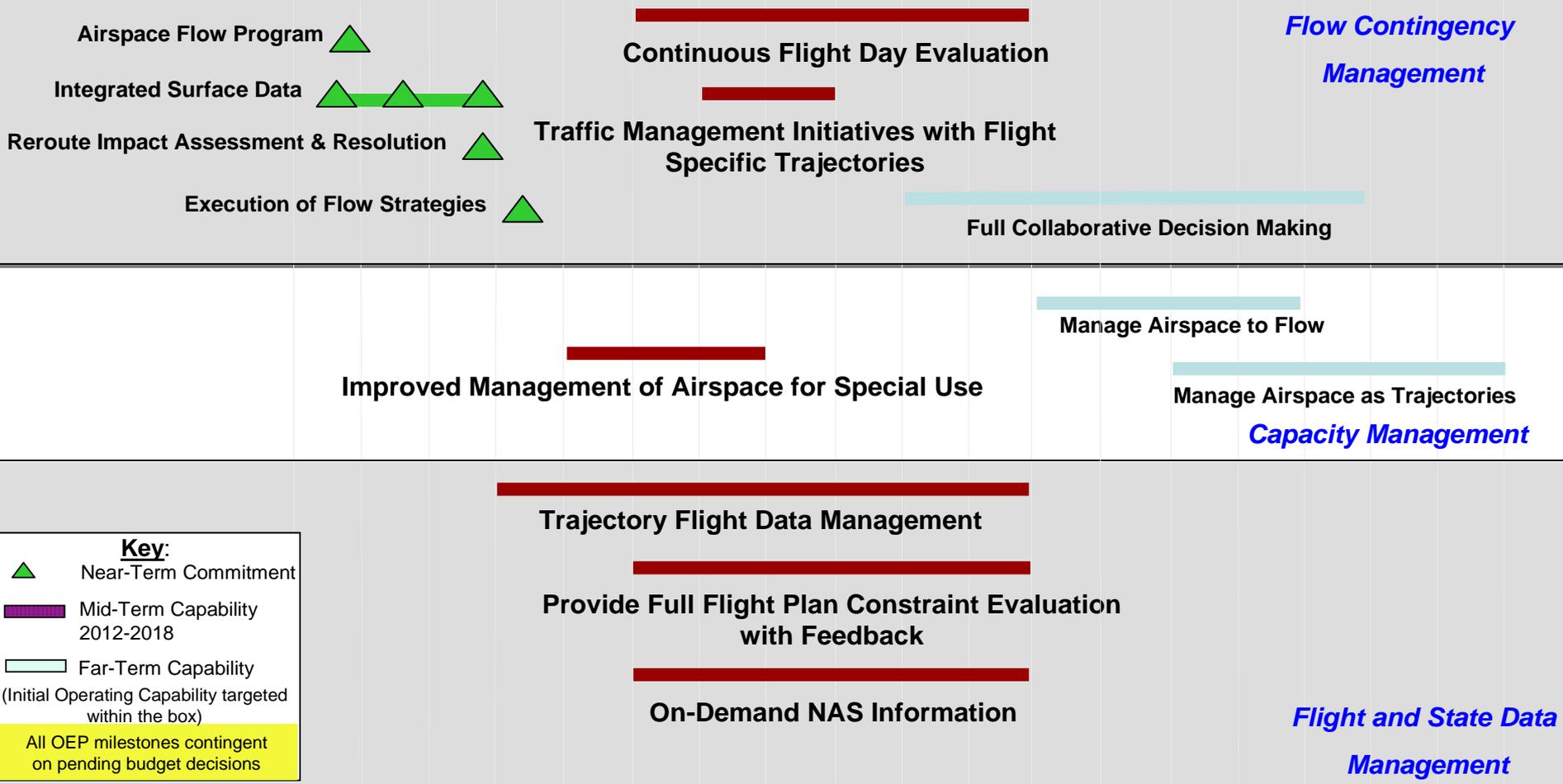
## Benefits

- Increase the efficiency of flow actions by tailoring the impact on individual flight through integration of weather into the decision process
- Reducing delays by improving Airborne Flow Program prediction & execution by adding surface information
- Increase the available capacity when weather and congestion occur by flexibly moving airspace
- Improve the efficiency and reduce delays associated with a traffic flow program by providing all constraint data to all participants

# Improve Collaborative ATM

FY 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

2025



# Reduced Weather Impact

- Improve *accuracy of weather forecast*
- Improve the scope & *use of weather information*
- Develop *improved products*
- Incorporate improved products into *decision support tools* to assess & manage the impact of both current and forecasted weather on individual flights and flows



