Aircraft & Operator Requirements

A Joint Initiative between
ATO-P/AVS/JPDO(MITRE)

To enable Timely and Consistent Implementation of Integrated Capabilities within the National Air Transportation System

Presented to: ICNS Conference, Washington D.C.

By: Ronald Stroup, FAA-ATO

Stephen Van Trees, FAA-AIR

Jay Merkle, JPDO

Date: May 3, 2007

NextGen Airborne Dilemma

Multiple Flavors of a Avionics Story

NextGen Airborne Story

"One Story"

JPDO/ATO/AVS

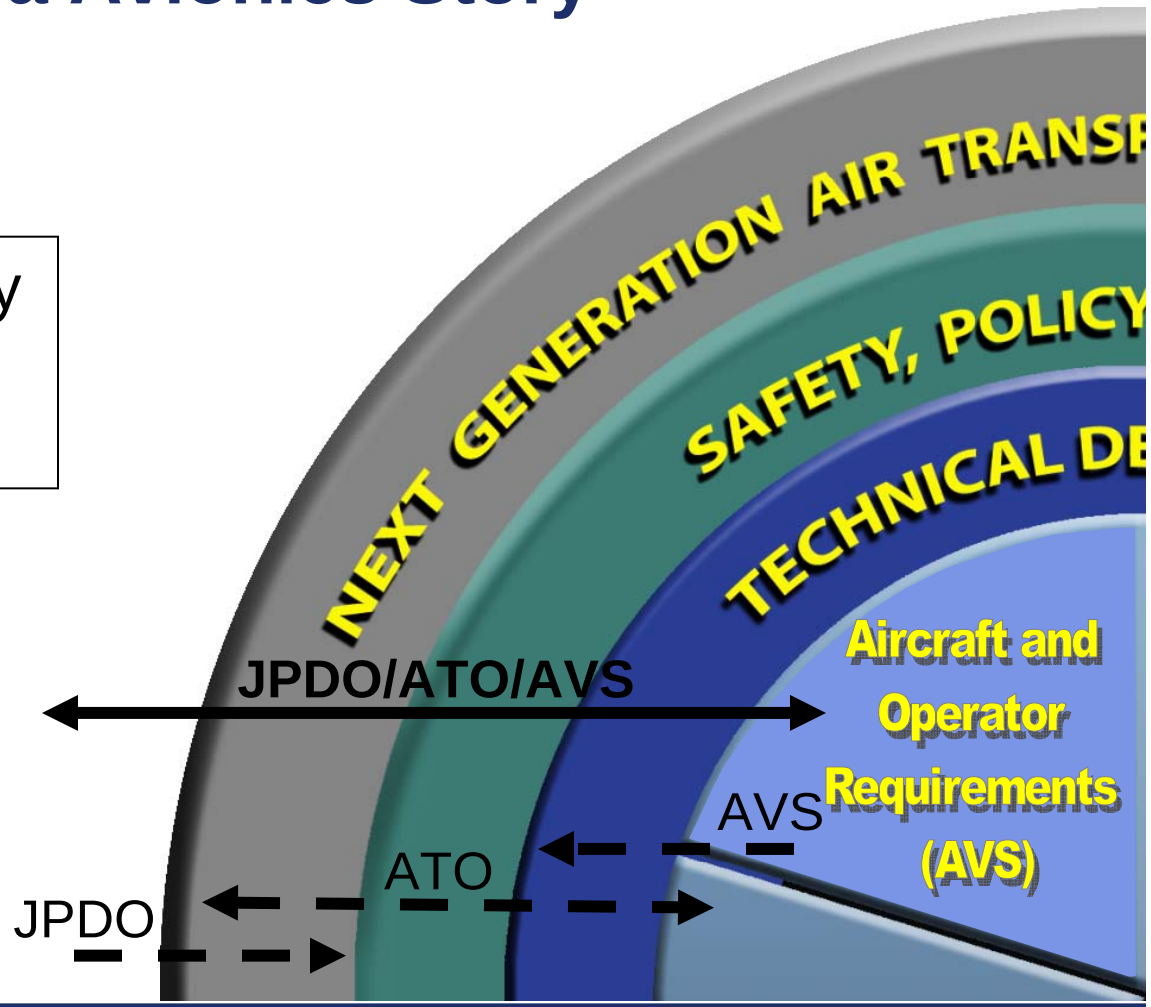
Operational Portfolio

Set of Capabilities

NextGen Avionics Roadmap

Associated Benefits

User Investments



NAS Transition Impact to Aircraft

Today		Tomorrow
Waypoint-based	Clearances	**Trajectory-based**
Rule-based	Airspace	**Performance-based**
Ground-based	Separation	**Aircraft-based**
Flight	Planning	**Flow**
Point-to-Point (Voice)	Communications	**Networked (Voice, Data, and Video)**
Terrestrial (Nav-aids)	Navigation	**Space-based**
Radar	Surveillance	**Cooperative-based**
Visual, Tactical environment	Surface	**Visual independent, Strategic environment**

