Trajectory Operations and Data Communications

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FAA “Master Plan” Development Process

Operational Improvements

Concept SHALLS

Mid-Term Conops

Operational Increments

Delivered Benefits

Desired Benefits

Roles & Responsibilities

Procedures

EA/NSIP 2015

NextGen

NextGen
The implementation timeframe for new NAS services and Infrastructure are dictated by the nature of current and future activities.

<table>
<thead>
<tr>
<th>Implementation Timeframe:</th>
<th>Near-term</th>
<th>Mid-term (3 – 10 year outlook)</th>
<th>Far-term (10+ year outlook)</th>
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</thead>
<tbody>
<tr>
<td>Activity:</td>
<td>Deployment</td>
<td>Development</td>
<td>Research &amp; Concepts</td>
</tr>
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</table>

- **NAS EA Service Roadmaps**
  - IOC
  - Investment Analysis System 1
  - Investment Analysis System 2

- **NAS EA Infrastructure Roadmaps**
  - OI1
  - OI2

- **FAA NextGen Planning: Implementation Timeframes**

![Diagram showing implementation timeframes](chart.png)
**Objective:** Integrate Portfolios, Increments and their relationships with the NAS EA, creating a consistent view for all stakeholders on NextGen plans and implementations.

**Benefits:** Common data source now used between EA and NSIP (reduces number of data calls and improves quality assurance); increased corporate access to information, i.e., Portfolio details, OI and increment timelines, etc.

Detailed information on NSIP 2015 is available on the NAS EA Portal: [https://nasea.faa.gov](https://nasea.faa.gov)
NSIP: Content Overview

NAS EA Service Roadmaps: Operational Improvements

Success Criteria

- Operationally available at selected airspace and key site locations Initial Operational Capability (IOC).

Benefits

- Efficiency (P): Increase throughput by reducing delays associated with congestion and weather, improving rerouting capabilities by providing automated information data exchange.
- Safety (S): Improve communication accuracy and safety with digital communication (i.e., reduced read/heartbeat errors, reduced loss of communications events)
- Environmental (E): Reduce environmental impact due to less fuel burn and emissions

System Dependencies

NSIP Operational Increments

NSIP 2015: 122 Alpha and Bravo Increments
<table>
<thead>
<tr>
<th>Infrastructure Element</th>
<th>Rationale</th>
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</table>
| CATM WP5                  | • CTOP and use of Trajectory Option Set (TOS) for airborne flights  
• Strategic Flow Management Application  
• UFPF                                                                                                                                                                    |
| TBFM WP4                  | • Enhanced Adjacent Center Metering  
• Path Stretch  
• Advanced Interval Management (A-IM)  
• Enhanced Arrival-Departure Scheduling                                                                                                                                 |
| TBFM WP5                  | • TBFM scheduler to utilize precise trajectory information that is downlinked via EPP to develop more stable and feasible schedules                                                                                                                                 |
| Data Comm S1P2            | • Full En Route Data Comm services                                                                                                                                                                            |
| TFDM Future               | • Provide access to surface/arrival data for FF-ICE                                                                                                                                                           |
| ERAM Future Work Package  | • Allocation of functions between ERAM and FOXS  
• Approval of User Requests  
• Vertical Conformance Verification  
• FMS Offset (closed trajectory)                                                                                                                                                                                                 |
| ATOP WP2                  | • Allocation of function to support “User Trajectory Planning” between ATOP and TFMS/CATM  
• New DSTs to support TBO  
• Accommodation of B2 Final                                                                                                                                                                                                 |
| SWIM Segment 3            | • Airborne access to SWIM to facilitate exchange of flight information                                                                                                                                          |
| Surface Traffic Management| • Airport Configuration Planning  
• Surface Scheduling Improvements  
• Surface Capabilities including Taxi Routing and Surface Conformance  
• Ground-Based support for flight deck Surface Trajectory Based Operations (STBO)                                                                                                                                     |
| AIMM Segment 3            | • Integration of SAA and Digital NOTAMs with NAS automation systems and Digitized static airspace constraint information in LOAs/SOPs                                                                             |
Implementing Capabilities to realize TBO vision