## Benefits

- Improved observation platforms with NAS-wide coverage
- Increased situational awareness by improving forecast of weather elements important to aviation (e.g., convection, icing, turbulence)
- Reduced impact of weather on capacity, efficiency and delay by provision of weather data into operational decision making – ATM, AOCs, and the flight deck

# Reduce Weather Impact

FY

2008

2009

2010

2011

2012

2013

2014

2015

2016

2017

2018

2025

**Trajectory-Based Weather Impact Evaluation**

*Trajectory Management*

**Automatic Hazardous Weather Alert Notification**

**Full Operational Weather Capability**

*Flow Contingency Management*

**Turbulence and Icing Available on Meteorological Data Collection and Reporting System (MDCRS)**

**Near-real time dissemination of weather information to all ground and air users**

*Flight and State Data Management*

Complete ITWS Deployment ▲

Weather Advisory Information to the Flight Deck (Nationwide) ▲

**Key:**

▲ Near-Term Commitment

■ Mid-Term Capability 2012-2018

□ Far-Term Capability (Initial Operating Capability targeted within the box)

All OEP milestones contingent on pending budget decisions



# Increase Safety, Security & Environmental Performance

- Includes activities that enhance safety, security and environment

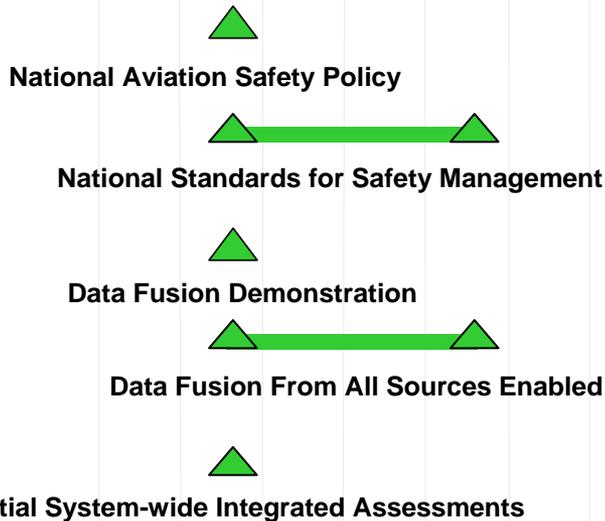
## Benefits

- Improves ATO's role in airspace security
- Address NextGen challenges for Information Security
- Meet Safety and SMS Mission
- Improve environmental performance



# Safety

FY 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2025



**Safety Management System**

**Aviation Safety Information Analysis & Sharing**

**Safety Management Enterprise Services**

**Fully Institutionalized National Aviation Safety Policy and Continuous Safety Improvement Culture**

**Key:**

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- Mid-Term Capability 2012-2018
- Far-Term Capability (Initial Operating Capability targeted within the box)

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# Environment

FY 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2025



**Environmental Policy and Long-Term Targets**



**Integrated Models Assess Trade-Offs Between Environment and Capacity**



**Establish Metrics and Formulate Policy**



**Explore Environmental Control Algorithms for Operational Procedures**



**Establish the Impacts of New Aircraft Technologies and Alternative Fuels**



**National EMS Supports Integrated Environmental Performance**



**NGATS Operational Initiatives Implemented that Reduce Environmental Impacts**

**Key:**

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Mid-Term Capability  
2012-2018

Far-Term Capability  
(Initial Operating Capability targeted  
within the box)

