

Implementing NextGen

Next Generation Air Transportation System



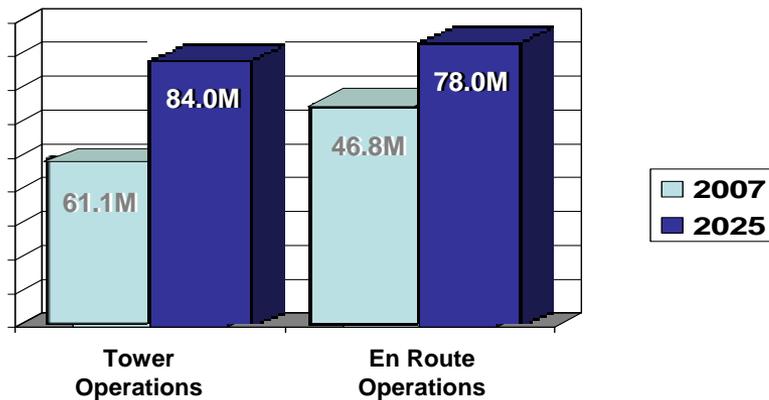
Presented By:
Date:

Ann Tedford
October 2008

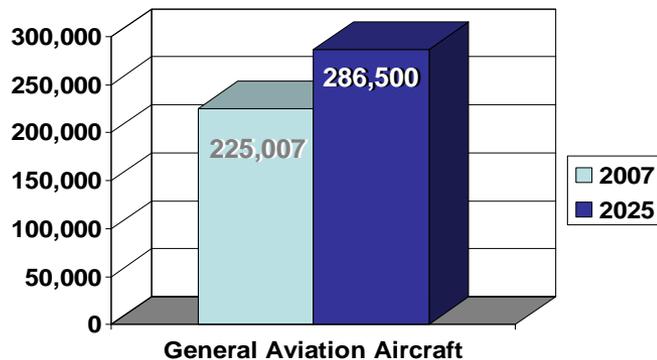


Federal Aviation
Administration

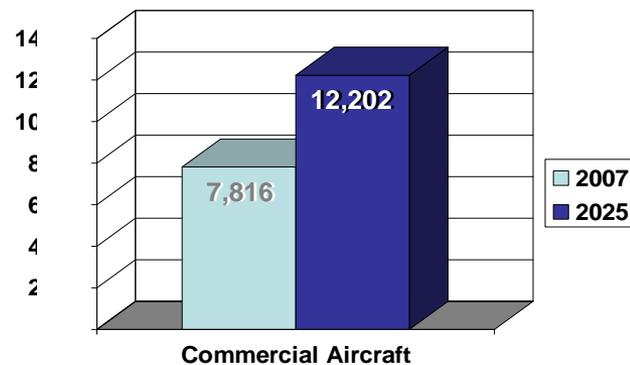
The Need for NextGen...Growing Demand



Operations



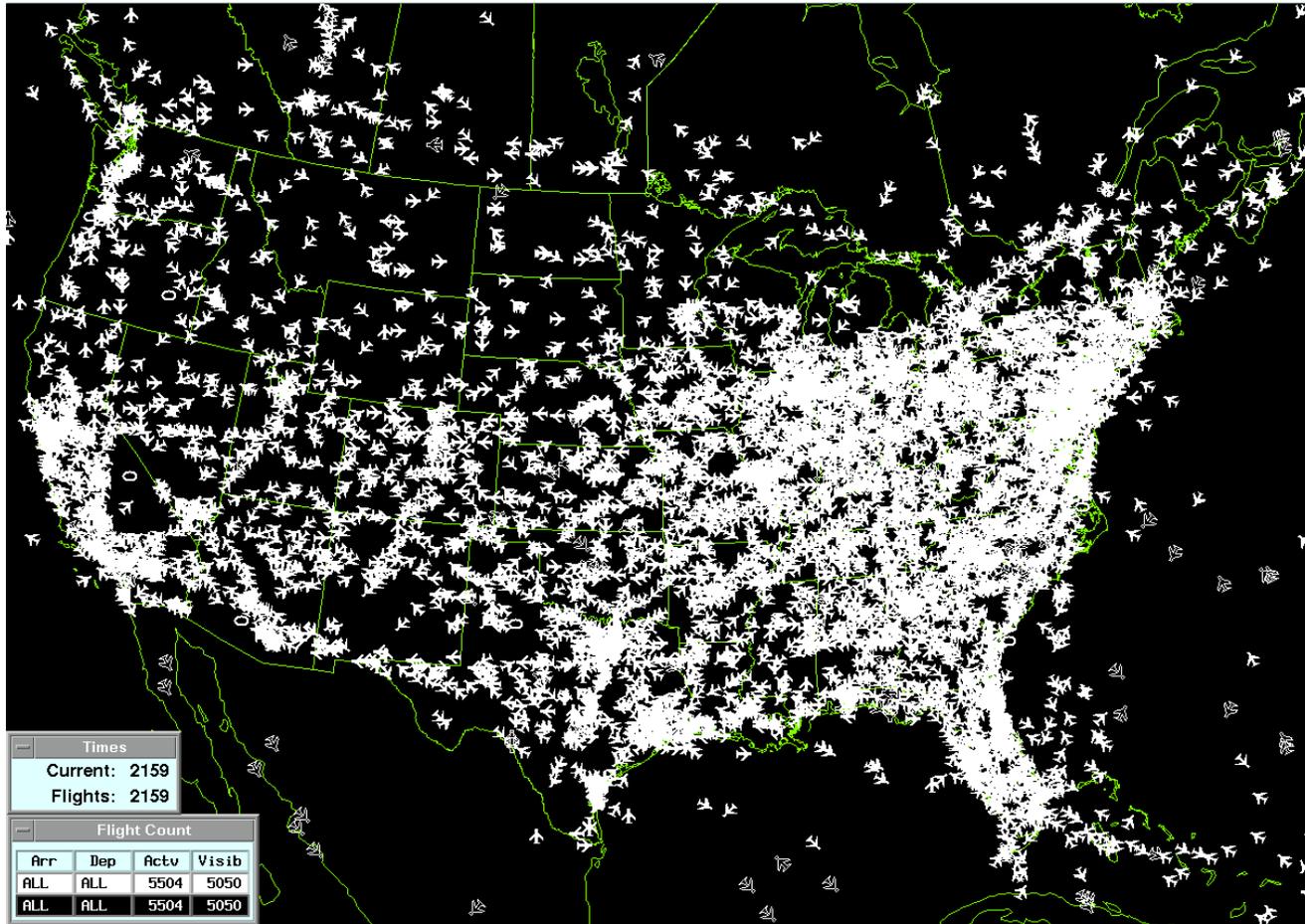
General Aviation



Commercial Aviation

* FAA 2008-2025 Forecast

Our National Airspace System in the Air



Peak aircraft traffic over the US

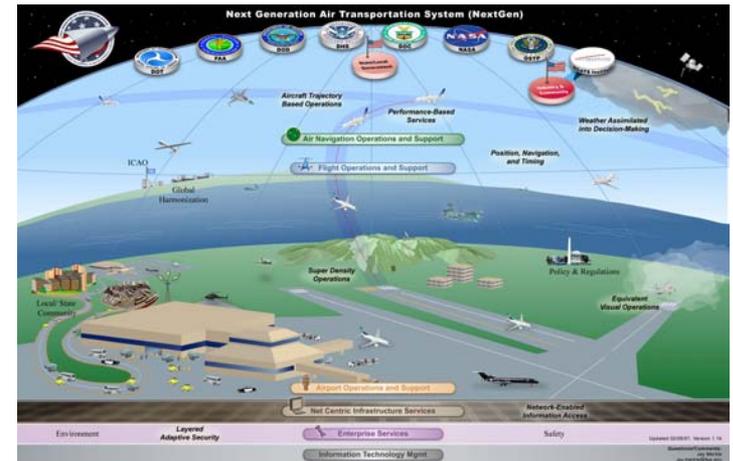
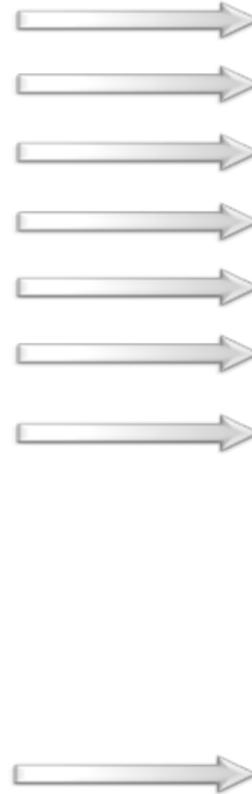
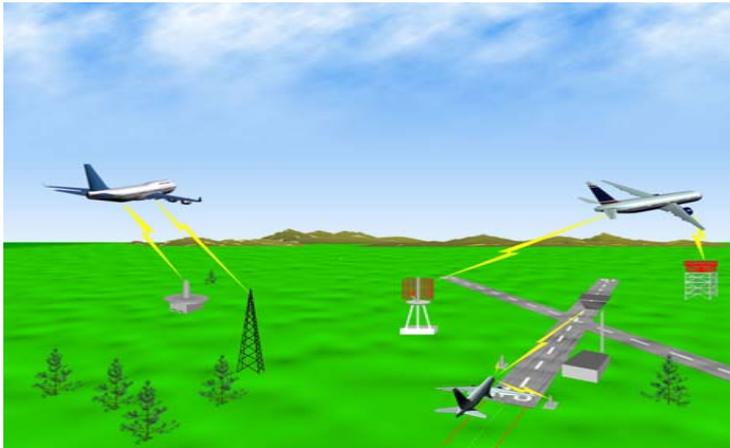
NextGen: Improving Service Delivery

