Next Generation Air Transportation System
Delivering NextGen Improvements

Legacy System
- Radar
- Inefficient Routes
- Voice Communications
- Disparate Information
- Fragmented Weather Forecasting
- Weather Restricted Visibility
- Forensic Safety Systems
- Nationwide Focus

NextGen
- Satellite
- Performance Based Navigation (fuel savings)
- Voice & Digital Communications
- Automated Decision Support Tools
- Integrated Weather Information
- Improved Access in Low Visibility
- Prognostic Safety Systems
- Focus on Congested Metroplexes

Implementation
- TFDM
- PBN
- TBFM
- ASIAS
- AIM
- NWP

Transformational
- ADS-B
- CATM-T
- SWIM
- CSS-Wx
- NVS
- DataComm

Foundational
- Terminal Automation Modernization and Replacement
- En Route Automation Modernization
- Terminal Automation Modernization and Replacement
### FAA ATM Transformation

#### Time Based Management and Trajectory Based Operations

<table>
<thead>
<tr>
<th>Past Practices</th>
<th>NextGen Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controllers and operators do not have same</td>
<td>Shared information (e.g., weather, traffic, system</td>
</tr>
<tr>
<td>information to inform decisions</td>
<td>status) for collaborative decision-making</td>
</tr>
<tr>
<td>Future time and position of the aircraft not</td>
<td>Future intended time and position of all aircraft</td>
</tr>
<tr>
<td>known by all parties*</td>
<td>known for optimal flight and traffic flow</td>
</tr>
<tr>
<td>Routing limited by ground-based navigational</td>
<td>More efficient flight routes and aircraft performance</td>
</tr>
<tr>
<td>infrastructure</td>
<td>based procedures using GPS navigation</td>
</tr>
<tr>
<td>Controllers communicate by voice to each</td>
<td>Controllers communicate via digital messages to</td>
</tr>
<tr>
<td>individual aircraft</td>
<td>multiple aircraft at a time</td>
</tr>
<tr>
<td>Operational choke points across phases of flight</td>
<td>Operations integrated across phases of flight for</td>
</tr>
<tr>
<td></td>
<td>gate-to-gate efficiency</td>
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<tr>
<td></td>
<td>Strategic air traffic management</td>
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</tbody>
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*Operators, aircrews, pilots, dispatchers, controllers, operations centers and traffic managers
# Building the Future NAS

<table>
<thead>
<tr>
<th>2014-2016</th>
<th>2016-2020</th>
<th>2020-2025</th>
<th>Beyond 2025</th>
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<tr>
<td><strong>Foundational Infrastructure</strong></td>
<td><strong>Expanded NextGen</strong></td>
<td><strong>Realize NextGen</strong></td>
<td><strong>Leverage NextGen</strong></td>
</tr>
<tr>
<td>• En Route Automation Modernization</td>
<td>• Delivering NAS information</td>
<td>• NAS Voice System</td>
<td>• Enhanced service delivery</td>
</tr>
<tr>
<td>• Terminal Automation Modernization and Replacement</td>
<td>• NextGen Weather</td>
<td>• ADS-B In</td>
<td>• Expand equipage</td>
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<tr>
<td>• Automatic Dependent Surveillance-Broadcast (ADS-B) Out infrastructure</td>
<td>• ADS-B Out Equip 2020</td>
<td>• Data Communications</td>
<td>• Advanced applications for NextGen systems</td>
</tr>
<tr>
<td>• System Wide Information Management</td>
<td>• Community engagement</td>
<td>• Terminal Flight Data Manager</td>
<td>• More easily address new capabilities</td>
</tr>
<tr>
<td><strong>NAC Priorities</strong></td>
<td><strong>Realize NextGen</strong></td>
<td><strong>Leverage NextGen</strong></td>
<td><strong>Beyond 2025</strong></td>
</tr>
<tr>
<td>Expanded Performance Based Navigation</td>
<td>• Integrate UAS</td>
<td>• Enhanced Decision Support software applications</td>
<td></td>
</tr>
<tr>
<td>Initial Data Comm</td>
<td>• Integrate commercial space operations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased surface efficiency</td>
<td>• Align aircraft equipage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expanded Multiple Runway Operations</td>
<td>• Enhanced Decision Support software applications</td>
<td></td>
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<tr>
<td><strong>Transparent, Sustainable, Agile, and Resilient NAS</strong></td>
<td><strong>Leverage NextGen</strong></td>
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<tr>
<td>community/stakeholder engagement, tech refresh, cybersecurity, cost containment</td>
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</tbody>
</table>
Keys to NextGen Success