All OEP milestones contingent  
on pending budget decisions



# Security

FY 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2025

**Operational Security Capability for Threat Detection and Tracking, NAS Impact Analysis and Risk-Based Assessment**

**SSA and Information System Security Integrated Incident Detection and Response**

**Information Management and Exchange Plan**

**Cyber Security**

**Information on System Security and Surveillance Integration / Protection**

**Full Integrated Surveillance and Information SSA Operational Security**

**Key:**

 Near-Term Commitment

 Mid-Term Capability  
2012-2018

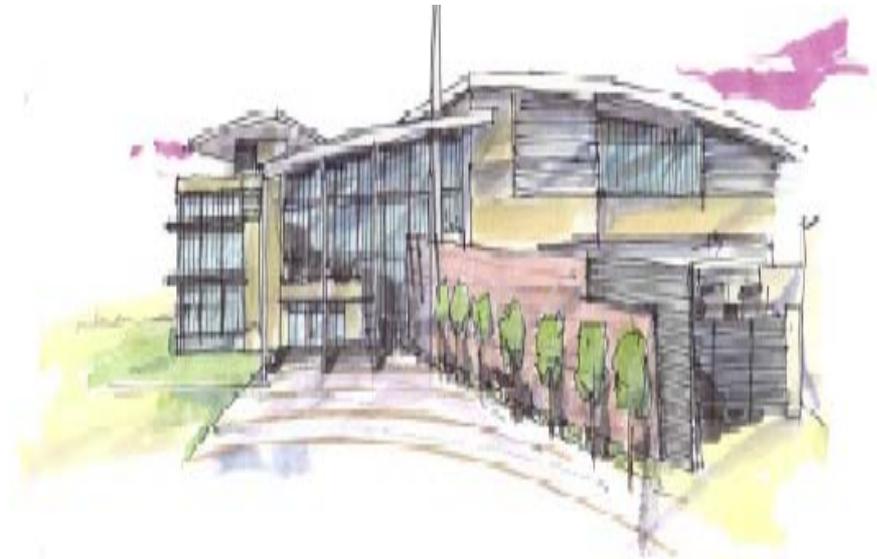
 Far-Term Capability  
(Initial Operating Capability targeted  
within the box)

All OEP milestones contingent  
on pending budget decisions



# Transform Facilities

- **Flexible infrastructure to support service delivery and meet changing ATC and user needs**
- **NextGen facilities to enable new operational capabilities**
- **Support “Big Airspace” integrated ARR/DEP facilities, hi-lo altitude GSDPS, and Staffed NextGen Facilities**



## Benefits

- **Improvements in resource management, reduce overhead and gives service providers a greater career progression**
- **Provide continuity of operations in the event of a major facility outage**

# Transform Facilities

FY 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2025

**Integration, Development and Operations Analysis Capability**

**NextGen Facilities**

**Net-Centric Virtual Facility**

**NAS Wide Sector Demand Prediction and Resource Planning**

**Key:**

▲ Near-Term Commitment

■ Mid-Term Capability  
2012-2018

□ Far-Term Capability  
(Initial Operating Capability targeted  
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on pending budget decisions



# NextGen: Improving Efficiency & Capacity

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Air Traffic Control Communications By Voice

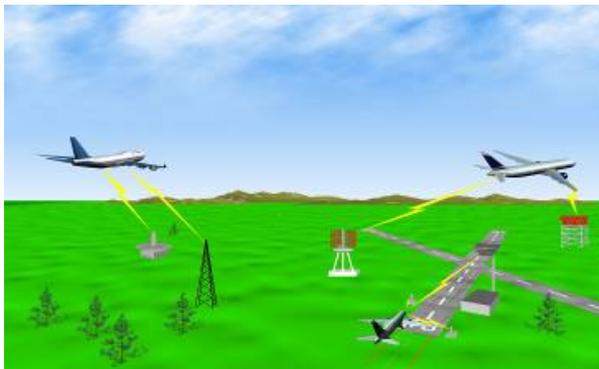
Disconnected Information Systems

Air Traffic "Control"

Fragmented Weather Forecasting

Airport Operations Limited By Visibility Conditions

Forensic Safety Systems



## NextGen

Satellite-based Navigation and Surveillance

Routine Information Sent Digitally

Information More Readily Accessible

Air Traffic "Management"