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)

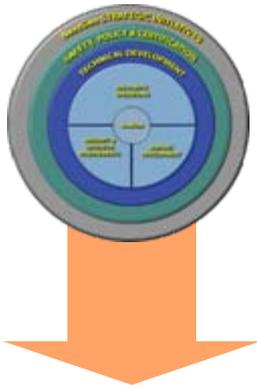
Seven US Government Departments and Agencies

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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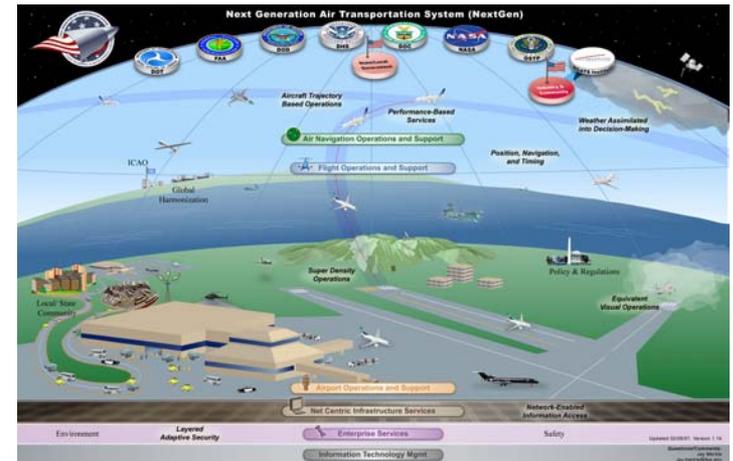
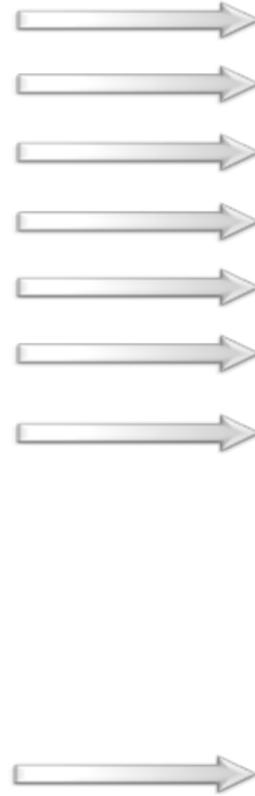
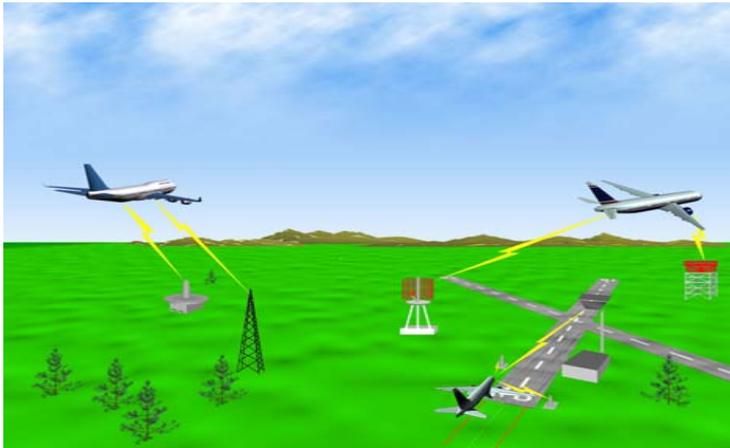
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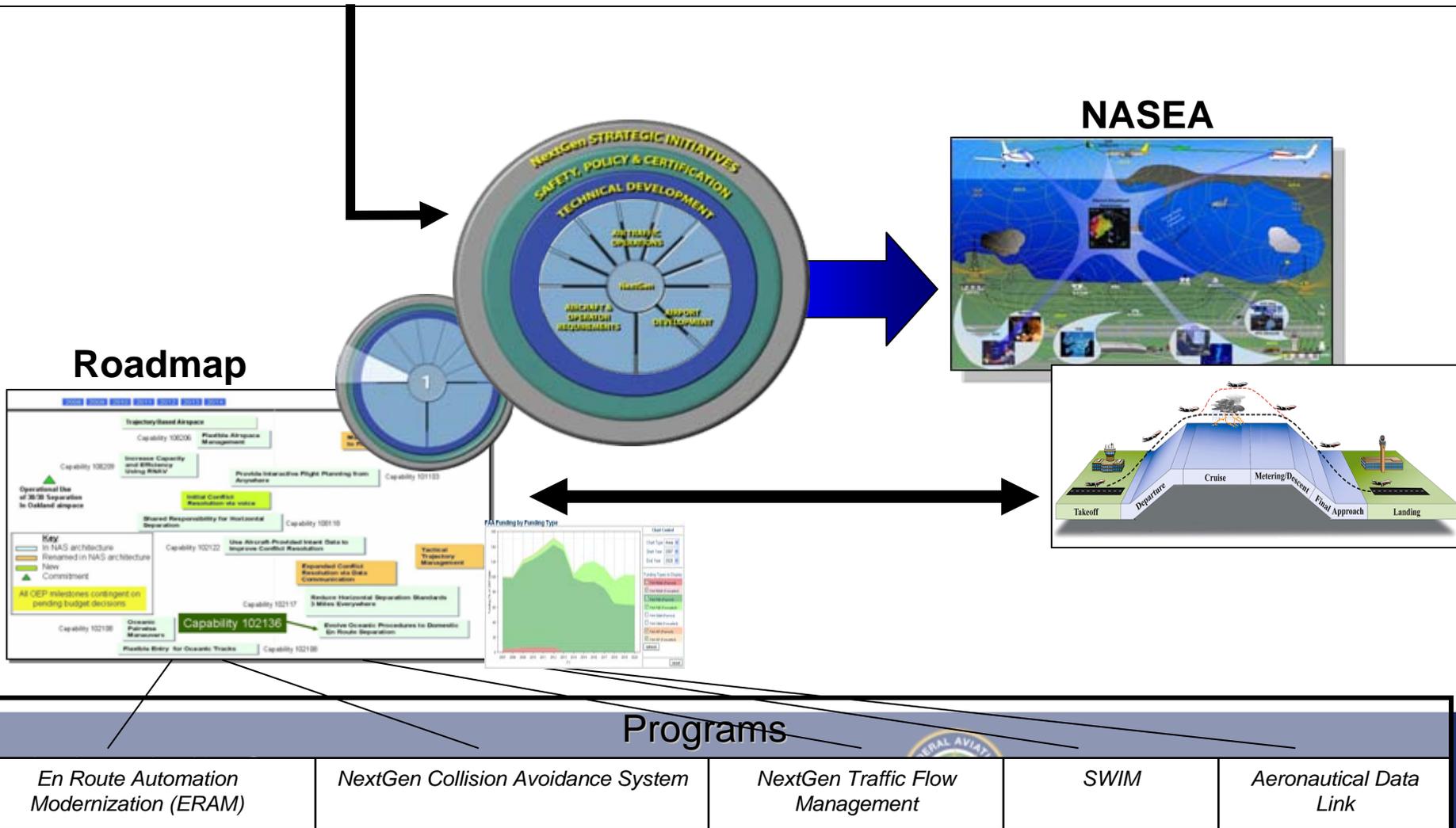
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NextGen Key Capabilities

- Initiate Trajectory Based Ops
- Increase Arrivals/Departures at High Density Airports
- Increase Flexibility in the Terminal Environment
- Improve Collaborative ATM

- Reduce Wx Impact
- Increase Security and Safety Performance
- Increase Environmental Performance
- Transform Facilities



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.

