NextGen Enterprise Architecture

NAS Enterprise Architecture Conference

Jay Merkle, NextGen Chief Architect
Washington, DC
23 June 2009

Objectives

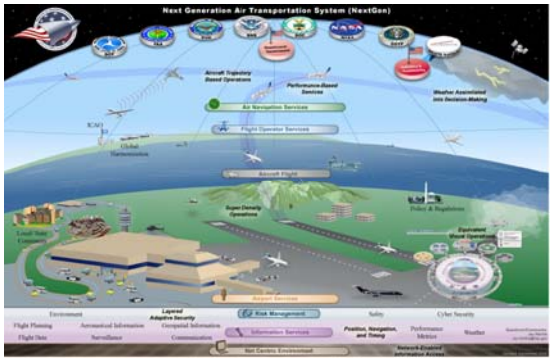
- What is the NextGen EA
- How to use the NextGen EA
- NextGen EA Federation Strategy
- Linkages with SESAR

Next Generation Air Transportation System
Joint Planning and Development Office

What is the NextGen EA?

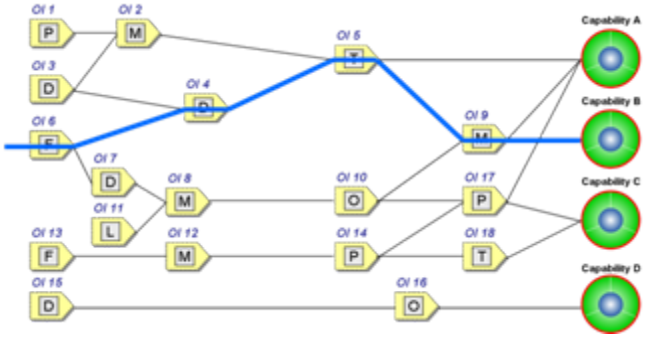
- ***JPDO's method and tools to decompose and describe:***
  - NextGen concepts and capabilities
  - Target operational and system architectures
  - Improvements and enabling solutions

  that achieves the goals by the target time



NextGen Concepts & Capabilities

Target Operational & System Architectures



Operational Improvements & Enabling Solutions, Policies, and R&D

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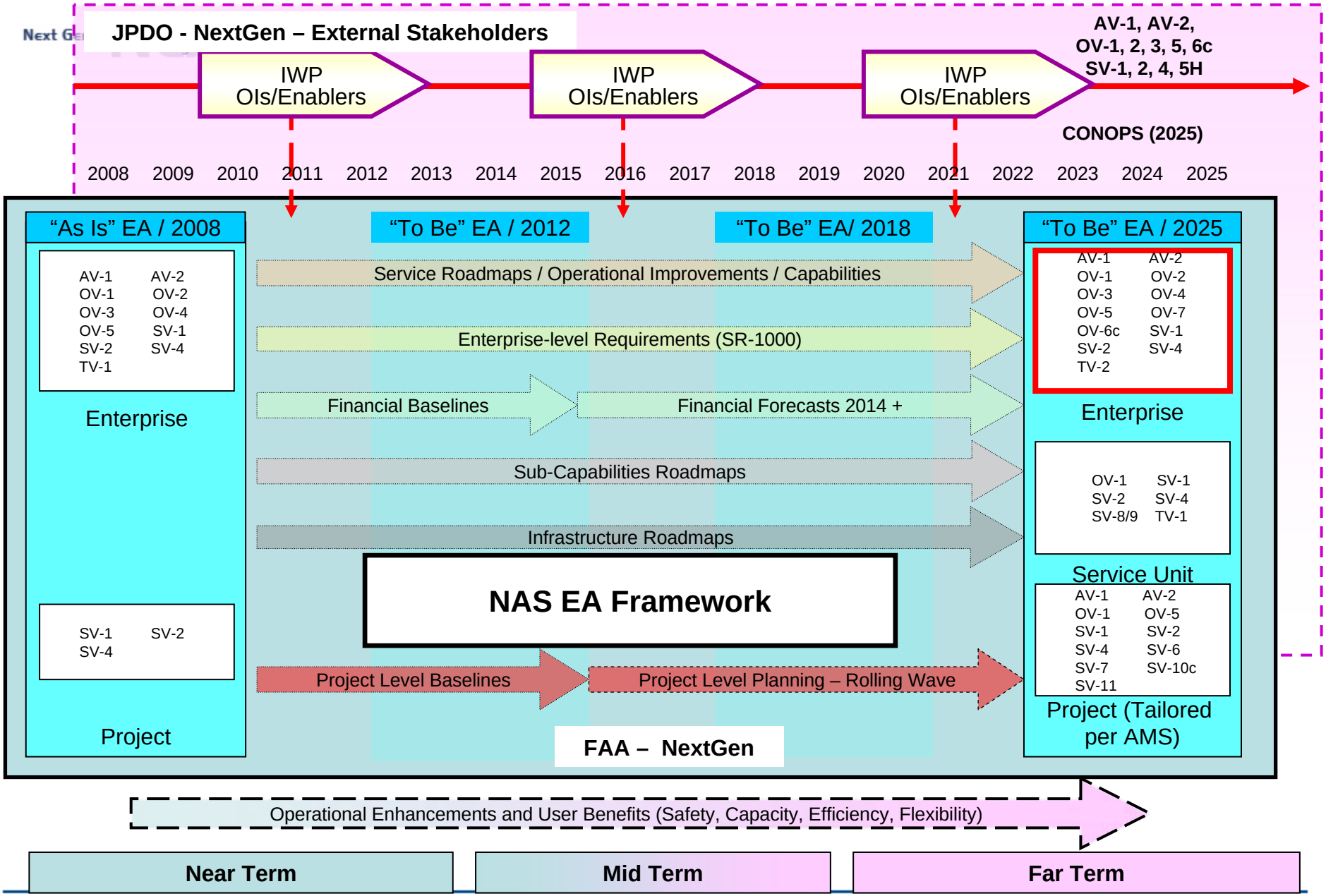
Why develop a NextGen EA?