Forecasts Embedded into Decisions

Operations Continue Into Lower Visibility Conditions

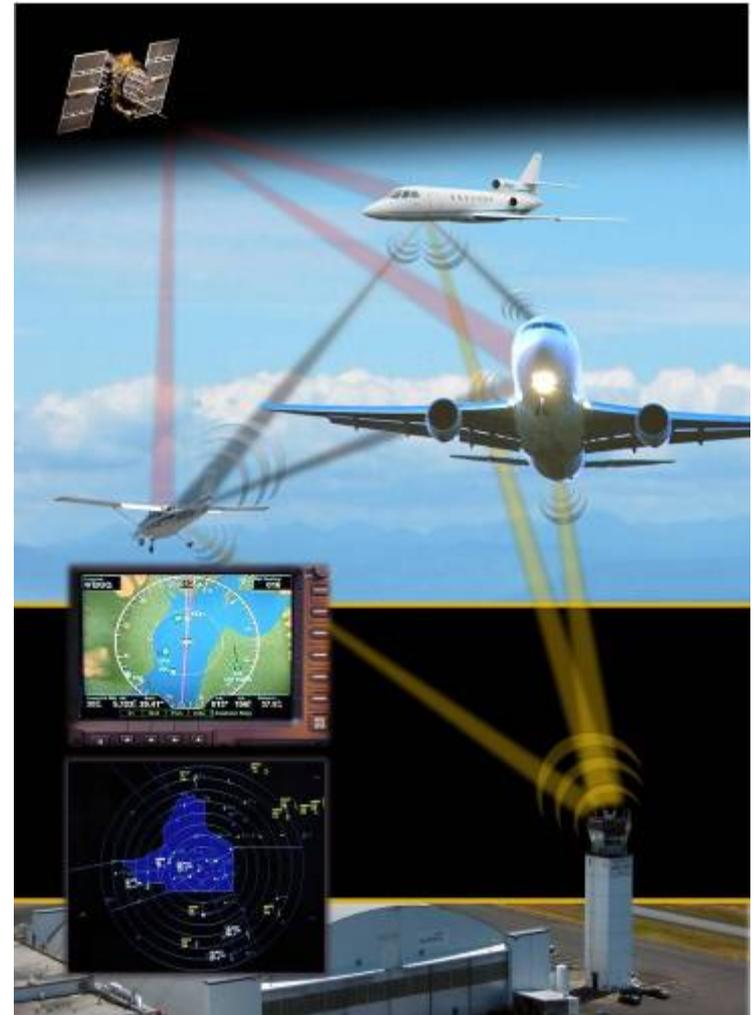
Prognostic Safety Systems



*The transition to NextGen has already begun.*

# Automatic Dependent Surveillance Broadcast (ADS-B)

- **A**utomatic
  - Periodically transmits information with no pilot or operator input required
- **D**ependent
  - Position and velocity vector are derived from the Global Positioning System (GPS)
- **S**urveillance
  - A method of determining position of aircraft, vehicles, or other asset
- **B**roadcast
  - Transmitted information available to anyone with the appropriate receiving equipment

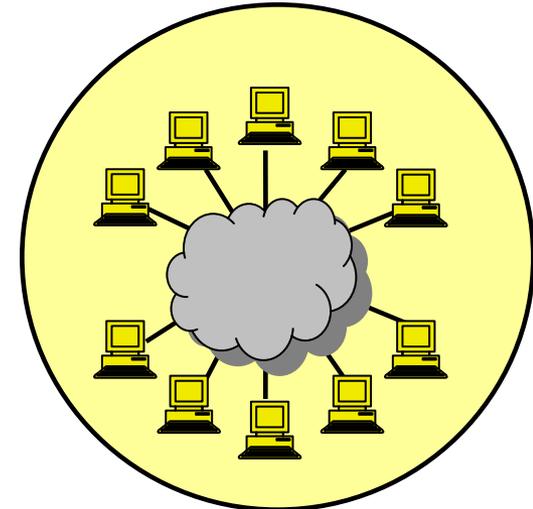
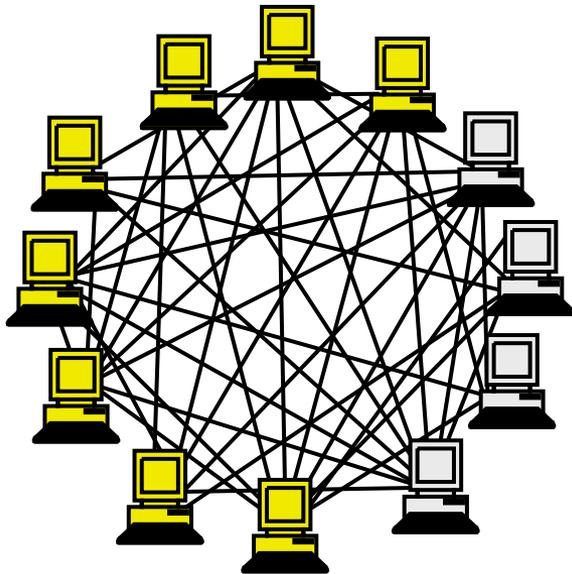