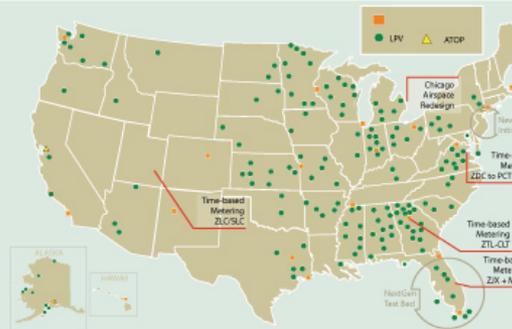
Airspace Capacity

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

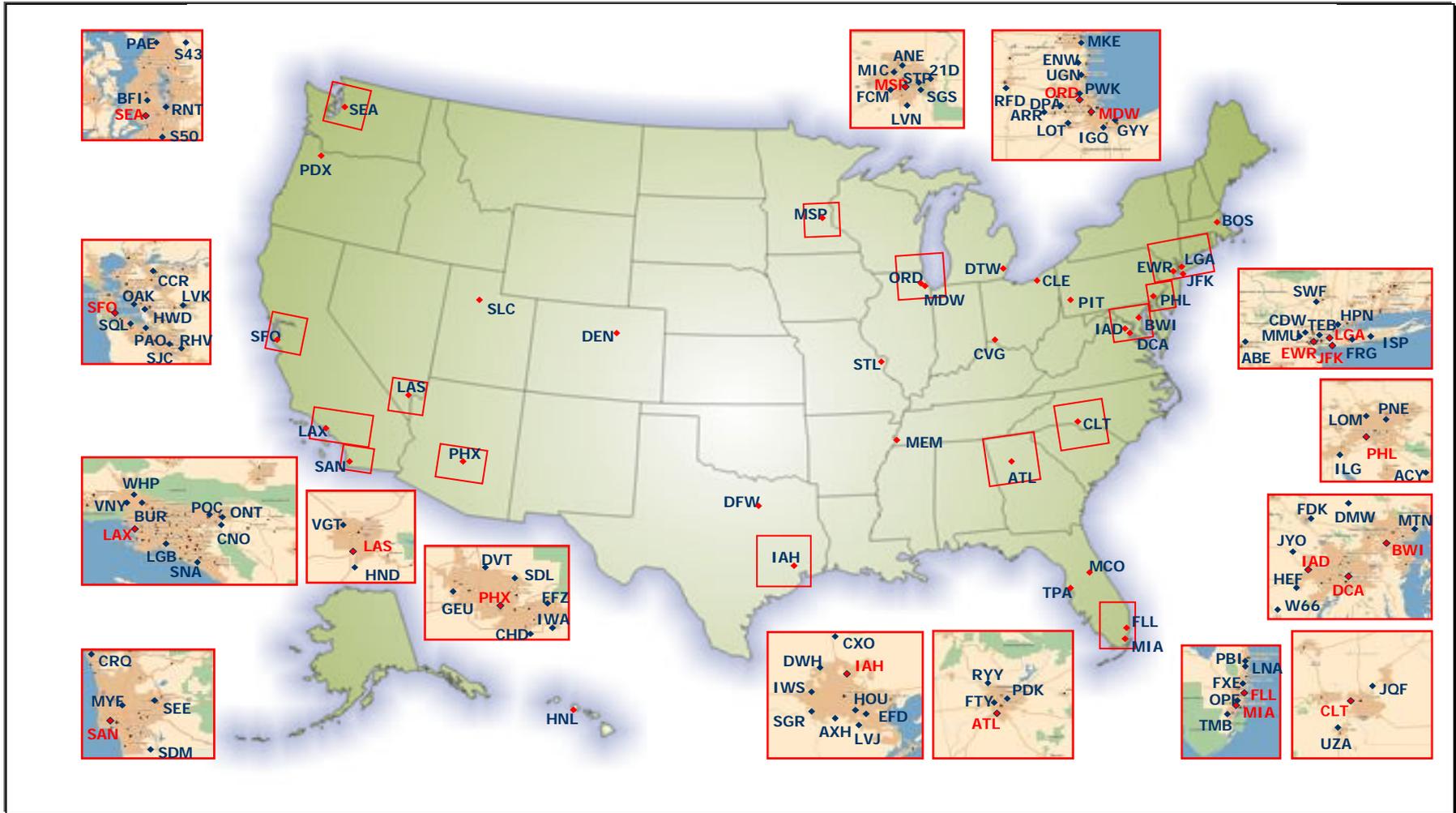
The largest capacity improvements for airports, building new runways and taxiways, require significant lead time (10-15 years) and substantial investment. NextGen technologies will allow greater design flexibility with closer simultaneous landing separations. Surface automation technology will improve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

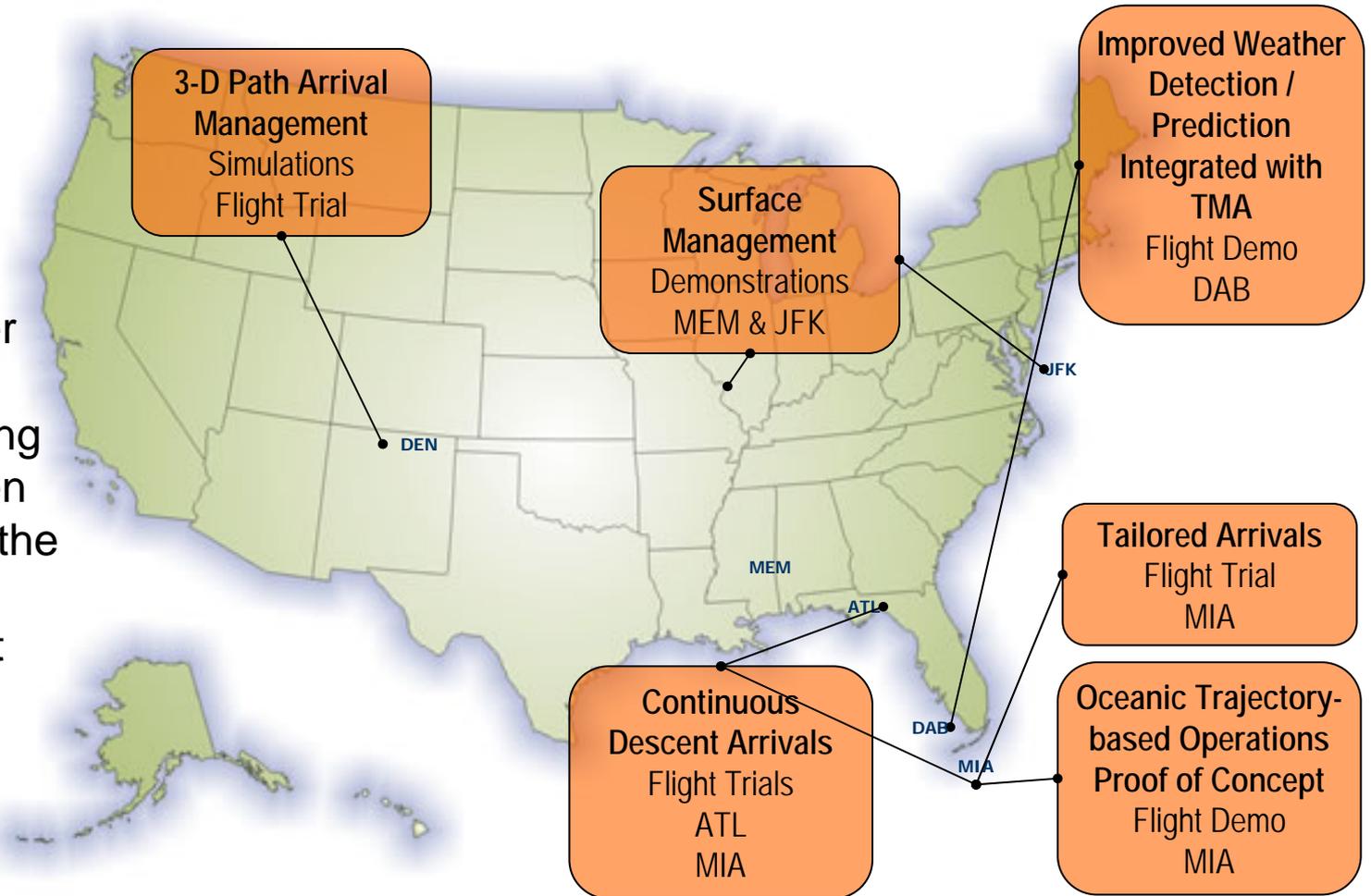
Identifying solutions for tomorrow's trouble spots



FAA's NextGen Implementation Plan

Flight trials

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



Implementing NextGen

Next Generation Air Transportation System

Solution Sets

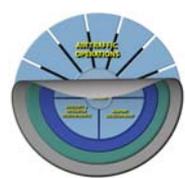


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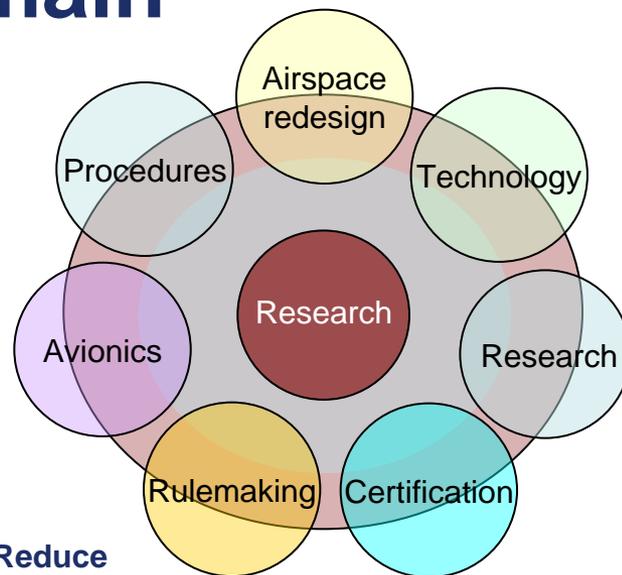
Federal Aviation
Administration