- ***The goal is curb to curb transformation of air transportation***

  Achieving the transformation will require…
  - New policies to create new behavior
  - Modernization to prepare the infrastructure
  - R&D to create new functionality

- ***Enterprise Architecture is your e-forum for conducting business***
  - Establish goals and guiding principles
  - Create a common language for NextGen
  - Set policy framework and define mission needs
  - Align research and development to validate the plan
  - Understand impacts based on research findings and policy decisions
  - Track commitments to transformational solutions


JPDO - NextGen – External Stakeholders
IWP OIs/Enablers
IWP OIs/Enablers
IWP OIs/Enablers
AV-1, AV-2, OV-1, 2, 3, 5, 6c SV-1, 2, 4, 5H
CONOPS (2025)
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025
"As Is" EA / 2008
"To Be" EA / 2012
"To Be" EA/ 2018
"To Be" EA / 2025
AV-1 AV-2 OV-1 OV-2 OV-3 OV-4 OV-5 SV-1 SV-2 SV-4 TV-1
Enterprise
Service Roadmaps / Operational Improvements / Capabilities
Enterprise-level Requirements (SR-1000)
Financial Baselines
Financial Forecasts 2014 +
Sub-Capabilities Roadmaps
Infrastructure Roadmaps
AV-1 AV-2 OV-1 OV-2 OV-3 OV-4 OV-5 OV-7 OV-6c SV-1 SV-2 SV-4 TV-2
Enterprise
OV-1 SV-1 SV-2 SV-4 SV-8/9 TV-1
Service Unit
NAS EA Framework
SV-1 SV-2 SV-4
Project
Project Level Baselines
Project Level Planning – Rolling Wave
AV-1 AV-2 OV-1 OV-5 SV-1 SV-2 SV-4 SV-6 SV-7 SV-10c SV-11
Project (Tailored per AMS)
FAA – NextGen
Operational Enhancements and User Benefits (Safety, Capacity, Efficiency, Flexibility)
Near Term
Mid Term
Far Term

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What are the differences between the NextGen EA and NAS EA?

NextGen EA

- Curb to Curb
- Contains activities outside the scope of the NAS EA
- Top-Down, Business Transformation
- Supports inter-agency analysis and federation with agency architectures
- Accounts for industry perspective
- High-level transition plan

NAS EA

- Gate to gate
- Takes NextGen EA as input on transformation
- Links to NextGen Implementation plan and Service Unit plans
- Infrastructure Roadmaps are Executive Views

NextGen EA maintains the primary focus on the operational transformation

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What can I find in the NextGen EA?

The NextGen EA, published in October 2008 currently includes…

- Architectural views of the Operational environment (i.e., actions performed by people and/or machines)
- Operational Activity Descriptions
- Operational Information Exchanges
- “Deep-dives” around the Weather and Surveillance Segments of the EA that include system interface and functionality descriptions
- Alignment of Enablers to the Operational Architecture

The NextGen EA can be found at
http://jpe.jpdo.gov

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NextGen EA Product Review

Community Model (OV-1)

Operational Activity Decomposition (OV-5)

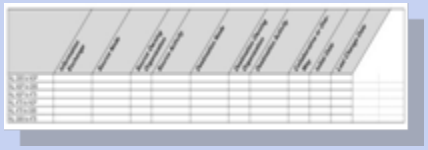
Operational Activity Flows (OV-5)

FEA Reference Models and Federal Transition Framework (FTF)

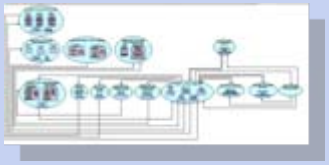
Weather, Surveillance, & Fixed-Object Deep Dive Products

Operational Node Connectivity Description (OV-2)

Operational Information Exchange Matrix (OV-3)



System Node Connectivity Description (SV-1)



System Functions (SV-4)