# System Wide Information Management (SWIM)

Today: Point to Point Information Management

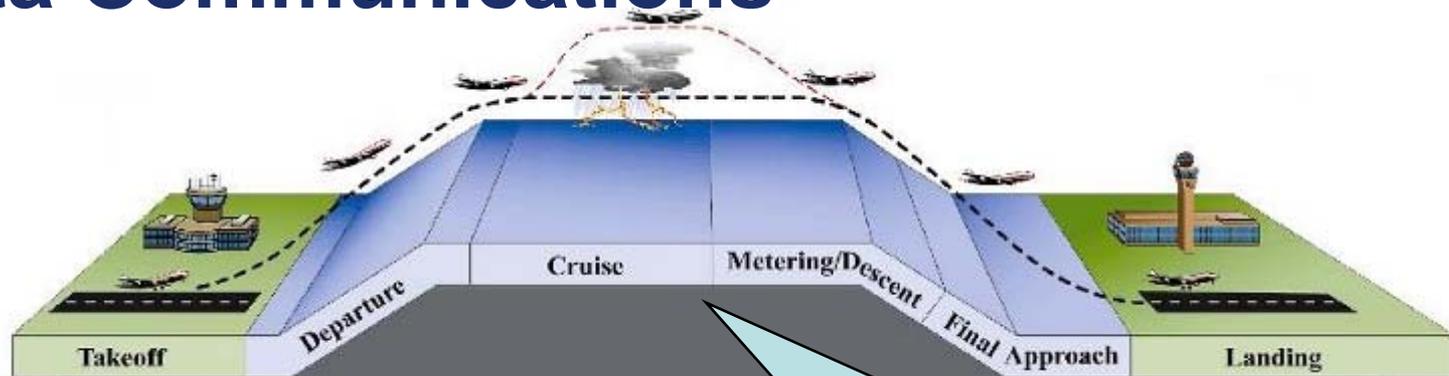


NextGen: System Wide Information Management



Business as Usual  
(NextGen without SWIM)

# Data Communications



- Revised Departure Clearance
- Taxi Clearances
- Airport Information
- Flow Initiatives

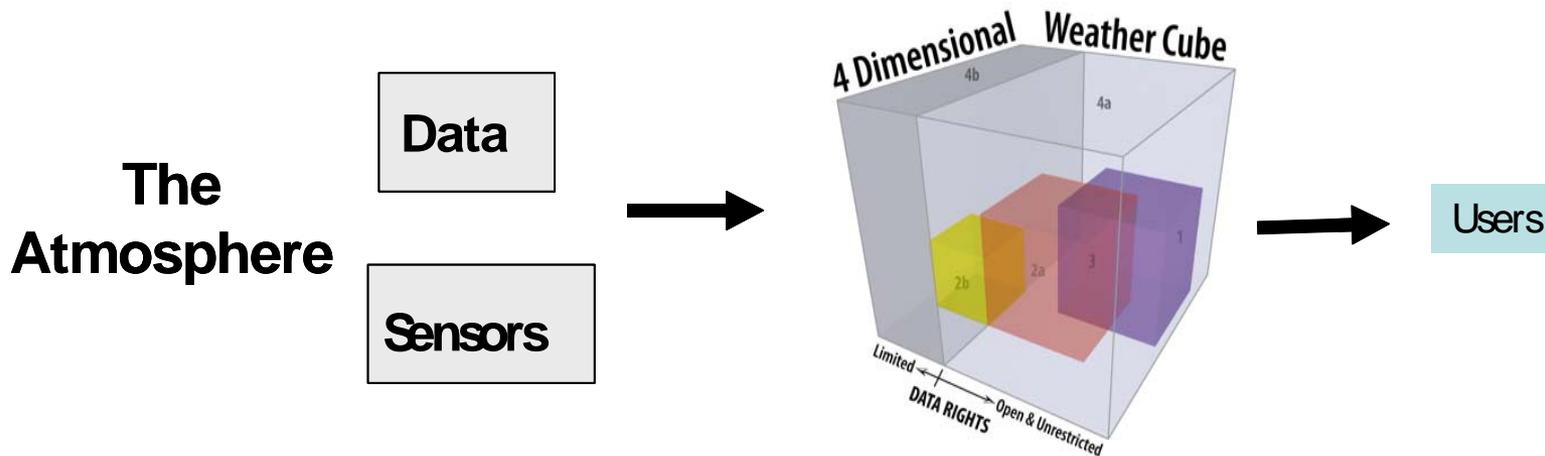
- Enroute Clearances
  - Heading, Speed, Altitude, Routes, Flow Initiatives, Crossing Restraints
- Enroute Notifications

## Data Communications Provides

- Two-way data between controllers, automation and flight crews
- Safety-of-flight air traffic control clearances, instructions, traffic flow management, flight crew requests and reports
- Automation enhancements for ATC message generation and exchange
- Communications link carrying data between aircraft and air traffic managers