Aircraft Dependency

Solution Sets	Aircraft	Air Traffic	Airport
Trajectory Based Operations (TBO)	X	X	
High Density Arrivals/Departures Terminals and Airports	X	X	X
Flexible Terminal and Airports	X	X	X
Collaborative ATM	X	X	
Reduce Weather Impact	X	X	X
Safety	X	X	X
Security	X	X	X
Environment	X	X	X
Facilities and Cost Effectiveness		X	X
Integrated Modular avionics	X		

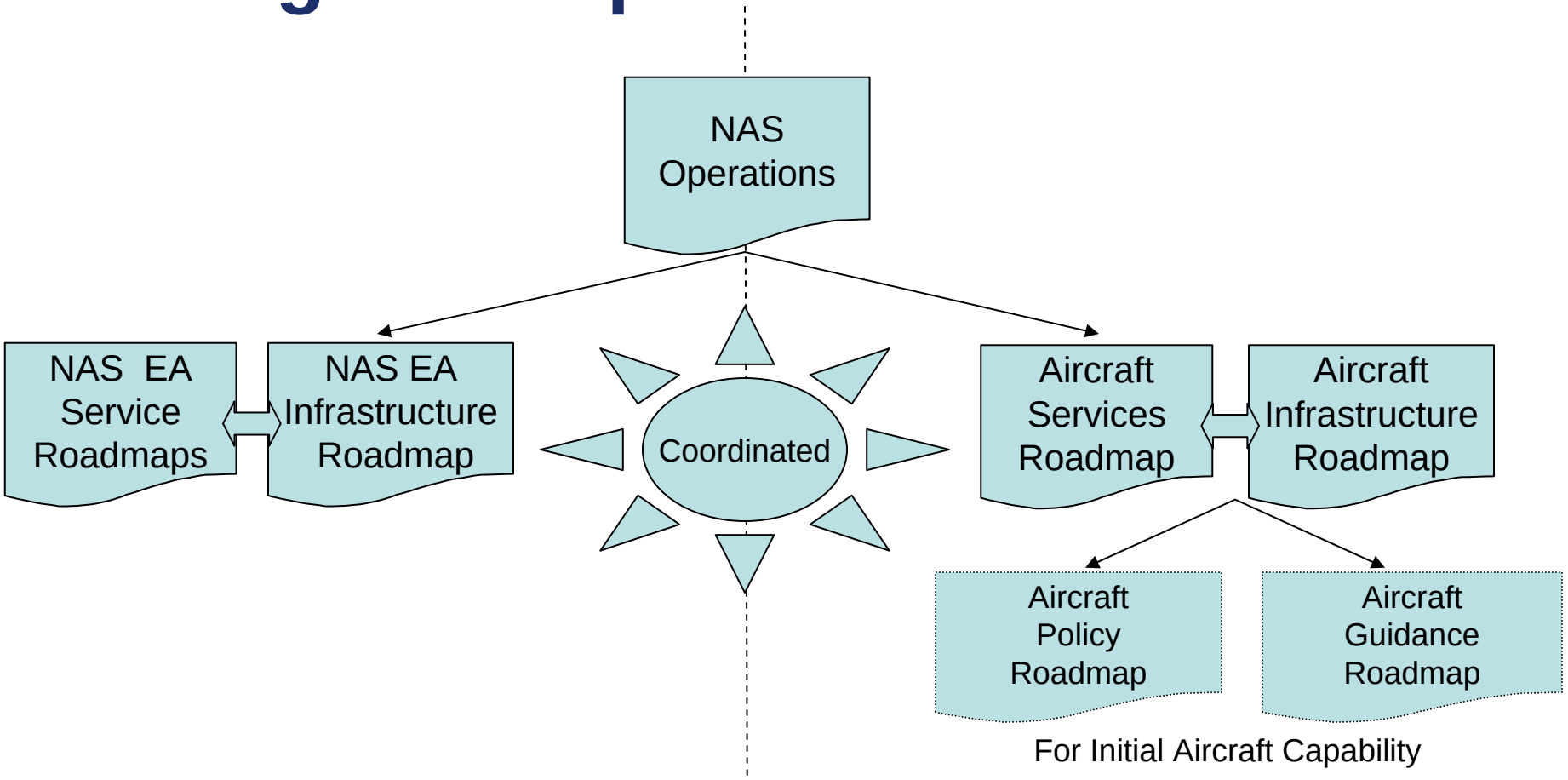
What is the Aircraft Roadmap?