Accessible at http://jpe.jpdo.gov

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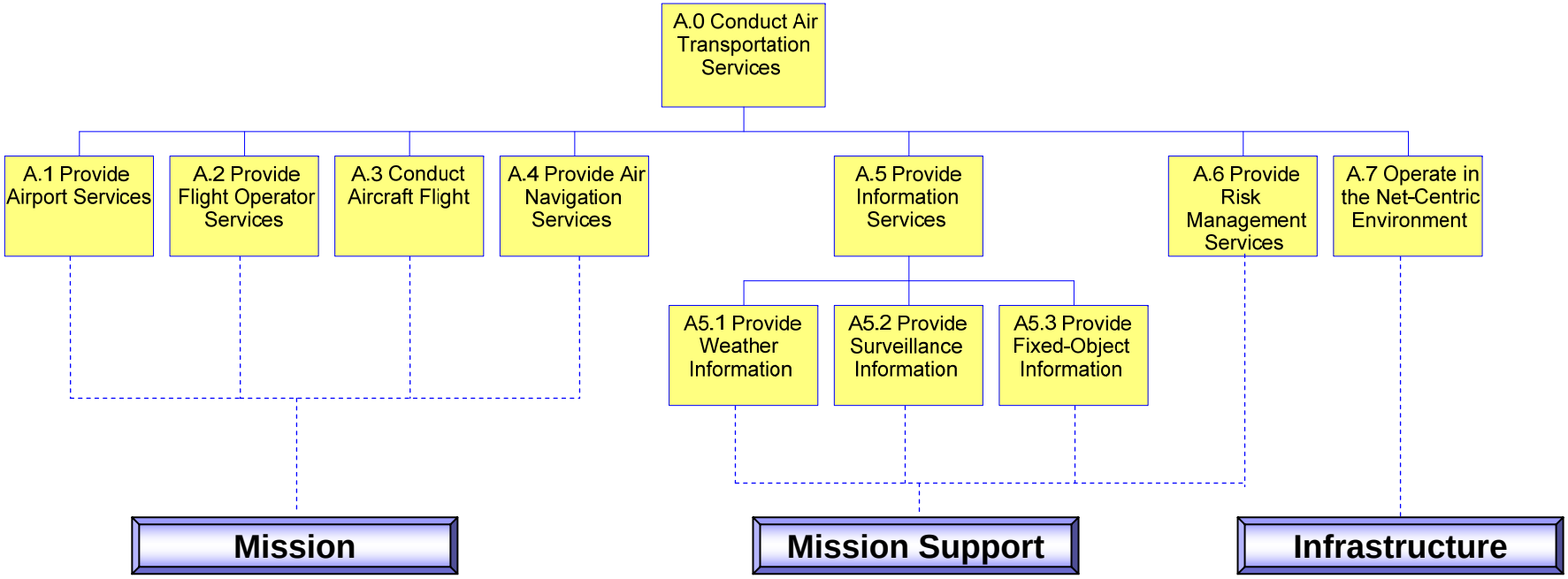
NextGen EA Segments



Operational Activity Description (OV-5)

Where is the NextGen EA heading?

- The ConOps, EA, and IWP are transitioning to a capability-based framework (rather than role-based)
  - 9 overarching NextGen capabilities with 12 sub-capabilities have been defined
  - Sections of the NextGen ConOps will reference the capabilities
  - The NextGen operational architecture views have been revised to better support the framework
  - The NextGen Operational Improvements have been aligned to the capabilities

The NextGen EA & IWP will be published online via the JPE

Where is the NextGen EA heading?

- Planned updates to the IWP
  - Working with FAA to align far-term Operational Improvements
  - Working with Agencies to gain ownership and acceptance of IWP elements, as well as enhance descriptions, dates, etc.
  - Classifying NextGen Enablers using a DOTMLPF construct

- Planned updates to the EA
  - Adding NextGen Enablers (i.e. materiel and not-materiel solutions) to the operational views
  - Developing NextGen system architecture views based on the materiel NextGen Enablers and NAS EA Infrastructure Roadmaps
  - Far-term operational scenarios and use cases are being developed to validate the ConOps, EA, and IWP content (i.e. Weather Impacts to the NextGen system, Integrated Surveillance, Integrated Comm, Navigation, and Surveillance, IFR, and Net-centric Operations)

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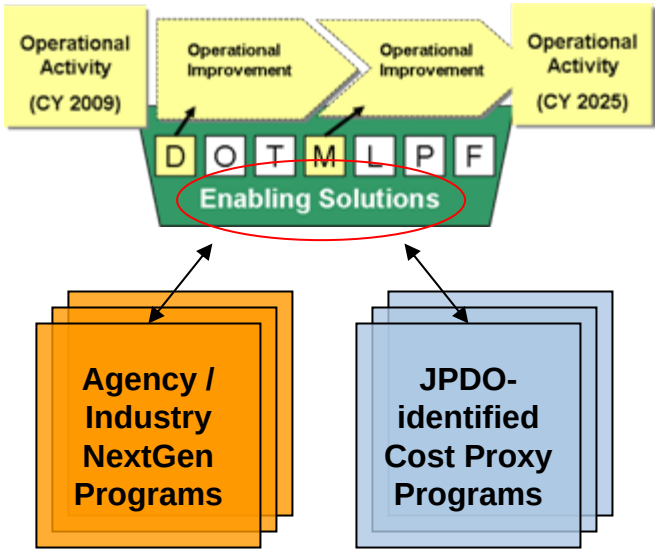
How is the NextGen EA being used?

The NextGen EA supports the NextGen Business Case



The JPDO Interagency Portfolio and Systems Analysis Division (IPSA) uses ***Agency architectures*** (*As-Is*) and the ***NextGen EA*** (*To-Be*) to identify the possible NextGen solution space.