Air Traffic Operations Domain

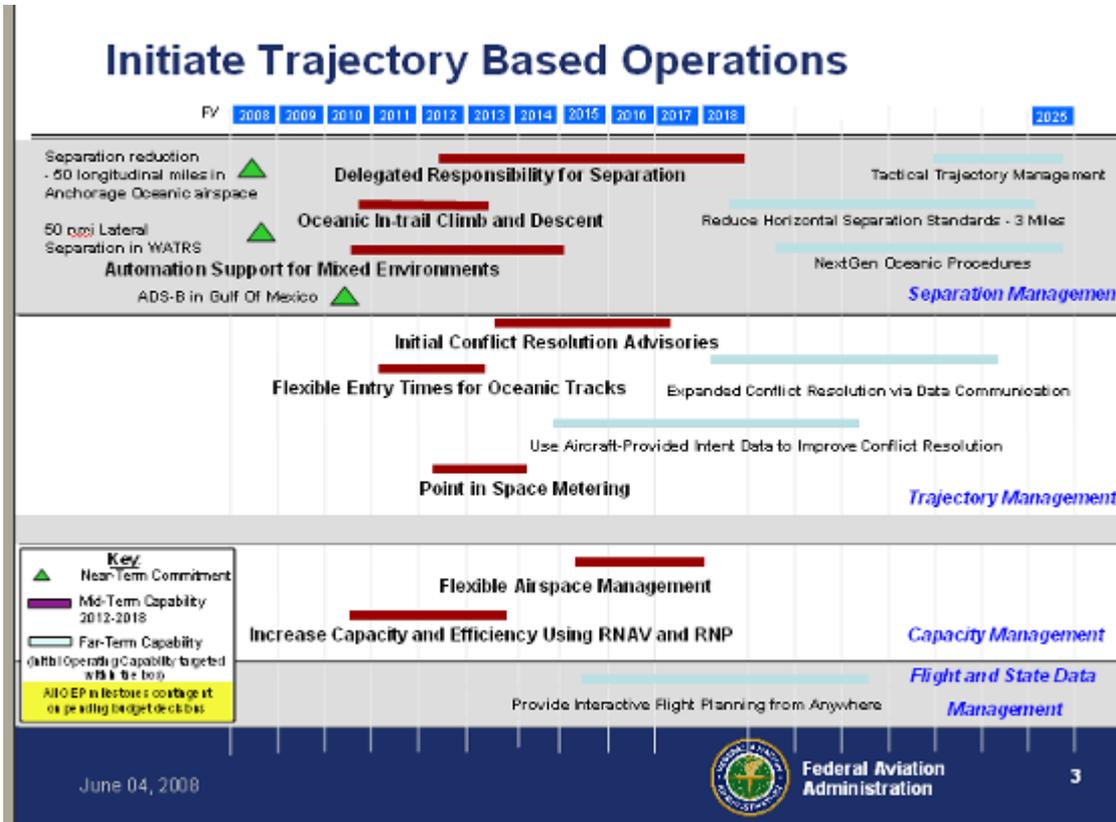
A solution set is a portfolio of *capabilities*

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***

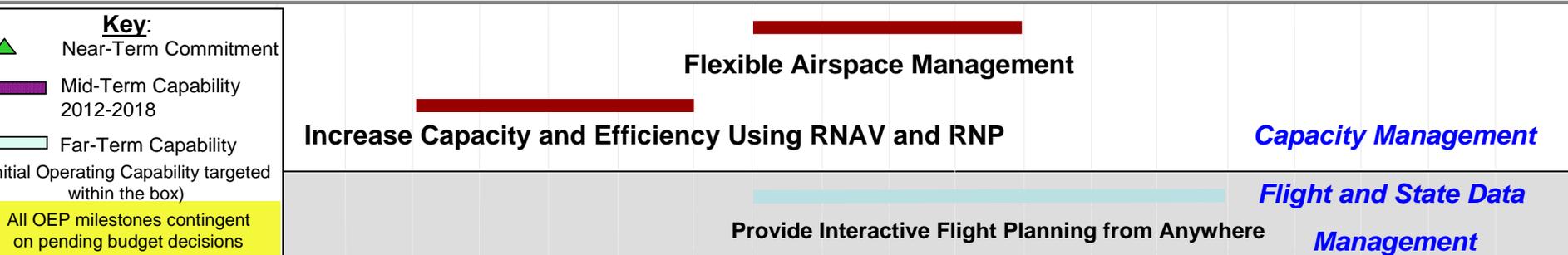
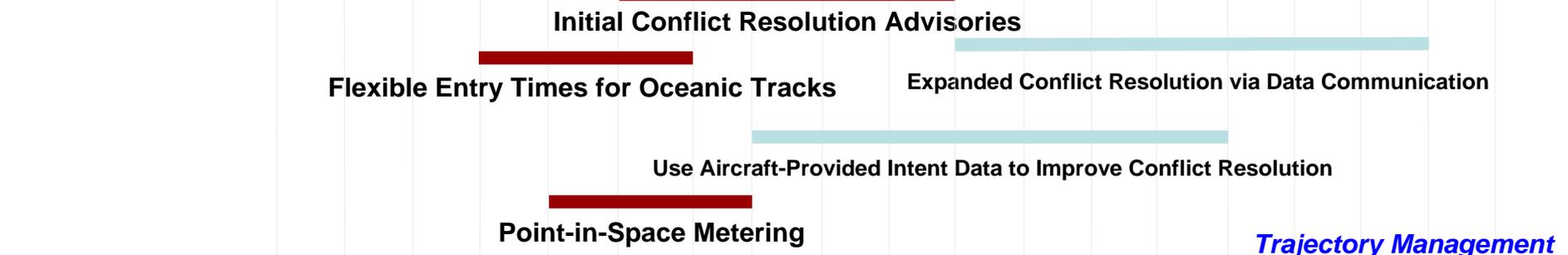
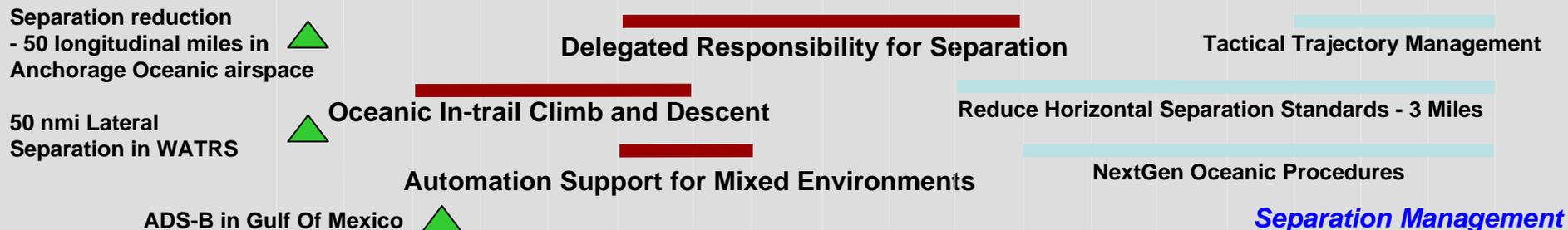


Benefits

- 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



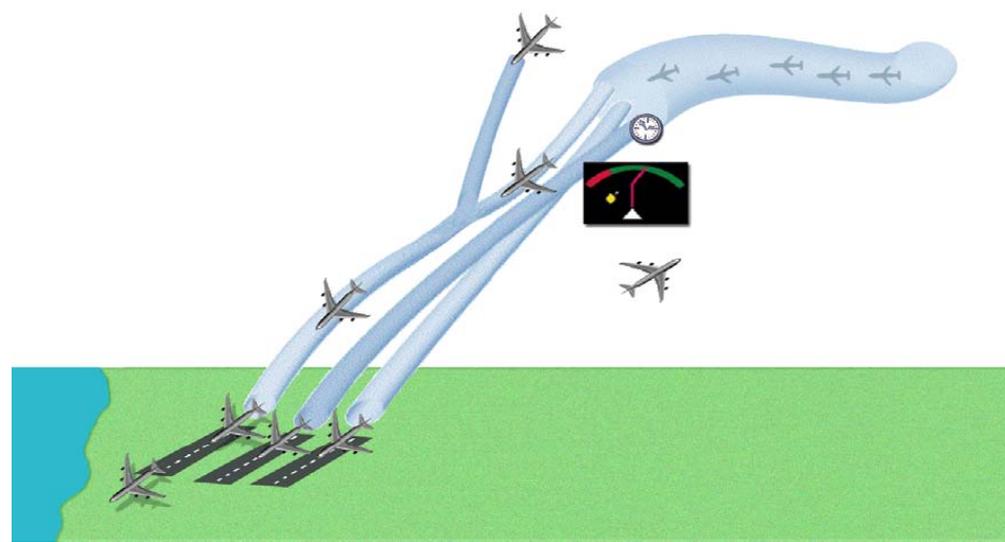
Enhanced Surface Traffic Operations

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

Implement ASDE-X

CAVS at Louisville

Improved Operations to Closely Spaced Parallel Runways

Delegated Responsibility for Horizontal Separation

Separation Management

Initial Surface Traffic Management

Wake Vortex Incorporated into Flow

Trajectory Management

Time Based Metering Using RNAV and RNP Route Assignments

Implement En Route Time Based Metering Procedures

Optimize Runway Assignments

Use Data Messaging To Provide Flow and Taxi Assignments

Full Surface Traffic Management with Conformance Monitoring

Use Aircraft-Provided Intent Data to Improve Flow and Conflict Resolution

Integrated Arrival/Departure Airspace Management

HAATS

Chicago Airspace

NY/NJ/PHL Metro Area Airspace

Northern California 3 Tier Airspace

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

Airspace Flow Program 

Continuous Flight Day Evaluation

Flow Contingency Management

Integrated Surface Data   

Traffic Management Initiatives with Flight Specific Trajectories

Reroute Impact Assessment & Resolution 

Execution of Flow Strategies 

Full Collaborative Decision Making

Manage Airspace to Flow

Improved Management of Airspace for Special Use

Manage Airspace as Trajectories
Capacity Management

Trajectory Flight Data Management

Provide Full Flight Plan Constraint Evaluation with Feedback

On-Demand NAS Information

Flight and State Data 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



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

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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

