Implementing NextGen
Next Generation Air Transportation System

Presented By: Ann Tedford
Date: 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
NextGen: Improving Service Delivery

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October 2008
**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

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**Roadmap**

**Programs**

- En Route Automation Modernization (ERAM)
- NextGen Collision Avoidance System
- NextGen Traffic Flow Management
- SWIM
- Aeronautical Data Link
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 fuel-effective automated trajectories. RNAV introduces the requirement for on-board 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 $300M savings annually at that location.

- Introduced 64 published routes and procedures.
- Accelerated implementation at four high-priority airports: Dallas-Fort 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.

Airspace Capacity

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

- Time-based metering procedures – 360° Fly Route Centers.
- Initial traffic flow management – modernization (IFM-M).
- Airspace Redesign – Chicago
- Airspace Redesign – New York/New Jersey
- Airspace Redesign – Houston
- Adaptive Composition tool for the Airspace Flow Program (AFP)
- Advanced Technologies and Operations Procedures (ATOP) for the West Atlantic Route System, the Atlantic portion of Miami Corridor, and the San Juan Flight Information Region.

New York Initiatives. The FAA embarked on a special effort to focus attention on the airspace around New York. Partnering with industry, the FAA sponsored an Aviation Rulemaking Committee (ARC) that resulted in the FAA’s recent recommendation for airspace adjustments around LaGuardia and JFK airports.

- Co-sponsored new LaGuardia approach/landing procedures.

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 operational awareness for all operators as well as lead to greater airport surface movement efficiencies.

- New Center Tower 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 with enhanced surface surveillance provided by the 12 total deployed ASDE-X systems that has reduced airport delays by one million minutes nationwide.
FAA’s NextGen Implementation Plan
Identifying solutions for tomorrow’s trouble spots
This summer FAA is demonstrating vital NextGen concepts in the operational environment.
Implementing NextGen
Next Generation Air Transportation System

Solution Sets

Presented By: Ann Tedford
Date: October 2008

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**

#### Initiate Trajectory Based Operations

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**Separation 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**

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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

---|---|---|---|---|---|---|---|---|---|---|---
Separation reduction - 50 longitudinal miles in Anchorage Oceanic airspace
Oceanic In-trail Climb and Descent
Automation Support for Mixed Environments
50 nmi Lateral Separation in WATRS
Delegated Responsibility for Separation
Tactical Trajectory Management
Reduce Horizontal Separation Standards - 3 Miles
NextGen Oceanic Procedures
Separation Management
Initial Conflict Resolution Advisories
Flexible Entry Times for Oceanic Tracks
Expanded Conflict Resolution via Data Communication
Use Aircraft-Provided Intent Data to Improve Conflict Resolution
Point-in-Space Metering
Trajectory Management
Flexible Airspace Management
Increase Capacity and Efficiency Using RNAV and RNP
Capacity Management
Provide Interactive Flight Planning from Anywhere
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

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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

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Increase Flexibility in the Terminal Environment

- **WTMD: Wind-Based Wake Procedures**
- **GBAS Precision Approaches**
- **ADS-B Services to Secondary Airports**
- **Use Optimized Profile Descent**
- **RNAV SIDs and STARs**
- **RNP Public SAAAR Approaches**
- **LPV approaches**
- **T Routes/ GPS MEAs**

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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

Integrated Arrival/Departure Airspace Management

Time Based Metering Using RNAV and RNP Route Assignments

Delegated Responsibility for Horizontal Separation

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

Key:
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All OEP milestones contingent on pending budget decisions

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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

Airspace Flow Program
Integrated Surface Data
Reroute Impact Assessment & Resolution
Execution of Flow Strategies

Continuous Flight Day Evaluation
Traffic Management Initiatives with Flight Specific Trajectories
Full Collaborative Decision Making

Improved Management of Airspace for Special Use

Flow Contingency Management
Manage Airspace to Flow
Manage Airspace as Trajectories
Capacity Management

Trajectory Flight Data Management
Provide Full Flight Plan Constraint Evaluation with Feedback
On-Demand NAS Information

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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

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**Trajectory-Based Weather Impact Evaluation**

- Complete ITWS Deployment
- Trajectory Management
- Automatic Hazardous Weather Alert Notification
- Full Operational Weather Capability
- Flow Contingency Management

**Weather Advisory Information to the Flight Deck (Nationwide)**

- 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

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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

National Aviation Safety Policy

National Standards for Safety Management

Data Fusion Demonstration

Data Fusion From All Sources Enabled

Initial System-wide Integrated Assessments

Safety Management System

Aviation Safety Information Analysis & Sharing

Safety Management Enterprise Services

Fully Institutionalized National Aviation Safety Policy and Continuous Safety Improvement Culture

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Environment

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

All OEP milestones contingent on pending budget decisions
Security

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

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Implementing NextGen
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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

Integration, Development and Operations Analysis Capability

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NextGen Facilities

Net-Centric Virtual Facility

NAS Wide Sector Demand Prediction and Resource Planning
Implementing NextGen
Next Generation Air Transportation System

Transformational Programs

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Date: October 2008

Federal Aviation Administration
Automatic Dependent Surveillance Broadcast (ADS-B)

• **Automatic**
  – Periodically transmits information with no pilot or operator input required

• **Dependent**
  – Position and velocity vector are derived from the Global Positioning System (GPS)

• **Surveillance**
  – A method of determining position of aircraft, vehicles, or other asset

• **Broadcast**
  – 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

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.