VISION
ConOps
Investments
R&D

People
FAA and Industry

Equipage
FAA and Industry

Policy, Processes and Procedures
FAA and Industry

Infrastructure
Decision Support Tools
FAA
NextGen Priorities

October 8, 2014
Final Report

October 17, 2014
Delivered to Congress

December 8, 2014
Signed

MRO

Data Comm

PBN

Surface
Multiple Runway Operations

MRO improves access to parallel runways, including those that are closely spaced, and can increase basic runway capacity and throughput by reducing separation between aircraft based on improved wake recategorization standards.

Performance-Based Navigation

PBN is a framework for defining performance requirements in “navigation specifications”

Data Communications

Data Comm is a program aimed at transitioning from an analog voice system of communication between controllers and pilots, to digital communication system.
Realizing NextGen (Highlights)

• Trajectory-based operations
  ➢ Performance Based Navigation
  ➢ Optimized Profile Descents and Ascents
  ➢ Time-based Aircraft Sequencing and Spacing
  ➢ Data Comm Transmission of More Complex Airborne Reroutes

• Static and Dynamic Information Access
  ➢ Additional Information Wanted by Users
  ➢ User Information (FOC and Aircraft) that will Benefit ATC operations

• Collaborative Air Traffic Management
  ➢ Automated Processes through Sharing of Data
  ➢ Execution of Flight Trajectories that More Closely Align to Business Objectives

• Integrated Surface Operations

• Aircraft Capabilities (e.g., to Conduct Low Visibility Operations, Airborne Collision Avoidance System-X)
Leveraging NextGen – Three Areas of Emphasis

• NextGen transformational systems will *continue to deliver improved services*
  - Enhancements to infrastructure will reduce time and cost to implement future enhancements and capabilities

• The NAS will *operate as a seamless system*
  - Capabilities will be seamlessly integrated across phases of flight with appropriate stakeholder and community engagement
  - Integration encompasses end-to-end operations and the data, systems, and people that have an operational role in the NAS

• Transparent, agile, resilient NAS must *meet new challenges*
  - New service demands must be supported and internal NAS improvements are necessary to ensure the integrity of the NAS
NextGen Documents and Tools

Future of the NAS
- Concept document
- Future look ahead at NAS evolution
- Goals for modernization
- Update to Midterm ConOps

Enterprise Architecture
- Planning & engineering tool
- Plan for entire NAS
- NAS Service & Infrastructure Roadmaps
- Internal

NAS Segment Implementation Plan
- Planning document
- All milestones for NextGen programs and execution
- Internal

NextGen Implementation Plan
- Tracking document
- Updates, milestones of major NextGen programs
- External

NextGen Integration Working Group
- Tracking document
- Short-term priorities
- External
NextGen Benefits

Current Benefits

MRO
- We’ve safely reduced wake separation standards at 14 TRACONs and 28 airports around the nation, reducing aircraft fuel usage and emissions.

DATA COMM
- 56 towers equipped
  - Tower departure clearances provide more efficient rerouting.