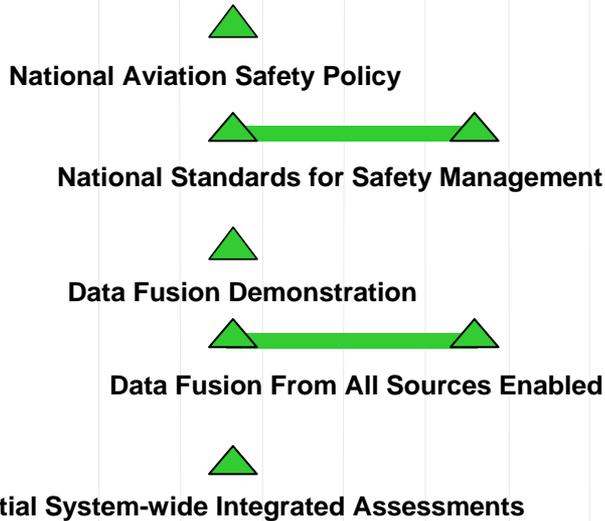
Benefits

- 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)

All OEP milestones contingent on pending budget decisions



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:

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2012-2018

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(Initial Operating Capability targeted
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All OEP milestones contingent
on pending budget decisions



Implementing NextGen

Next Generation Air Transportation System

Transformational Programs

Presented By:

Ann Tedford

Date:

October 2008



Federal Aviation
Administration

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

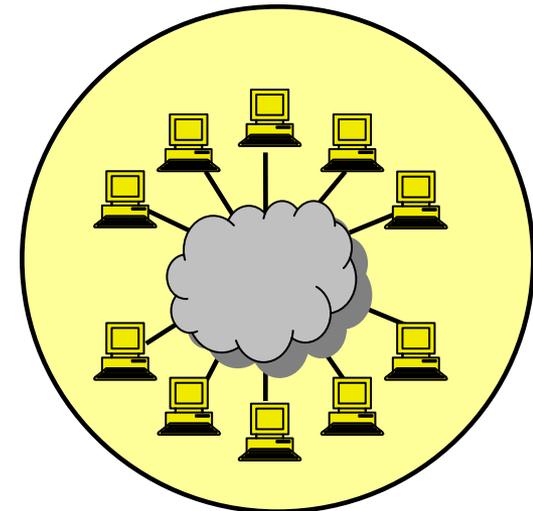
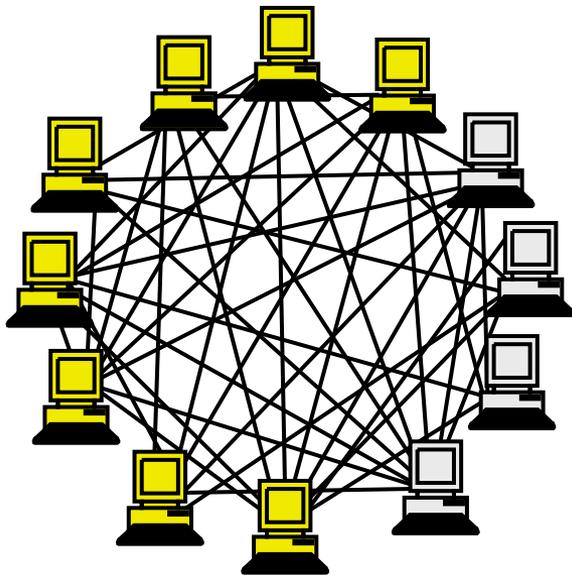


System Wide Information Management (SWIM)

Today: Point to Point Information Management

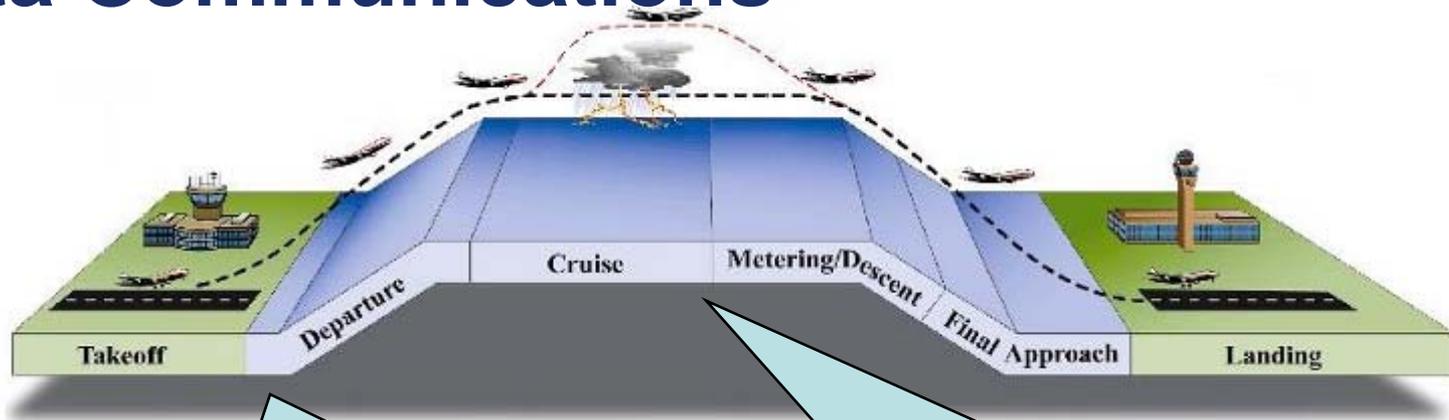


NextGen: System Wide Information Management



Business as Usual
(NextGen without SWIM)

Data Communications



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

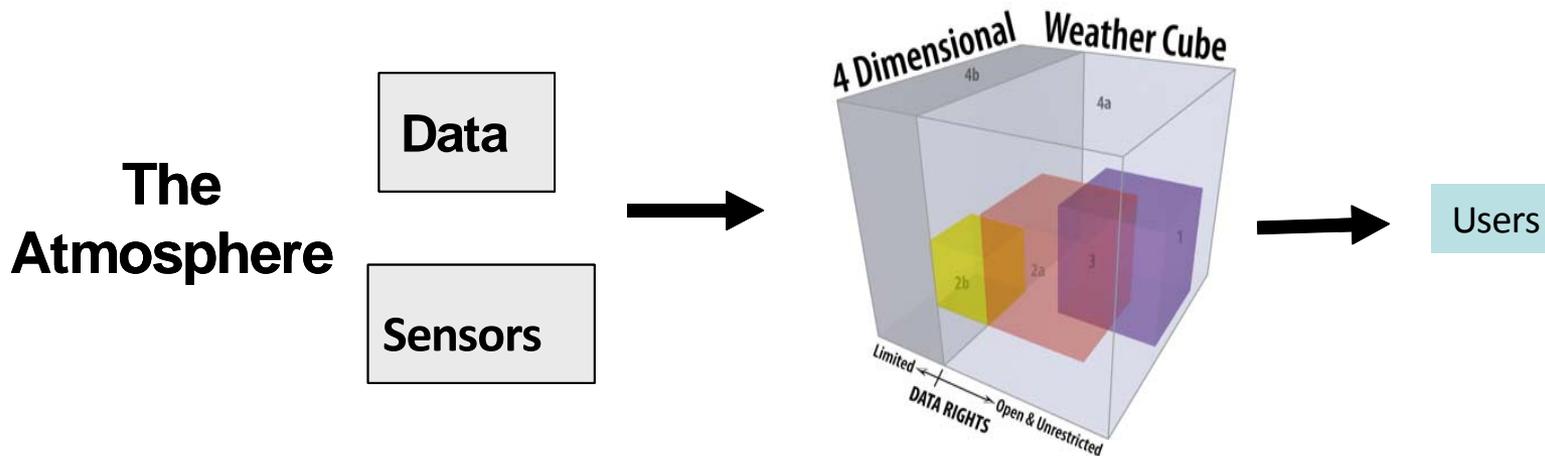
- Enroute Clearances
 - Heading, Speed, Altitude, Routes, Flow Initiatives, Crossing Restraints
- Enroute Notifications

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

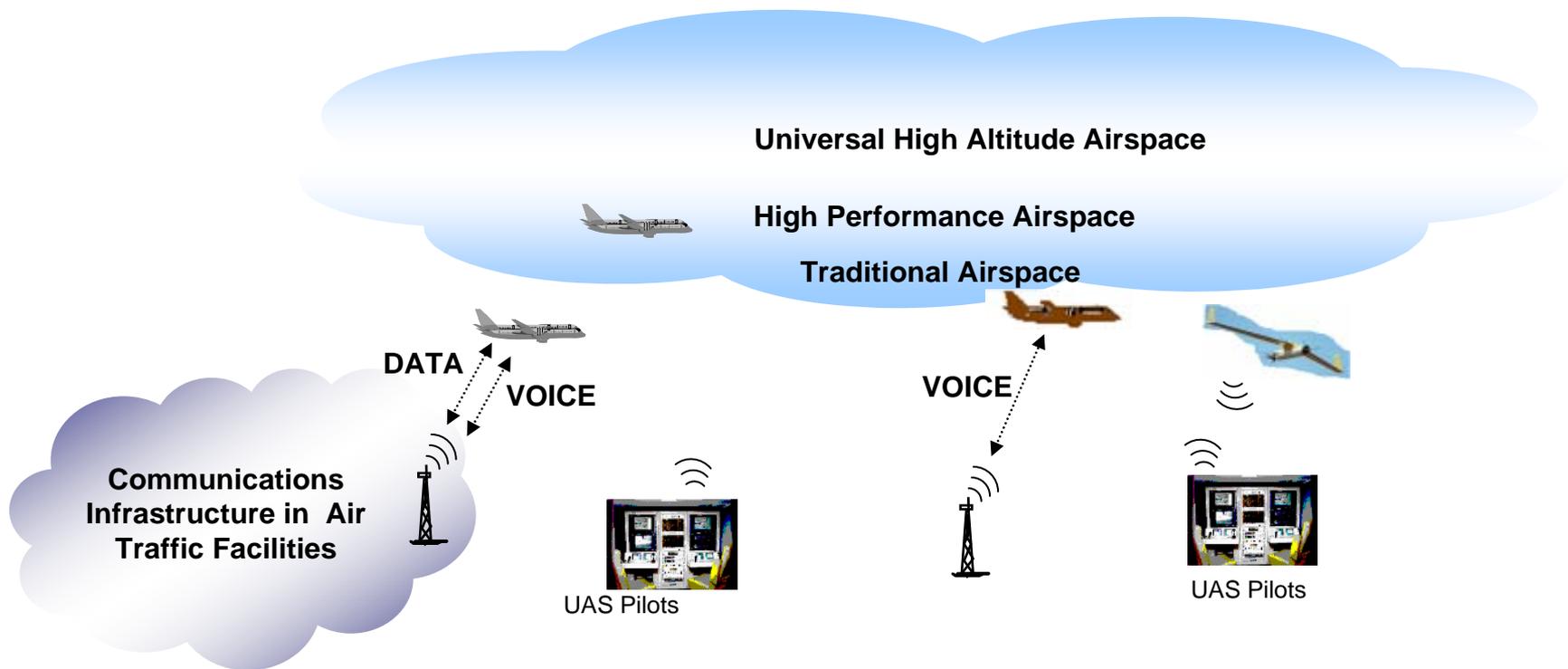
NextGen Network Enabled Weather (NNEW)