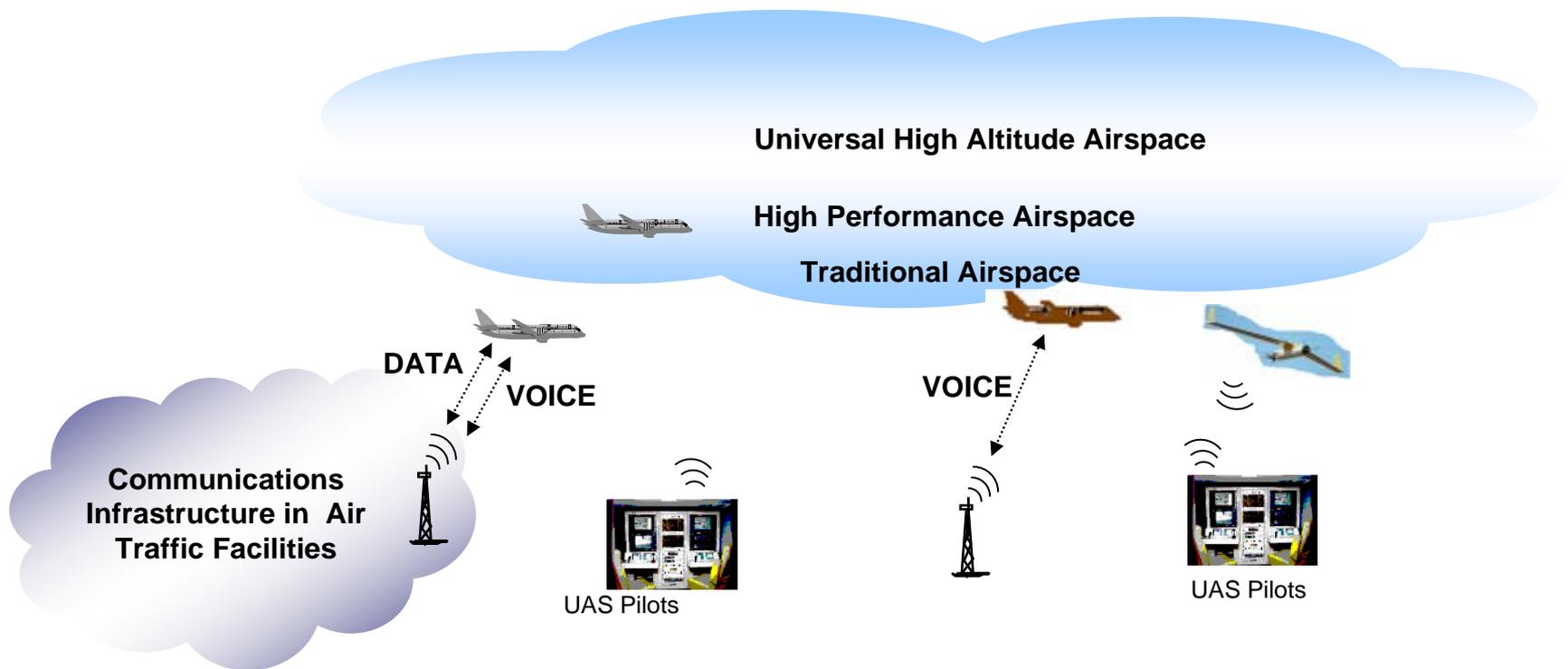
# NextGen Network Enabled Weather (NNEW)

- A net-enabled distribution of weather information to enhance collaborative and dynamic NAS decision making.
- It is a 4-Dimensional Weather Data Cube that draws information from multi-agency sources into a consolidated virtual data cube for aviation users



# NAS Voice Switch (NVS)

Current voice architecture is limiting, inflexible and does not support sharing communication within and across facility boundaries. NVS replaces existing voice switches at En Route, Terminal and support facilities with network-capable switches to enable flexible voice communications.



# NextGen is...

- **Reduction of delays and system gridlock**
- **Integration of weather information into decision support tools to reduce weather-related delays**
- **Reduced adverse impacts to environment**
- **Reduced fuel consumption**
- **Precise trajectory-based operations**
- **Network-enabled real-time information access by air traffic control and system users**
- **Moving more and varied air vehicles through the National Airspace System.**
- **Moving more and happy passengers from gate to gate!**



# NextGen... “What It Isn’t...”

- **NextGen is not a single project...** It is the integration of many projects, concepts, and technologies.
- **NextGen is not a program plan...** It is the integration of many program plans to deliver new service capabilities to meet increasing demand.
- **NextGen is not simply a new system...** It is the integration of new systems, new procedures, new aircraft performance capabilities, new supporting infrastructure and a new way to do business as the Air Transportation System.