ADS-B
- Enhanced surveillance in areas radar didn’t reach
  - New routes

PBN
- 101→105 Departure increase / hour
  - Equivalent Lateral Spacing Operations (ELSO) saves time in Atlanta
- 1.8M Gallons of fuel saved at Houston Metroplex

Future Benefits

2030
- $161 Billion

$158 Billion
- Estimated remaining benefits of NextGen through 2030

$114.2 Billion
- Passenger value of time

$1.6 Billion 2014
$2.7 Billion 2016

NAS Performance
- 2.8 billion gallons of fuel saved by 2030

NextGen ROI
- 3:1 Benefit-to-cost ratio of $35.8 billion investment, discounting to present value
Drivers of Our Future

- New Entrants (Commercial Space, Unmanned Aircraft Systems)
- Cyber Security
- Realizing Trajectory-Based Operations
- International Collaboration
- Equipage
- Fiscal Uncertainty
Looking Beyond NextGen

• FAA is conducting early work to look at future possibilities in the 2040 timeframe.

• FAA has a partnership with NASA to create technologies to help NextGen fulfill its promise.

• The goal is to clearly define the most compelling technical challenges facing the aviation industry, and retire these challenges in a time frame that is supported by the stakeholders and required by NASA’s customers.
Looking Beyond NextGen

• NASA fulfills this goal through four primary programs:
  • **Advanced Air Vehicles Programs**
    • Studies, evaluates and develops technologies and capabilities that can be integrated into these aircraft systems, as well as exploring far-future concepts that hold promise for revolutionary improvements to air travel.
    • Projects include: evaluation and test capabilities, advanced air transport technology, advanced composites, commercial supersonic technology and vertical lift technology.
  • **Airspace Operations and Safety Program**
    • Studies methods and means to provide advanced levels of automated support to air navigation service providers and aircraft operators for reduced air travel times and air travel-related delays, and to insure greater safety in all weather conditions.
    • Projects include: airspace technology demonstrations, Shadow Mode Assessment Using Realistic Technologies for the National Airspace System (SMART-NAS) for Safe Trajectory Based Operations (TBO), Safe Autonomous Systems Operations (SASO).
Looking Beyond NextGen

• Integrated Aviation Systems Program
  • The goal is to conduct flight oriented, integrated, system-level research and technology development that supports flight research needs.
  • Projects include: Unmanned Aircraft Systems Integration in the National Airspace System (UAS in the NAS) and flight demonstrations and capabilities including UAS Traffic Management concepts (UTM).

• Transformative Aeronautics Concepts Program
  • The goal is cultivate multi-disciplinary, revolutionary concepts to enable aviation transformation.
  • Projects include: Convergent Aeronautics Solutions (CAS), Transformational Tools and Technologies (TTT), Leading Edge Aero Research for NASA (LEARN)
The FAA William J. Hughes Technical Center

- Supports the advancement of the Next Generation Air Transportation System by
  - Being the nation's leading federal laboratory for Research, Development, Test, and Evaluation
  - Integrating systems and capabilities through collaboration with Industry, Academia, and Government
  - Provides the gateway for National Airspace System upgrades, improvements, and operational sustainment
FAA Technical Center Research Priorities

Human Factors - Air Traffic Control (ATC) and Flight Deck
Terminal Area Safety
System Safety Management
Airport Safety - Wildlife mitigation
  Lighting and Signage
  Soft ground arrestor
Cyber Security
Alternative (unleaded) Fuel for General Aviation
Aircraft Icing
Fire Safety
Airport Pavement
Aircraft Materials – metallic and composites
Aircraft Maintenance and Inspection
Delivering NextGen
En Route Automation Modernization

Benefits
- Provides real-time aeronautical information, enabling more efficient data management
- Increases flexibility in routing aircraft around congestion, weather and other airspace restrictions – automatic flight coordination increases efficiency and capacity.
- Enables seamless information sharing and coordination between controllers and en route centers.

ERAM
- ERAM provides the platform needed for NextGen operations in high-altitude airspace.
- It replaced the legacy HOST automation system, which was not scalable and could therefore not accommodate NextGen capabilities.