- 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.



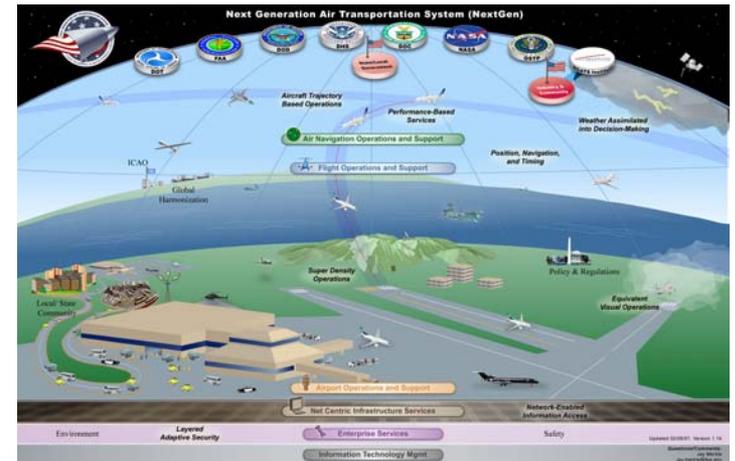
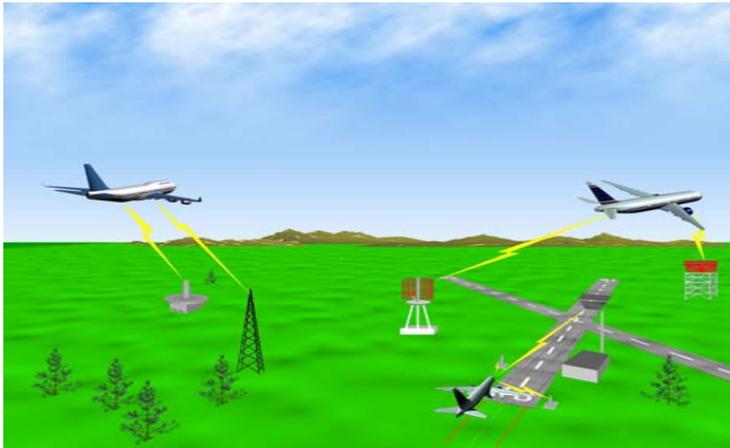
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Today's NAS

- 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



Implementing NextGen

Next Generation Air Transportation System

NextGen Integration & Implementation

Presented By:

Ann Tedford

Date:

October 2008



Federal Aviation
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NextGen Integration & Implementation



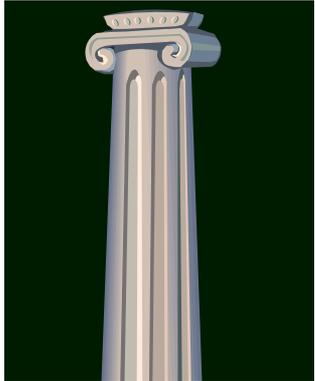
- **Ensures effective and efficient application, planning, programming, budgeting and execution of FAA's NextGen portfolio**
 - Focus on near & mid-term (now – 2018) NextGen implementation
- **Manages NextGen portfolio across FAA lines of business**
 - Service-level agreements
 - Program-level agreements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

NextGen Integration & Implementation

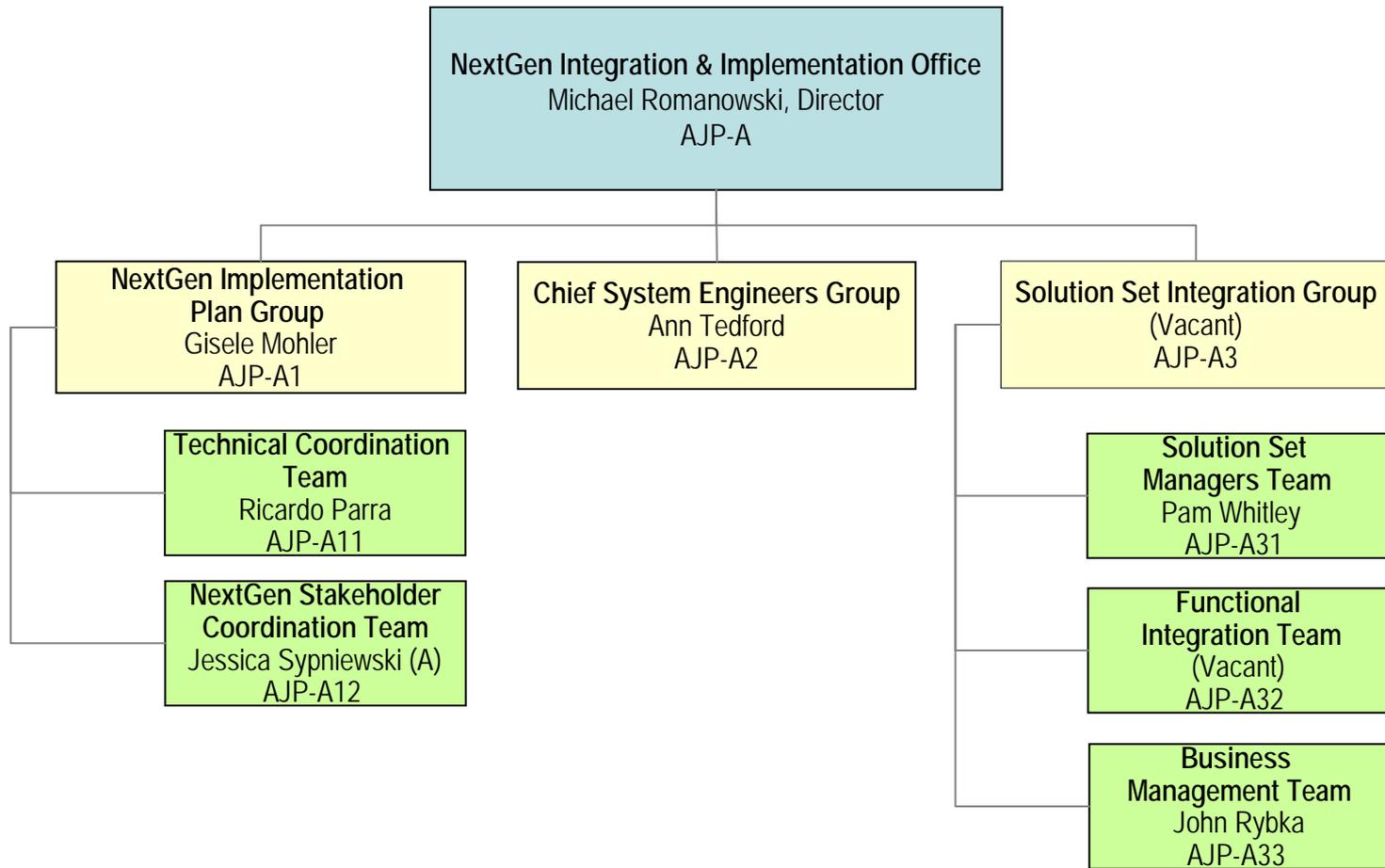


- **NextGen Planning Group**
 - Top-level integrated NextGen portfolio management
 - Supports governance framework for cross-agency decision making processes & accountability
 - NextGen Review Board
 - NextGen Management Board
 - Stakeholder engagement
 - Publishes & maintains NextGen Implementation 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



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System Engineering Manual: Validation & Verification