- **Mapping of Operational Improvements (OIs) to aircraft functions or equipment**
  - Goal to identify and plan standards and policy (AVS wedge)
- **Timeline of:**
  - Key aircraft and operational research
  - Implementation decisions affecting aircraft equipment
  - Certification and operational standards and criteria to support adoption of a particular capability
  - Strawman to serve for understanding and collaboration on [proposed] Operational Improvements
- **Must link to ATO Roadmaps for planned services**
- **Also must address aircraft-centered operations**
  - Delegated separation, autonomous navigation, etc.

What is it Not?

- **Aircraft architecture or equipment**
  - Identify functions which warrant standards, but not imply architecture
- **Roadmap of functions YOU should buy or when**
  - Aircraft fleet remains very diverse
    - Broad range of costs and aircraft architectures to consider
    - Timeframe to retire (or transfer) older aircraft must be considered
  - Focus of Roadmap is on *first* aircraft through the enabling standards and criteria
    - Rate of equipage after enabling policy depends on adoption strategy: operator return on investment, government incentives, preferential routes, potential mandates, etc.

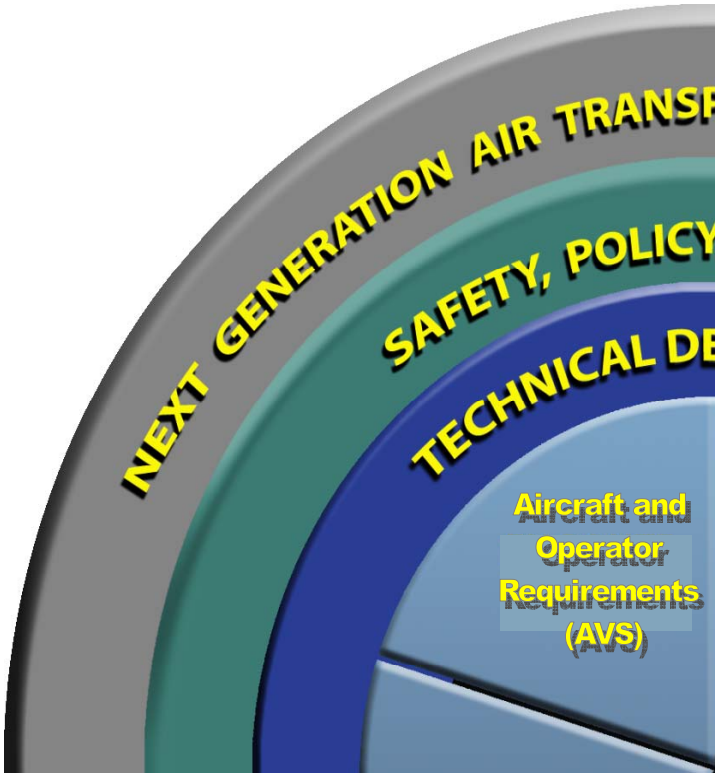
Coordination of Capabilities through Enterprise Architecture



Establish an environment in which operational implementation of integrated Air-Ground capabilities are coordinated.

Aircraft Transition Plan

The aircraft must evolves in lockstep with the ground and space-based air traffic control modernization for NextGen to be realized