The Atmosphere

Data

Sensors

4 Dimensional Weather Cube

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: 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
Implementing NextGen

Next Generation Air Transportation System

NextGen Integration & Implementation

Presented By: Ann Tedford
Date: October 2008
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
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

- Requirements Management
- Functional Analysis
- Integrated Technical Planning
- Specialty Engineering
- Integrity of Analyses
- Lifecycle Engineering
- Configuration Management
- Risk Management
- Trade Studies
- Validation & Verification
- Synthesis
- Interface Management
- Integrated Technical Planning
- Functional Analysis
- Risk Management
- Trade Studies
- Validation & Verification
- Synthesis
- Interface Management
Validation & Verification

Validation: Confirming that the right system is being built.

Verification: Ensuring the system was built right.
Validation Process-Based Management Chart

ID No: 4.12.1 (iCMM PA 8)
Date: December 26, 2001
Revision Date: May 8, 2002

Process Objective: Validation of requirements and other system products.

<table>
<thead>
<tr>
<th>PROCESS TASKS</th>
<th>Life Cycle Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mission Analysis</td>
</tr>
<tr>
<td></td>
<td>Investment Analysis</td>
</tr>
<tr>
<td></td>
<td>Solution Implementation</td>
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</tbody>
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Determine/baseline system requirements, resources, and constraints
- Collect identified system requirements and constraints
- Review existing technical plans
- Identify and gather resources
- Enter identified requirements into Validation Table (VT)
- Analyze requirements documents and system analyses
- Document validation information in VT
- Peer review the VT with Stakeholders
- Complete VT

Distribute Validation Report

Inputs
- a) Stakeholder Need
- b) Standards
- c) IPP, NAS Architecture, SEMP (Tech Plans)
- d) Requirements
- e) Functional Architecture, OSED, CONOPS (Functional Analysis)
- f) Operational Concept Demo
- g) IRDs
- h) Demonstrations
- i) Design Analysis Reports
- j) NAS SEMP
- k) Physical Architecture

Providers
- a, b) EXT
- c) TP
- d) RM
- e) FA
- f, k) S
- g) IM
- h, i) SpecEng
- j) MSE

Outputs
- a) Planning Criteria
- b) Validation Reports
- c) Validated Need
- d) Constraints
- e) Concerns/Issues

Customers
- a) TP
- b) RM, SpecEng
- c) FA
- d) TS
- e) RSK
Verification Process-Based Management Chart

PROCESS:

VERIFICATION

ID No: 4.12.2 (ICMM PA 8)
Date: December 26, 2001
Revision Date: Sept 12, 2002

Next Higher Level Process: Perform System Engineering
Process Owner: System Engineering Council

Process Objective: Determine that the system and process requirements have been met.

PROCESS TASKS

Beginning Boundary Task:
Validation Table complete and in Requirements documents

- Collect applicable information
- Develop Master Verification Plan (from ITP process)
- Develop verification approach
- Populate Verification Requirements Traceability Matrix (VRTM)
- Develop individual verification procedures
- Conduct Verification Readiness Review (VRR)
- Execute verification procedures
- Develop verification reports
- Develop Requirements Verification Compliance Document (RVCD)

Ending Boundary Task:
Complete Requirements Verification Compliance Document (RVCD)

Life Cycle Phase

- Mission Analysis
- Investment Analysis
- Solution Implementation
- In-Service Mgmt
- Service Life Ext
- Disposal

Inputs

a) Technology
b) Test & Assessment Articles
c) Integrated Program Plan, Master Verification Plan, NAS Architecture, SEMP
d) Requirements, VRTM
e) Functional Architecture
f) ICDs
g) Demonstrations, Verification Criteria, Design Analysis Reports
h) Updated Baselines, Configuration Status Report, Approved Baseline Changes
i) Validation Reports
j) Physical Architecture
k) NAS SEMP

Providers

a, b) EXT
c) ITP
d) RM
e) FA
f) IM
g) SpecEng
h) CM
i) Validation
j) S
k) MSE

Outputs

a) Planning Criteria
b) RVCD
c) VRTM
d) Constraints
e) Tools/Analysis
f) Concerns/Issues

customers

a) ITP
b, c) RM
d) TS
e) IA
f) RSK
System Engineering and Acquisition Management
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• FAA’s Enterprise Architecture
  http://www.nas-architecture.faa.gov/nas/

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Thank You. Any Questions?

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