Agency / Industry Investments and JPDO-identified ***Cost Proxy Programs*** (i.e., placeholders for future investments) and their associated ***cost and benefit estimates*** are analyzed to identify the ***optimal target NextGen portfolio.***

Assigned Performance Levels to the Functional Clusters: ANSP ATM Configurations

Enabler	NGOps-1	NGOps-2	NGOps-3	NGOps-4	NGOps-5
En route applications	**Conflict probe**	**Conflict resolution Initial data link apps**		**Enhanced conflict resolution Sector action list**	**Automation responsible for separation Adv data link apps**
Terminal applications	**Enhanced infrastructure and DSTs**	**Initial data link apps**			**Adv data link apps**
Tower applications	**Enhanced infrastructure and DSTs**	**Advanced surface traffic mgmt applications**		**Integrated Arrival and Departure**	**Adv data link apps**
TFM applications	**Reroute impact assessment**	**Simple congestion resolution**		**Complex congestion resolution**	
Weather applications	**Legacy applications & infrastructure**	**Enhanced applications**		**Enhanced infrastructure**	
A/G voice network	**Switched NVS**				**IP-addressable NVS**
A/G data link subnet	**Shared commercial service provider subnet**				**ATS-specific subnet**
G/G data network (SWIM)	**Weather and flow**	**Flight data**		**Surveillance data**	
ADS-B network	**Current ADS-B network topology**			**Additional sites**	
Airspace	**Big airspace**	**Initial performance-based airspace**		**Adv performance-based airspace**	**Full trajectory-based operations airspace**
Positioning	**GPS / DME-DME / IRU**				**SBAS / GBAS**

14

Assigned Performance Levels to the Functional Clusters: Aircraft Operator Configurations

Enabler	NGOps-1	NGOps-2	NGOps-3	NGOps-4	NGOps-5
A/G voice (# radios)	25kHz (2)				No change modeled [may be FCS]
A/G data (#)	ACARS (1)	Shared ATS / AOC VDL Mode-2 (1)			ATS-specific subnet (2)
Data Link Applications	PDC and FANS-1/A	ATN Baseline 1 / FANS-1/A+ (CMU or FMS)	ATN Baseline 1 / FANS-1/A+ (integrated with FMS)		SC-214 applications integrated with FMS
Lateral conformance	RNAV-2 En Route RNAV-1 Terminal	RNAV-2 En Route RNP-1 Terminal RNP-.3 Approach	RNP-2 En Route RNP-1Terminal RNP-.3 Approach w/ RF leg		RNP-1 En Route RNP-.3 Terminal RNP-.11 Approach
Vertical conformance	Uncoupled VNAV				Coupled VNAV
Speed conformance	Uncoupled auto-throttle, Single RTA, tolerance of +/- 30 seconds				Coupled auto-throttle; multiple RTAs, tolerances of +/- 10 seconds
Missed approach	RNAV-1 equivalent containment		RNP-1 equivalent containment		RNP-.3 equivalent containment
ADS-B In (display)	NA	Non-FFOV [Class 2 EFB] display for surface situational awareness applications		FFOV for ASAS CSPO Applications & IMC CAVS [Class 3 EFB] Non-FFOV for M&S & MMC CAVS	
ADS-B out	DO-260A (as per NPRM)				
Positioning	GPS or DME-DME-IRU		GPS TSO 129a		TSO C145C (SBAS)
TCAS	TCAS Change 7			NextCAS	

15

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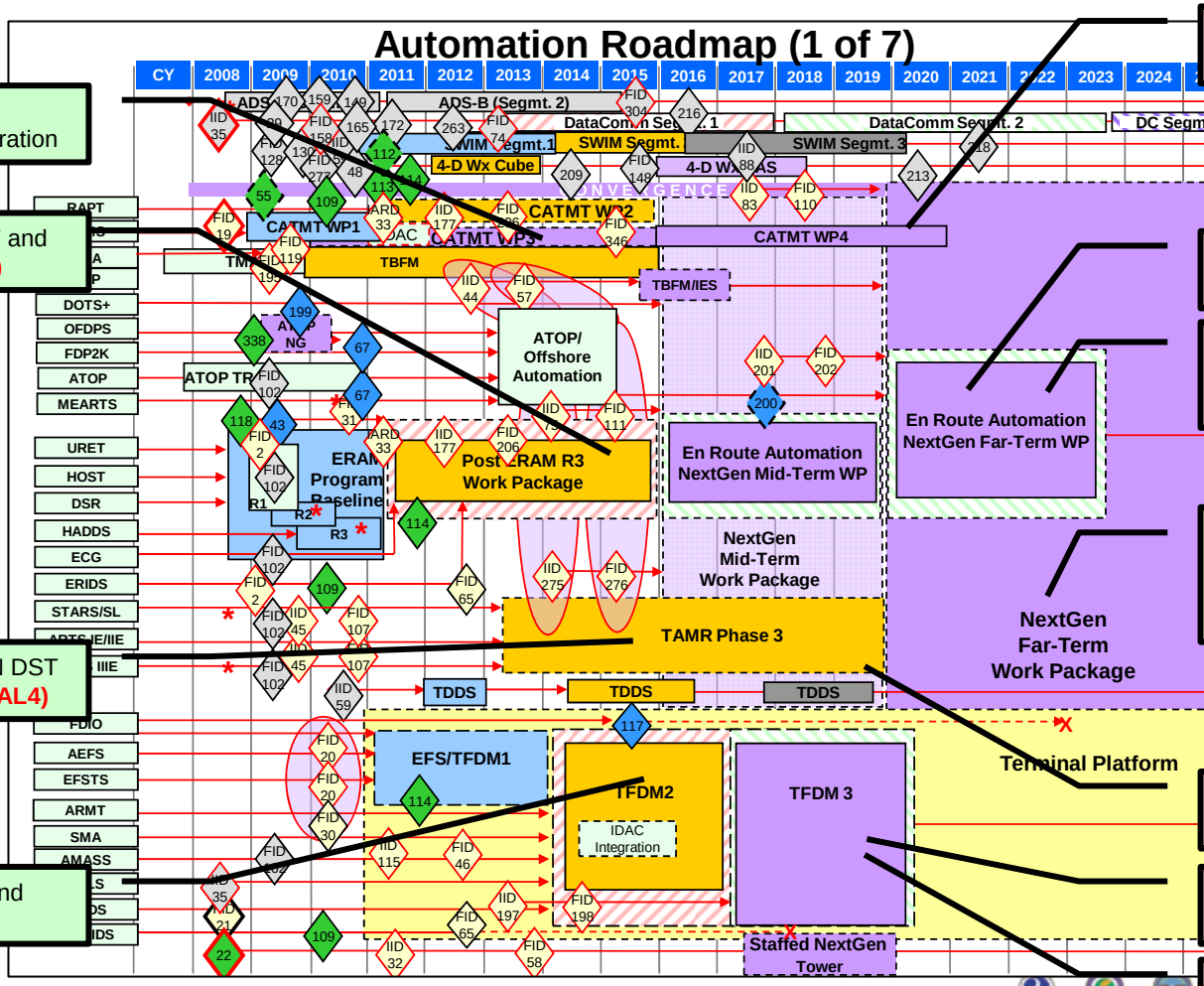
Target Portfolio Components
Automation (1)