NAS EA Service Roadmaps: Operational Improvements

NAS EA Infrastructure Roadmaps/NSIP

Support Activity Analyses
- Prototype CHI for En Route Services
- Develop end-to-end operational scenarios and trials for testing
- Conduct system performance and loading analysis

Prototype CHI for En Route Services
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- Conduct system performance and loading analysis

DP 985 (2015, Q4): Final Investment Decision (FID) for Data Communications Segment 1 Phase 2 En Route Services Full

NSIP Operational Increments
- [102158-02] Full En Route Data Communication Services (2022 - 2025)
  Increment Overview
  Data Communication services will be provided to deliver additional clearances for Tailored Arrivals and control instructions for speed and heading changes. Data Communication will also be available for sending beacon codes, advisory messages, and stuck microphone messages. These services will assist controllers in managing aircraft more efficiently, leading to increased productivity of controllers with the consequential effects of increasing sector capacity and throughput. This capability will reduce system errors and pilot deviations due to missed or misunderstood communications via voice, thereby enhancing system safety. Automation tools will assist controllers with the generation of more complex clearance and other Data Comm messages.
Transformation of Methods

**Procedural Based Control:**
Control on Where We Think the Aircraft Is
- Landmark Navigation
- Radio Beacons
- Position Reports

**Surveillance Based Control:**
Control on Where We Know the Aircraft Is
- VOR/DME
- RADAR

**Trajectory Based Control:**
Control on Where We* Know the Aircraft Will Be
- RNP
- ADS-B
- DataComm

* Shared Trajectory

FAA

NextGen
Historical Interactions: Between Stakeholders w/o automation

Definitions:
- **Voice**: Communications is by voice (person to person)
- **Data**: Communications involving automation tools (automation to automation or automation to person)
Present Day Interactions: Between Automation and Stakeholders

Definitions:
- **Voice**: Communications is by voice (person to person)
- **Data**: Communications involving automation tools (automation to automation or automation to person)
Future Interactions: Between Automation and Stakeholders

Definitions:
- **Voice**: Communications is by voice (person to person)
- **Data**: Communications involving automation tools (automation to automation or automation to person)
Information requirements in support of TBO

- Information exchange
  - Shared Environment (AIM, WX, Constraints)
  - Shared Trajectory (synchronized representations)
  - Shared Adjustments
Required for Data Distribution

• Network
   Cross-boundary coordination/distribution

• Information Protocols for
   Publish/subscribe
   Command and control – logon/address

• Connectivity
   Ground-ground
   Air-ground link(s)

• Messaging
   Datacomm
   AAtS
Communication of Data is Multi-Layer

- Harmonization efforts
  - Messages
    - SC214/WG78, FIXM
  - Pipelines
    - VDL-2, L-Band, Aeromacs, Satcomm,
  - Protocols
    - ATN evolution
  - Network
Air Transportation – Coordination Today

- Voice coordination and control
- Disparate Plans in Automation
  - Imprecise execution
  - Automation not Informed
- ATFM Automation
- Limited In-Flight Coordination
  - High Uncertainty
- FD Automation
- FOC Automation
- Multiples Participants Control a Flight
  All Affect the Trajectory
- Transform to Trajectory-Based: Decision-Making, Control and Coordination
TBO Transformations

Transform Control Methods
- Accurate Execution
- Improved Control Precision
- Closed Trajectory

Transform Control Tasks
- FD Automation
- Transform Information
- Transform Information
- Shared plans, consistent trajectories
- ATFM Automation
- Trajectory Constraints
- ATC Automation
- Automation Informed

FOC
- FOC Automation
- Negotiated Trajectory

ATC
- ATC Automation

NextGEN
FAA
Thank You