Moving Forward
- ERAM operational across entire continent of US airspace
- ERAM completed ORD at all en route centers
- Subsequent updates will enable key NextGen capabilities: ADS-B, SWIM, Data Comm, Trajectory Based Operations
En Route Automation
As of: September 2015

Key
- Airspace Boundaries
- Operational Readiness Demonstration
- Continuous Operations
- Initial Operating Capability (IOC)
- HOST Sites: Pre-IOC

ORD 20 of 20
Cont Ops 20 of 20
IOC 20 of 20
Pre-IOC 0 of 20

Changes from Previous Month: No Changes

En Route Automation Modernization (ERAM)
- Complete Final / 20th IOC
  Sep 2014
- Complete Final / 20th ORD Mar 2015
Delivering NextGen
Performance Based Navigation (PBN)

Precision routes

- Reduced flight time and fuel
- Flexible weather reroutes
- Integrated traffic flow
- End-to-end PBN network
- Airspace deconfliction
Delivering NextGen
Automatic Dependent Surveillance - Broadcast

Benefits
• Provides more frequent position update-rates than radar = precise location information of aircraft
• Provides in-cockpit traffic and weather information
• Improves safety for pilots

ADS-B
• ADS-B uses GPS technology to determine an aircraft's location (and other information, such as airspeed), and broadcasts that information to controllers and other equipped aircraft via a nationwide network of ground stations.
• ADS-B provides surveillance where radar can not be deployed, such as remote areas of Alaska and the Gulf of Mexico, where ADS-B radio stations are mounted on oil platforms.
• ADS-B also enables aircraft-to-aircraft surveillance.

Moving Forward
• Baseline radio stations are in place nationwide
• Surveillance coverage available
  • En Route by 2015 - Complete
  • Terminal and Surface by 2019
• Reduced separation
• Oceanic in-trail altitude changes

Changes from Previous Month: No Changes
Data Communications
Departure Clearance Tower Service
As of: February 2016

Changes from Previous Month: No changes
Terminal Automation
As of: July 2015

Key
- STARS
- ARTS 2E
- ARTS 3E
- DOD
- STARS Lite
- ARTS 1E

STARS Tech Refresh
- Site survey: Completed 8 out of 47 sites.
- Equipment deliveries Completed at 6 out of 47 sites.
- IOC achieved at 5 out of 47 sites.

CARTS (large TRACON) replacement
- Site Survey: Completed 11 of 11 sites
- Equipment deliveries completed at 11 out of 11 sites.
- IOC achieved at 5 (+1) out of 11 sites.

ARTS IIE (lower level terminal) replacement
- Site survey: Completed 67 (+2) out of 97 sites.
- Equipment deliveries completed at 12 out of 97 sites.
- IOC achieved at 11 out of 97 sites.

Changes from Previous Month: Changes highlighted in red

Terminal Automation Modernization and Replacement (TAMR)

1 ARTS IIE IOC (Dallas – D10) Apr 2013
Complete 3 ARTS IIE IOCs Sep 2014
Final ARTS IIE IOC Oct 2016
Performance-Based Navigation (PBN)

Portfolio Description

- PBN is the framework for defining navigation performance along a route, during a procedure or in an airspace. Progressive stages of PBN capabilities include the safe implementation of more closely spaced paths for departure, arrival and approach that allow for improved operations and efficiency. Complementary efforts to new capabilities include NAS right-sizing activities that allow for the removal of non-beneficial procedures and infrastructure currently in place.