NGOps-2&3: Initial TFM applications and DST integration

NGOps-2&3: En route DST and data link applications **(AL4)**

NGOps-2, 3, & 4: TRACON DST and data link applications **(AL4)**

NGOps-2&3: Tower FDP and DSTs **(AL4)**

NGOps-4: TFM applications to DST integration

NGOps-5: En route DST and data link applications **(AL2)**

NGOps-5: Automation-centric en route DST and data link applications **(AL2)**

Automation convergence

Out of scope for target portfolio

NGOps-5: TRACON data link applications **(AL3)**

NGOps-4: Tower FDP and DSTs **(AL4)**

NGOps-5: Tower data link applications **(AL3)**

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How can the working groups use or improve the NextGen EA?

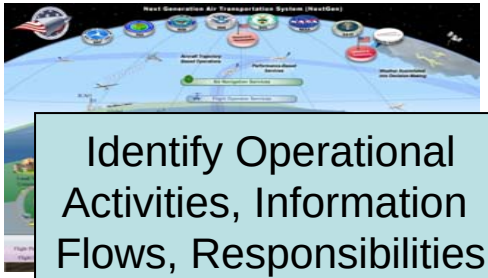
Example

The NASA NRA effort used the NextGen EA along with a scenario and use case development to validate advanced vehicle concepts in NextGen

By linking the scenarios and use cases to the NextGen EA, the NRA effort has begun to see deficits in the current Operational Improvements and Enablers

NextGen Institute Integrated Communication Navigation and Surveillance task is using the same methodology

Approach Overview



Identify Operational Activities, Information Flows, Responsibilities within the Scenario

Based on Enterprise Architecture FY11

Develop Time Sequence Diagram (OV-6c)

ID NextGen Enablers, Operational Improvements

Based on IWG V1.0

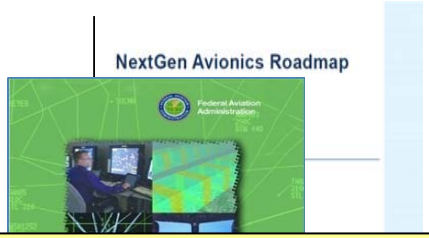
Establish ICNS Design Space

Based on NextGen Implementation Plan

Develop Critical Functional, Performance, and Interoperability Requirements for Enablers