# NextGen Integration & Implementation



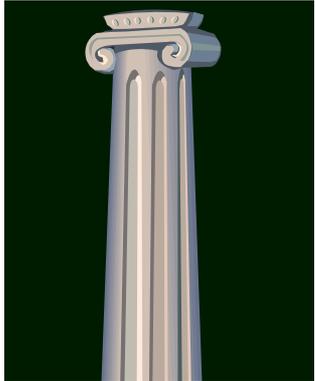
- **Ensures effective and efficient application, planning, programming, budgeting and execution of FAA's NextGen portfolio**
  - Focus on near & mid-term (now – 2018) NextGen implementation
- **Manages NextGen portfolio across FAA lines of business**
  - Service-level agreements
  - Program-level agreements
  - Cross-agency decision-making processes & accountability
- **Industry partnerships key to successful NextGen implementation**

# NextGen Integration & Implementation

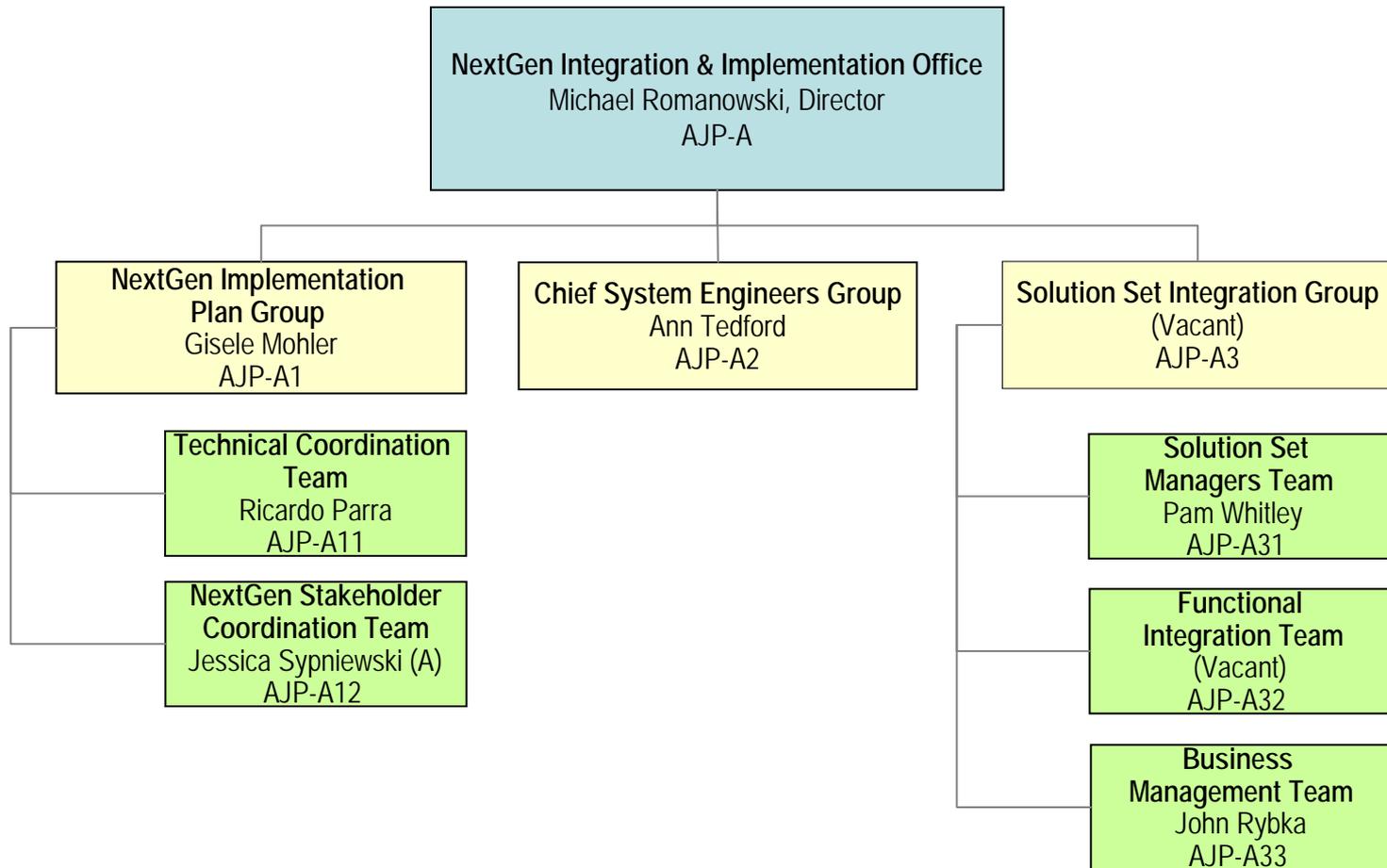


- **NextGen Planning Group**
  - Top-level integrated NextGen portfolio management
  - Supports governance framework for cross-agency decision making processes & accountability
    - NextGen Review Board
    - NextGen Management Board
  - Stakeholder engagement
  - Publishes & maintains NextGen Implementation Plan
- **Chief System Engineers Group**
  - NAS-wide system engineering for NextGen portfolio
    - NextGen critical path definition
    - Overarching NextGen risk matrix
    - Top-level requirements allocation
  - Top-level trade studies & business decision support