Anticipated Benefits

- Fuel efficient routing
- Reduced delays with increased throughput
- Predictability and flexibility of the system
- Direct routes between busy cities pairs
- Integrated STAR and SID procedures, and reduced noise and emissions

Implementation Approach

- Developing PBN in Metroplex airspace allows more efficient use of airspace and improved arrival and departure flows. Metroplex solutions are focused on optimizing procedures and traffic flows, and may include airspace structure changes to support those optimal routings. Specific operational changes include converting conventional procedures to PBN, removing level-offs on arrivals, segregating arrival routes to deconflict flows, adding departure points, expediting departures, adding new high-altitude PBN routes, and realigning airspace to support those changes.
- The national emphasis on Metroplex programs is intended to provide early benefits to large populations of Stakeholders.
- Single site implementation of PBN procedures are processed through FAAO 7100.41 process which has been recently established.

Project Stakeholders

- Airlines
- Communities
- MITRE
- Unions – NATCA, ALPA

Risks and Execution Challenges

- AEE
- AFS
- AJI
- AJM
- AJT
- ANG
- APO
- ARP
- PASS
- Safety – ATO

Complete/Operational | On Track/Low Risk | Delayed/Medium Risk | Overdue/High Risk
---|---|---|---
PBN Capability (* NAC Priority) | OA | Status
PBN Route Eligibility Check | 2013 | B
Large-Scale Redesign of Airspace Leveraging PBN | 2014 | B
Transition to PBN Routing for Cruise Operations | 2015 | G
Equivalent Lateral Spacing Operations (ELSO)* | 2018** | G
RNAV (GPS) Approaches | 2016 | G
RNAV (RNP) Authorization Required (AR) Approaches | 2016 | G
RNAV SIDs and STARs at Single Sites* | 2016 | G
Metroplex PBN Procedures | 2018 | G
Advanced and Efficient RNP* | 2017 | G

Only Near Term Bravo increments are displayed (2016-2017) Success Criteria

**ELSO National Standard (NAC/NIWG Commitment) was completed in June, however ELSO Success Criteria extends to 2018
SWIM Infrastructure Deployment
NAS Enterprise Messaging Service (NEMS)
As of: February 2016

NEMS Deployment Status
FAA Internal Messaging Capabilities
16 nodes deployed of 20 total nodes

FAA Mission Support Messaging Capabilities
2 nodes deployed in Mission Support Network

FAA External Messaging Capabilities
8 nodes deployed in 4 NESG sites (ACY, OKC, ZLC, ZTL)
26 Total NEMS Messaging Nodes deployed

Changes from Previous Month: No changes

System Wide Information Management (SWIM)

2015-2021: Final Segment 2B IOC

Key
- Existing NEMS Nodes
- 2016 Planned NEMS Nodes
- NEMS Gateway
- R&D FNTB Nodes
- Mission Support Nodes (Admin)
- ARTCC Sites
- FTI Operations Center

NEMS Nodes Planned for FY2016:
ZHU, ZOB, ZME, ZDV in July 2016

Hidden SWIM Segment
2B FID October
Accomplishments Overview

Infrastructure
• En Route Automation Modernization
• Automatic Dependent Surveillance–Broadcast
• Data Communications Tower Services
• System Wide Information Management
• Surface Operations and Data Sharing
• Terminal Flight Data Manager
• Time Based Flow Management

Policy, Processes and Procedures
Optimizing Airspace:
• Performance Based Navigation
• Time Based Flow Management
• Traffic Flow Management System
• Separation Management

Collaborative Progress:
• RTCA Task Force 5
• NextGen Advisory Committee (NAC)
• NAC Priorities Joint Implementation Plan
• Airspace Technology Demonstrations
• SESAR Harmonization
• Mini Global Demonstrations
• Equip 2020
• PBN NAS Navigation Strategy

Safety and Environment:
• Aviation Safety Information Analysis & Sharing
• Engine, Aircraft Technologies
• Environmental Design Tool

People
• Customer-Focused Air Traffic Management
• Community Outreach
• Controller and Pilot Training — New Technology, Airspace, and Procedures

Equipage
• Automatic Dependent Surveillance–Broadcast
• Data Communications
• Performance Based Navigation