Develop alternative ICNS Architectures

Develop Analytical Approach To Evaluate Alternative ICNS Architectures



Establish Nextgen Timeframe And Change Extent for ICNS OI's and Enablers

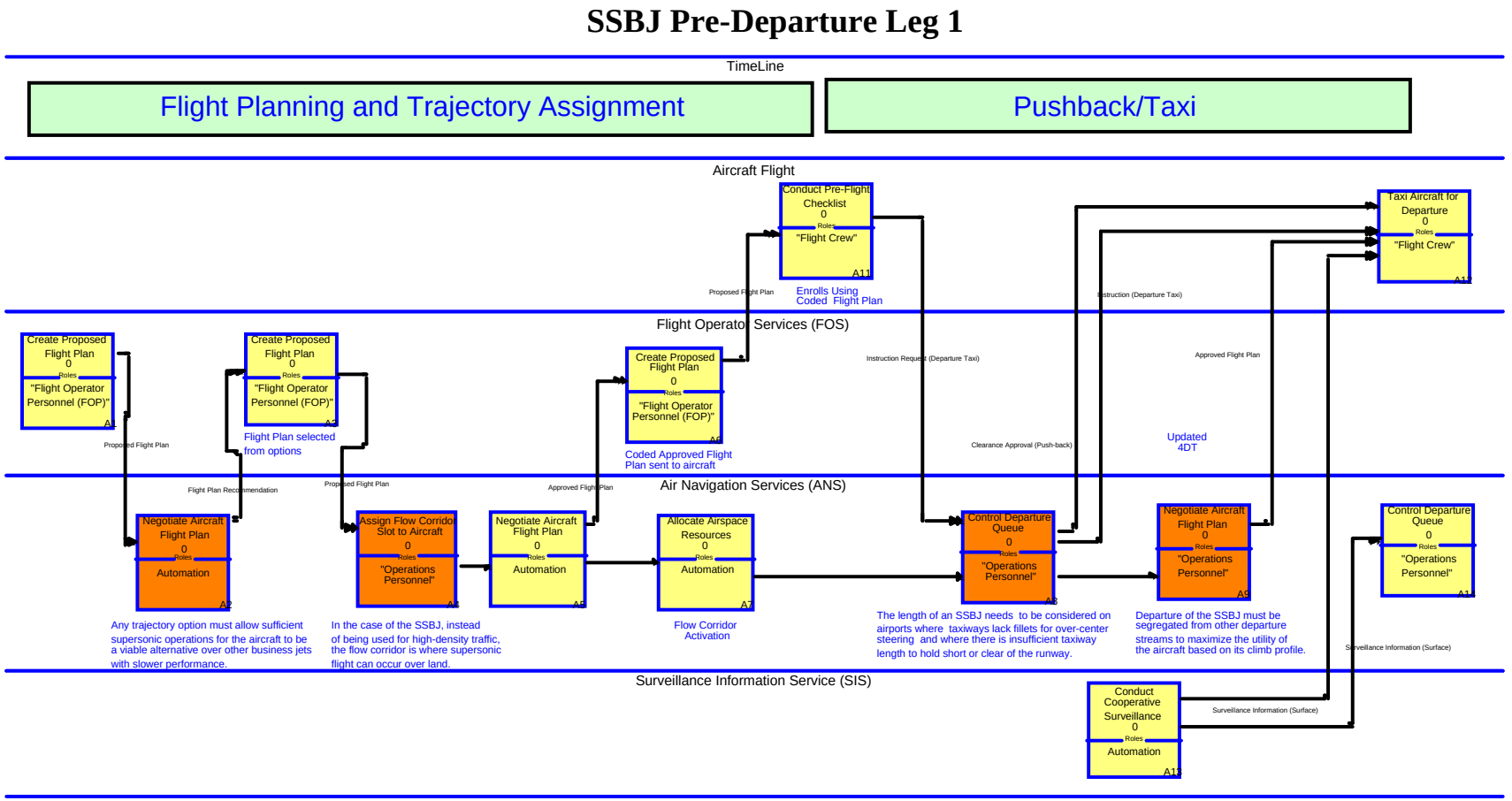
Based on AWG Roadmap and FAA Roadmap for Performance Based Navigation

Use Case Example (SSBJ Departure)

EVENTS (time sequenced)		NODE	ROLE	Activity	NODE	ROLE	NOTES	Information Transfer
1		FOS	FOP	Conducts Log in and Sends Flight Object with desired business trajectory for flight from Van Nuys to TEB	ANS	Automation	Netcentric connectivity	Flight Plan
2		ANS	Automation	**Provides trajectory options due to down-stream flow contingency with other traffic and adjusts for previous weeks supersonic flight paths to distribute the overpressure footprint.**	FOS	FOP	Using automation tools; options may include change in take-off time by 3 min, different cruise altitude, and stretching climb by 3 min. **Any trajectory option must allow sufficient supersonic operations for the aircraft to be a viable alternative over other business jets with slower performance. Also need to disperse the sonic boom footprint to different geographic areas.**	Flight Plan trajectory options
3		FOS	FOP	Selects trajectory option	ANS	Automation	Time constraint for selection	Flight Plan trajectory
4		ANS	Operation Personnel	**Assigns 4D trajectory to Aircraft**	ANS	Automation	**Trajectory and flight object information reserves the airspace for the operation in the strategic planning window for this operation**	4D trajectory
5		ANS	Automation	Provides coded 4D trajectory based on selected option	FOS	FOP	The coded message provides necessary information about the trajectory plus information for authentication when the pilot logs into net-centric operations	4D trajectory plus coding

Map Use Case to NextGen

Use Cases provide time sequenced operations and information flows…(DoDAF OV-6c View)



Enabler Assessment Example – (SSBJ Use Case)

Step	Use Case Activity	NextGen Activity	Enablers	Description	Assessment	Shortcomings	Alternative Use Case Step
33	Performs passing maneuver	Perform Self-Separation	(EN-0032) Avionics - Airborne Self-Separation (EN-0202) Avionics - Traffic Display Level 1 Cockpit Display of Traffic Information (CDTI) (EN-0204) Avionics - Traffic Collision and Avoidance System - Level 2	EN-0032: Development, validation, and implementation of aircraft technologies and procedures, including those for wake turbulence separation, for airborne separation capability to meet requirements for all NextGen airborne separation applications … EN-0202: Refers to flight crew knowledge of nearby traffic depicted on a cockpit traffic display without any change of separation tasks or responsibility. EN-0204: The Traffic Collision and Avoidance System (TCAS) is a computerized avionics device which is designed to reduce the danger of mid-air collisions between aircraft….	good match		
34	Provides position information	Control Aircraft En Route	No enabler for this action		The mapped enablers do not include ADS-B Out as necessary for this action		
41	Provides Sequencing info for arrival	Assign Spacing and Sequencing for Arrival	(EN-0009) Integrated Trajectory/Separation Management - Terminal (EN-1214) Air - Ground Data Exchange Clearance and Instructions Services TRACON Group 3	EN-0009: Air Navigation Service Providers (ANSP) automation integrates the management of arrival/departure and surface operations including the generation, negotiation and active management of full Four Dimensional Trajectories (4DTs)…. EN-1214: This enabler provides Terminal Radar Approach Control (TRACON) air /ground data exchange service for clearance and instructions services consisting of the following types of data exchanges: …	good match in general, but not clear if it addresses creating segregated arrival stream for high performing aircraft.		