Research

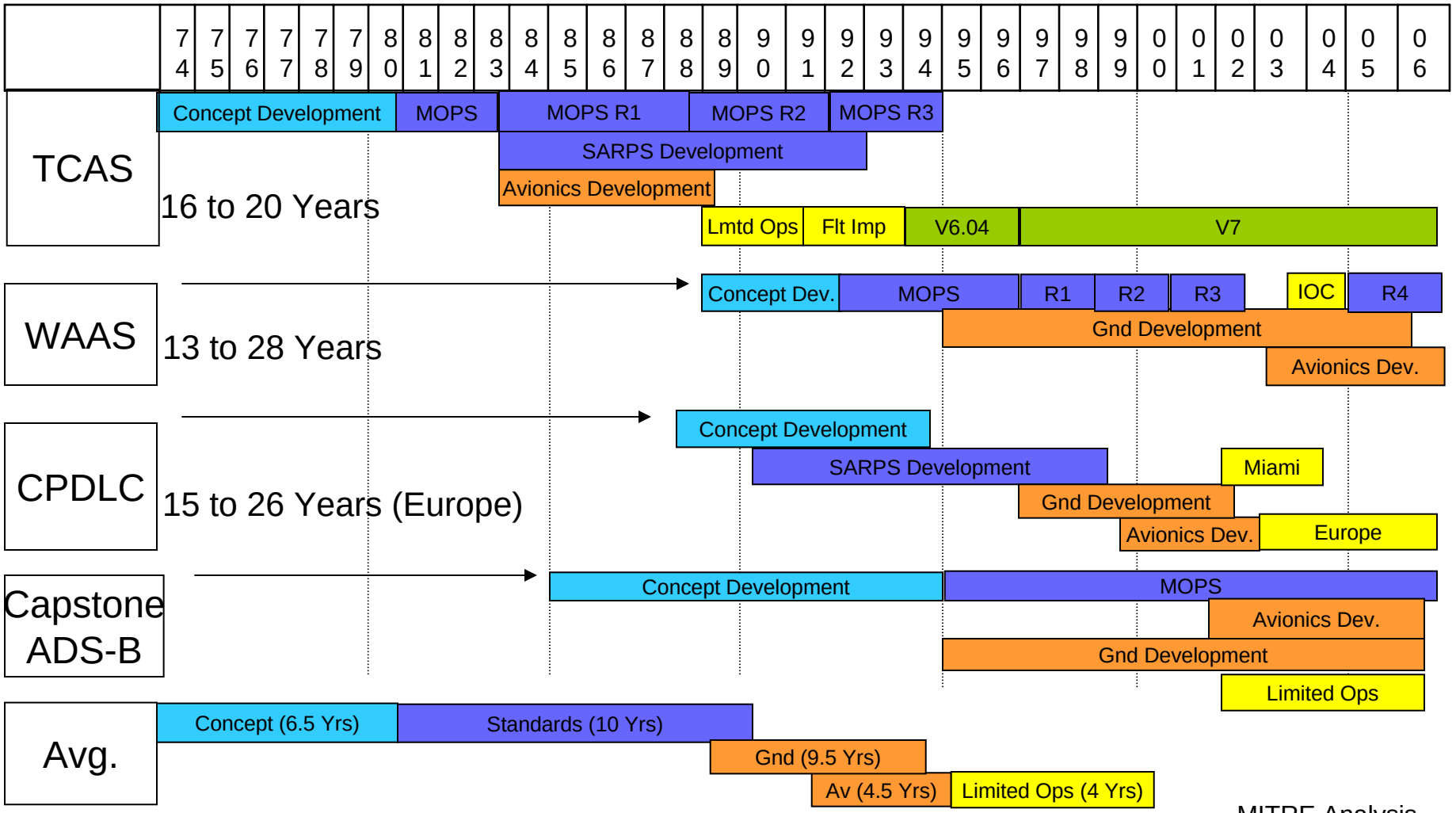
Standards

Development

Implementation

Operations

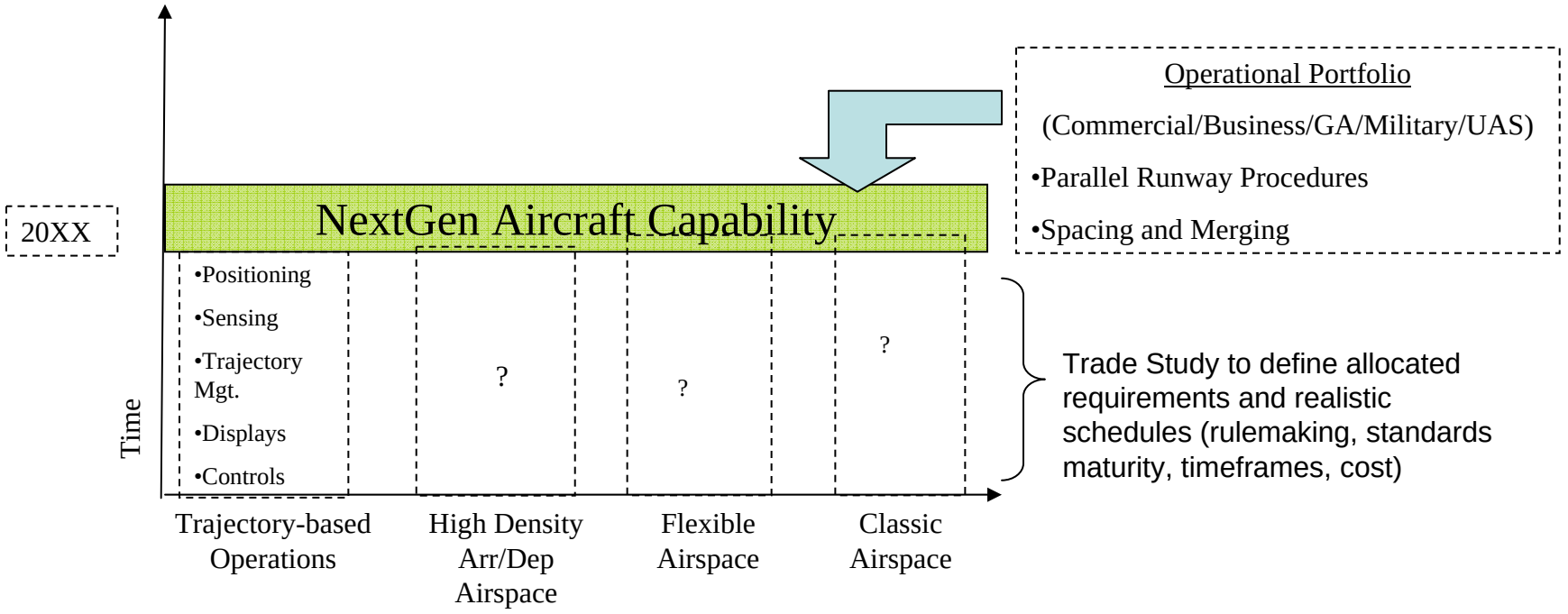