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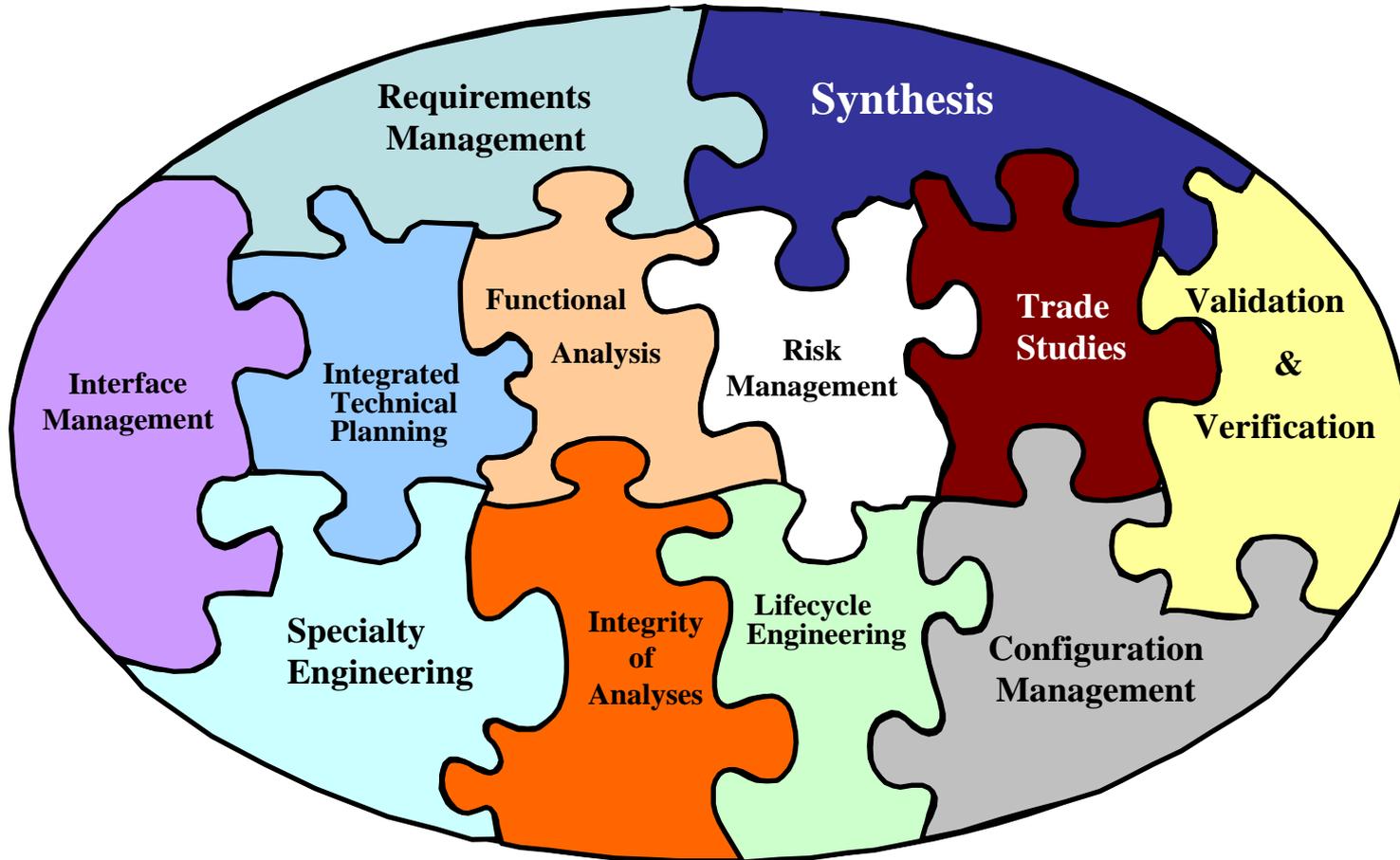


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System Engineering Manual

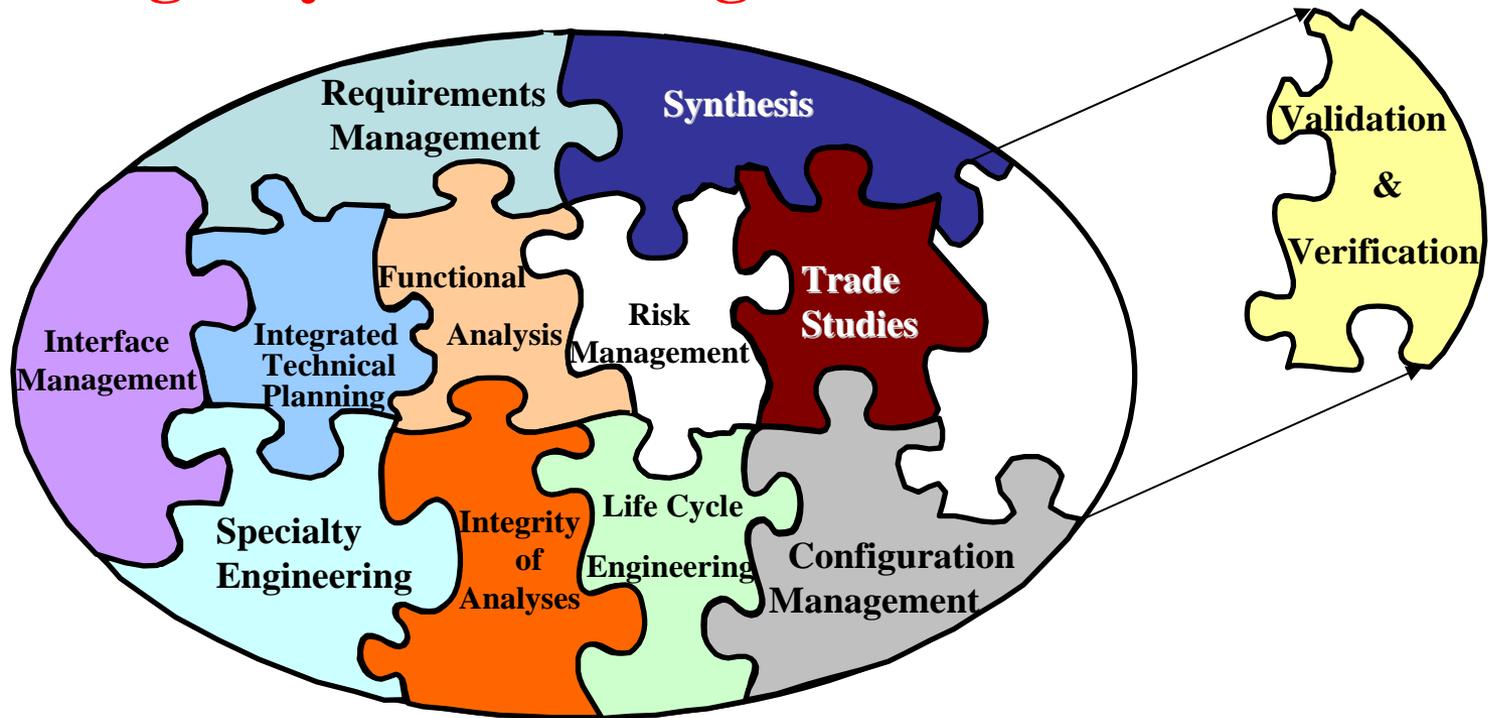
- **The System Engineering Manual – a HOW-TO guide**
 - Defines major system engineering elements
 - Establishes best practices for applying these elements to the NAS
- **System Engineering**
 - Is a discipline that concentrates on the design and application of the whole (system) as distinct from the parts
 - Involves looking at a problem in its entirety, taking into account all the facets and all the variables and relating the social to the technical aspects
- **Purpose**
 - Define the FAA's integrated practice of system engineering
 - Provide methods and tools
 - Identify competency areas