# NextGen Integration & Implementation



- **Solution Set Integration Group**
  - Detailed portfolio management for integrated capabilities
    - Programs & enabling activities
  - Functional integration across Solution Sets



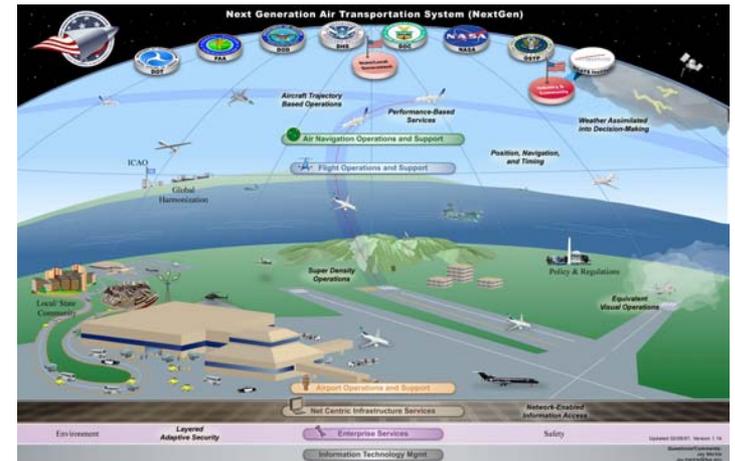
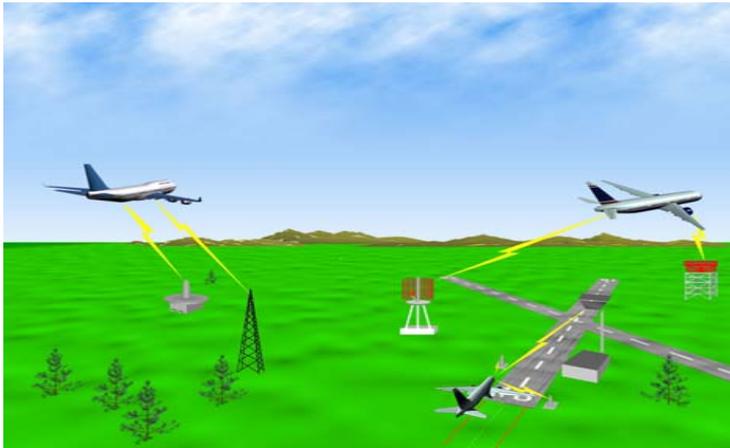
# NextGen: Improving Service Delivery

## Today's NAS

- Ground-based Navigation and Surveillance
- Air Traffic Control Communications By Voice
- Disconnected Information Systems
- Air Traffic "Control"
- Fragmented Weather Forecasting
- Airport Operations Limited By Visibility Conditions
- Forensic Safety Systems

## NextGen

- Satellite-based Navigation and Surveillance
- Clearance Trajectories and Routine Information Sent Digitally
- Information More Readily Accessible
- Air Traffic "Management"
- Forecasts Embedded into Decisions
- Operations Continue Into Lower Visibility Conditions
- Prognostic Safety Systems



# References

- **JPDO's Concept of Operations and Enterprise Architecture**  
<http://www.jpdo.gov/>
- **FAA's NextGen Implementation Plan**  
<http://www.faa.gov/nextgen>
- **FAA's Enterprise Architecture**  
<http://www.nas-architecture.faa.gov/nas/>