System Practices/ Change Assessment

Operational Improvement Assessment

Functional, Performance, & Interop baseline

OI-0307 Integrated Arrival/Departure Airspace Management

Description: New airspace design takes advantage of expanded use of terminal procedures and separation standards. This is particularly applicable in major metropolitan areas supporting multiple high-volume airports. This increases aircraft flow and introduces additional routes and flexibility to reduce delays. Air Navigation Service Provider (ANSP) decision support tools are instrumental in scheduling and staging arrivals and departures based on airport demand, aircraft capabilities, and gate assignments. This capability expands the use of terminal separation standards and procedures (e.g., 3 nm, degrees divergence, and visual separation) within the newly defined transition airspace. It extends further into current en route airspace (horizontally and vertically). A redesign of the airspace will permit a greater number of Area Navigation (RNAV) and Required Navigation Performance (RNP) procedures within the transition airspace to allow for increased throughput. Extended application of terminal procedures and separation standards allows greater flexibility for traffic to be re-routed during severe weather and other disruptions to normal flows. Certain routes can be bi-directional and are used for either arrival or departure, depending on the traffic situation and the location of the severe weather.

Functional Drivers: There are a number of pre-defined configurations for arrival/departure airspace (including arrival/departure routes, airspace boundaries, etc) that are tailored to typical flow patterns and weather events. These configurations are stored in automation adaptations and can be easily selected (either as planned configuration changes or they can be selected to meet unanticipated situations). This will be transparent to pilots with exception of the assignment of different arrival/departure routes done as clearance amendments. When a planned airspace change will affect access (e.g., due to increased performance requirements), this will have to be communicated to affected flights. Separation managers and trajectory managers will need to be able to adjust to a finer set of changes than is done today with sector splits/recombines. For flight planning, known changes to configuration are available to flight planners.

SOPR: FAA *SOPR Unique Reference:* 104122

SOCR: *Primary Supported OIs:* OI-0406

OI Group: Capacity Management Operational Improvements

	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
OI-0307: Integrated Arrival/Departure Airspace Management								O	2015									
OI-0351: Flexible Airspace Management								O	2015									
EN-2680: Methodologies and Algorithms for Weather Assimilation into Decision-Making - Level 1				E	2011													
EN-0033: Airspace/Capacity/Flow Contingency Management Decision Support - Level 1						E	2013											
EN-0034: Trajectory Management Decision Support - Level 1						E	2013											
EN-2010: NextGen 4D Weather Cube Information - Level 1 Initial Operating Capability						E	2013											
EN-0300: Networked Air Navigation Support Facilities								E	2015									
EN-1037: Ground Voice Network - NAS Voice Switch Level 2								E	2015									
EN-1143: Ground Based Navigation System (GBNS) - eLORAN								E	2015									

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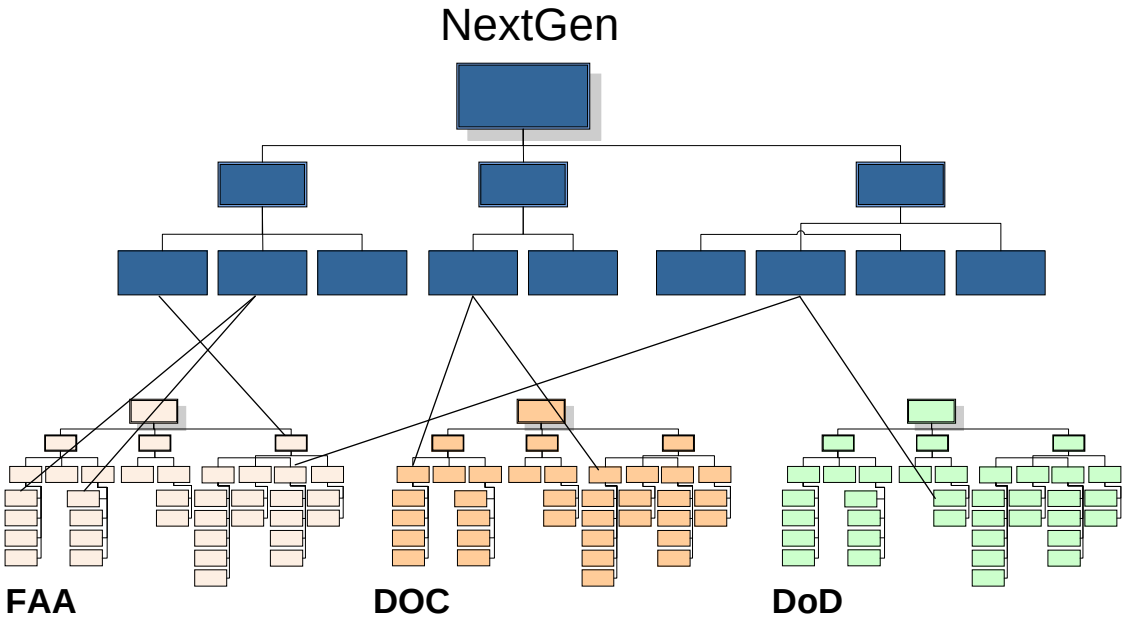
NextGen EA Federation

The JPDO works with partner agencies to establish alignment, linkages, and relationships among relevant EAs. By creating a federated environment the JPDO can conduct critical analysis (i.e. gap analysis).