System Engineering Elements



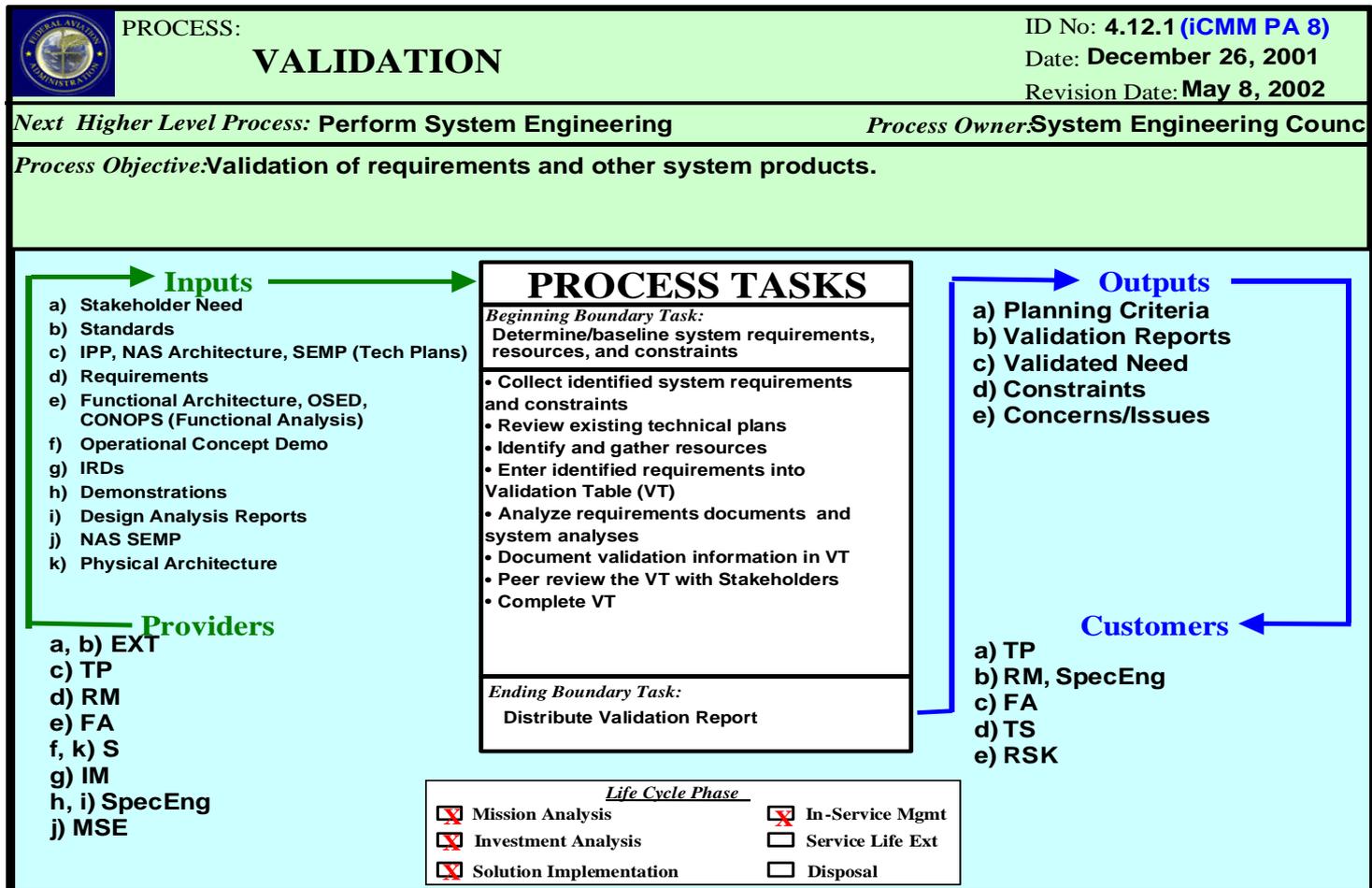
Validation & Verification

Validation: Confirming that the right system is being built.

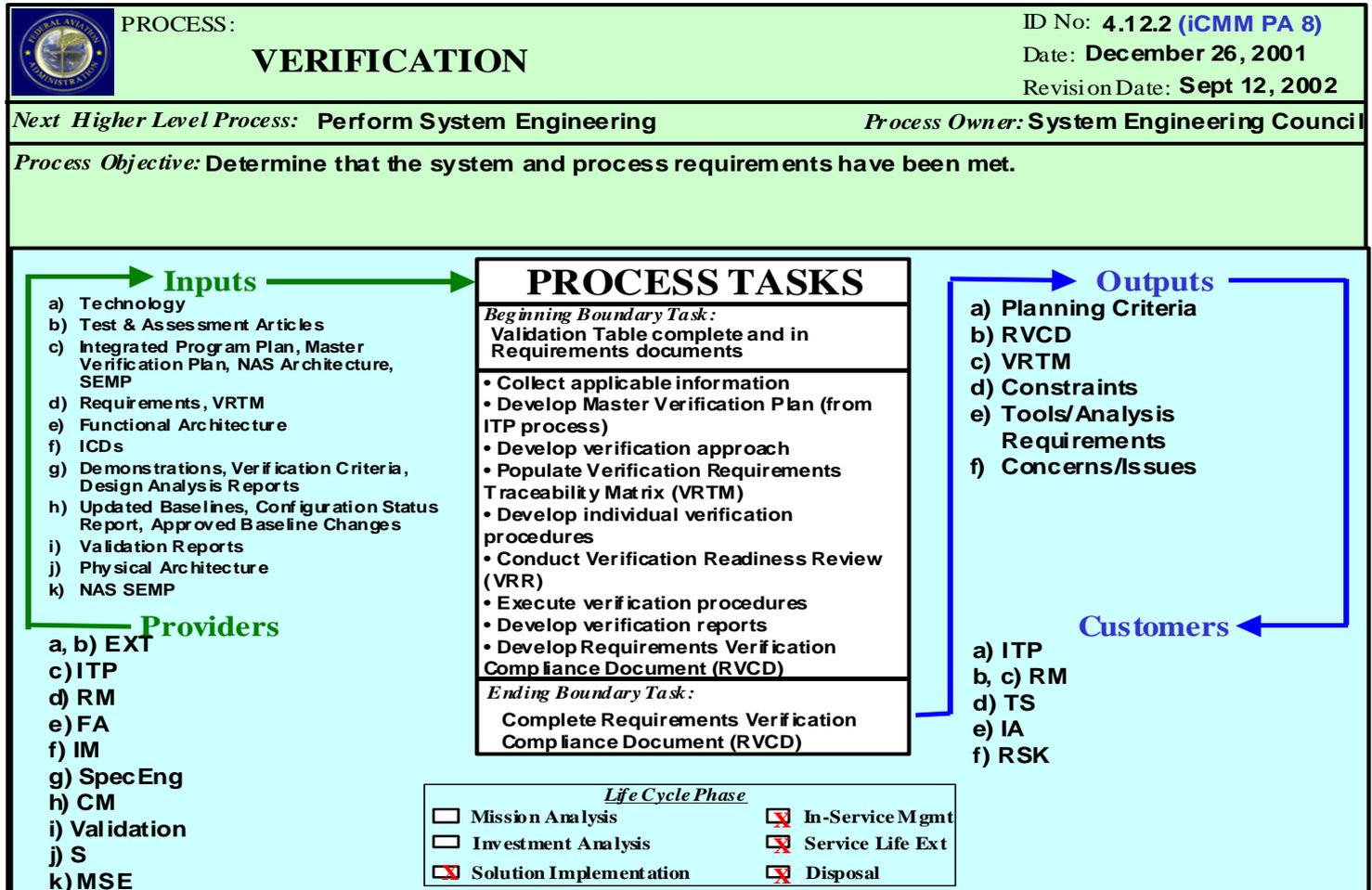


Verification: Ensuring the system was built right.

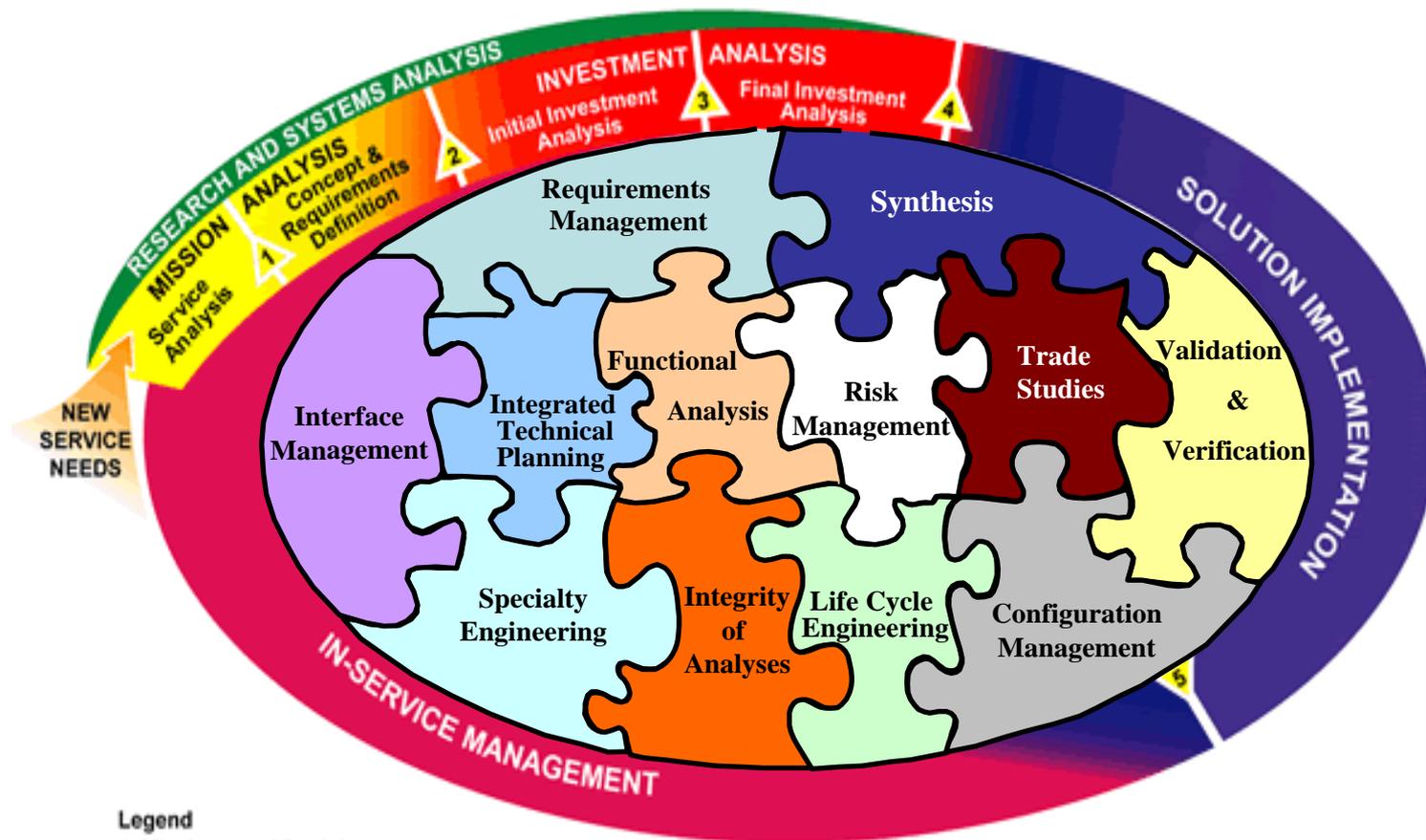
Validation Process-Based Management Chart



Verification Process-Based Management Chart



System Engineering and Acquisition Management



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/>
- **FAA's System Engineering Manual**
http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/operations/sysengsaf/seman/

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Thank You. Any Questions?

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