(Notional view; all stakeholder agencies aligned appropriately)

Federation Strategies

- During Enterprise Architecture Segment Development
  - Weather
  - Integrated Surveillance
  - Coming Attraction - UAS
- With Partner Agency Architectures
  - FAA
  - DoD
- With Partner Agency Programs, Investments, and resources
  - NASA
- Leverage OMB Enterprise Architecture Segment Reports and Federal Transition Framework

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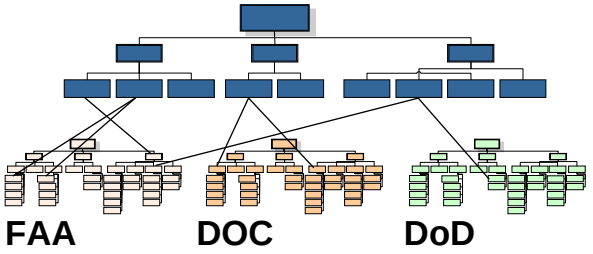
What is Architecture Federation?



- Federation:
  - Provides a mechanism for aggregating and linking information across NextGen stakeholder community.
  - Serves as a framework that defines high level concepts that establish a common environment of understanding.
  - Allows various stakeholders to focus on particular segments relevant to their planning and implementation tasks (i.e. Mission).
- Federation will create alignment between the NextGen EA and stakeholder agencies' architectures that depict the appropriate level of detail to aid decision making.

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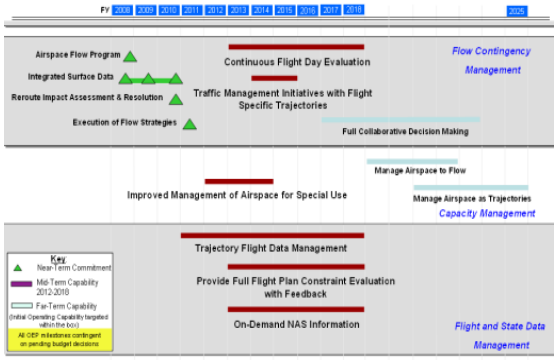
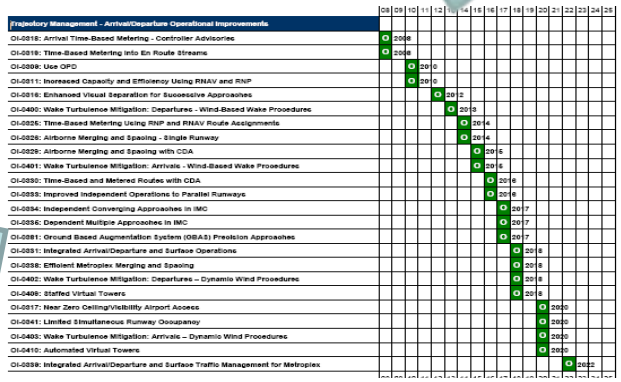
EA Federation Example: Alignment of NextGen EA to NAS EA

Operational Improvements

Title, Description, Schedule

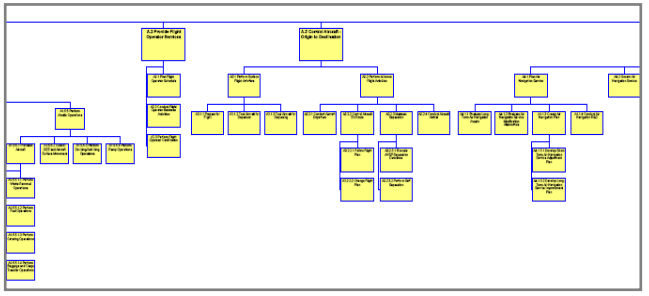


NAS Service Roadmap

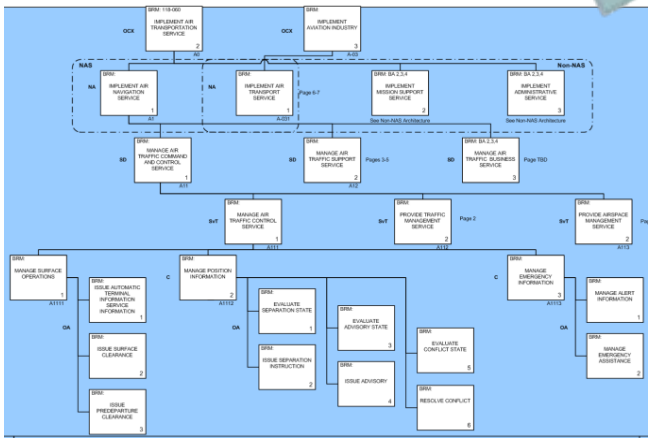


Enterprise Architecture

Common Framework



JPDO NextGen EA OV-5 Node Tree



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NextGen EA Linkages with SESAR

JPE Links to SESAR:

- JPDO IWP Section to SESAR Operational Improvement Listing
- JPDO IWP Section to SESAR Enabler Listing
- JPDO IWP Section to SESAR Lines Of Change
- Individual NextGen Goals aligned to individual SESAR Performance Areas

Next Steps:

- Align individual NextGen OIs to Individual SESAR OIs
- Align individual NextGen ENs to Individual SESAR ENs

NextGen EA and SESAR linkages can be found at http://jpe.jpdo.gov/

Thank you

For additional information please contact

jay.merkle@faa.gov