CNS Programs - Historical Timelines



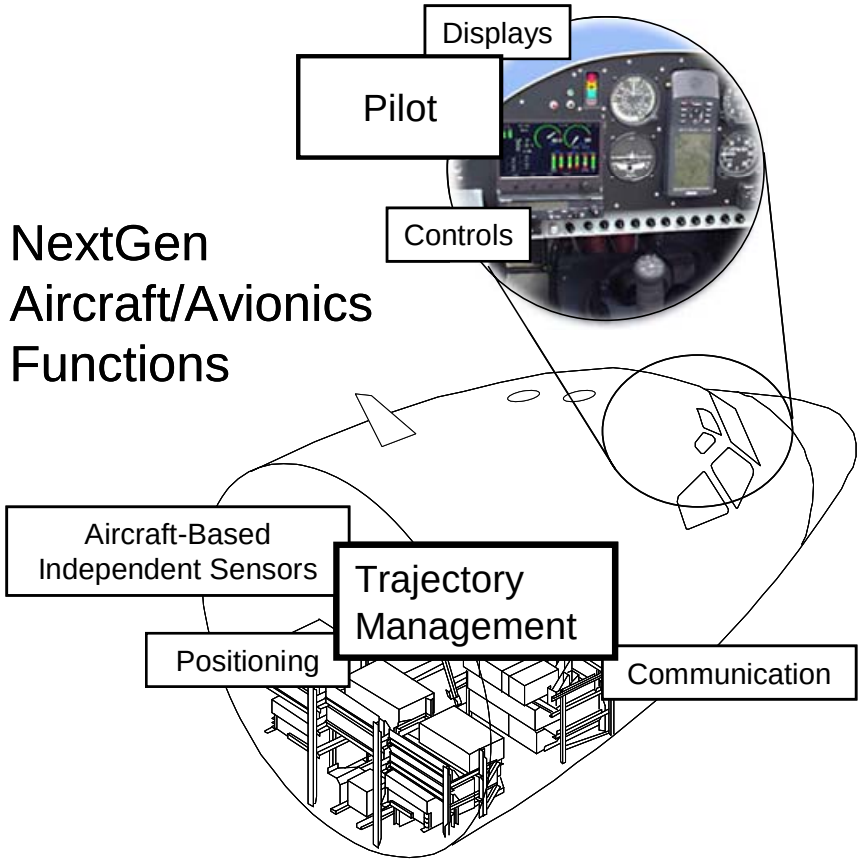
MITRE Analysis

Balancing Operations/Capabilities/Time

Notional



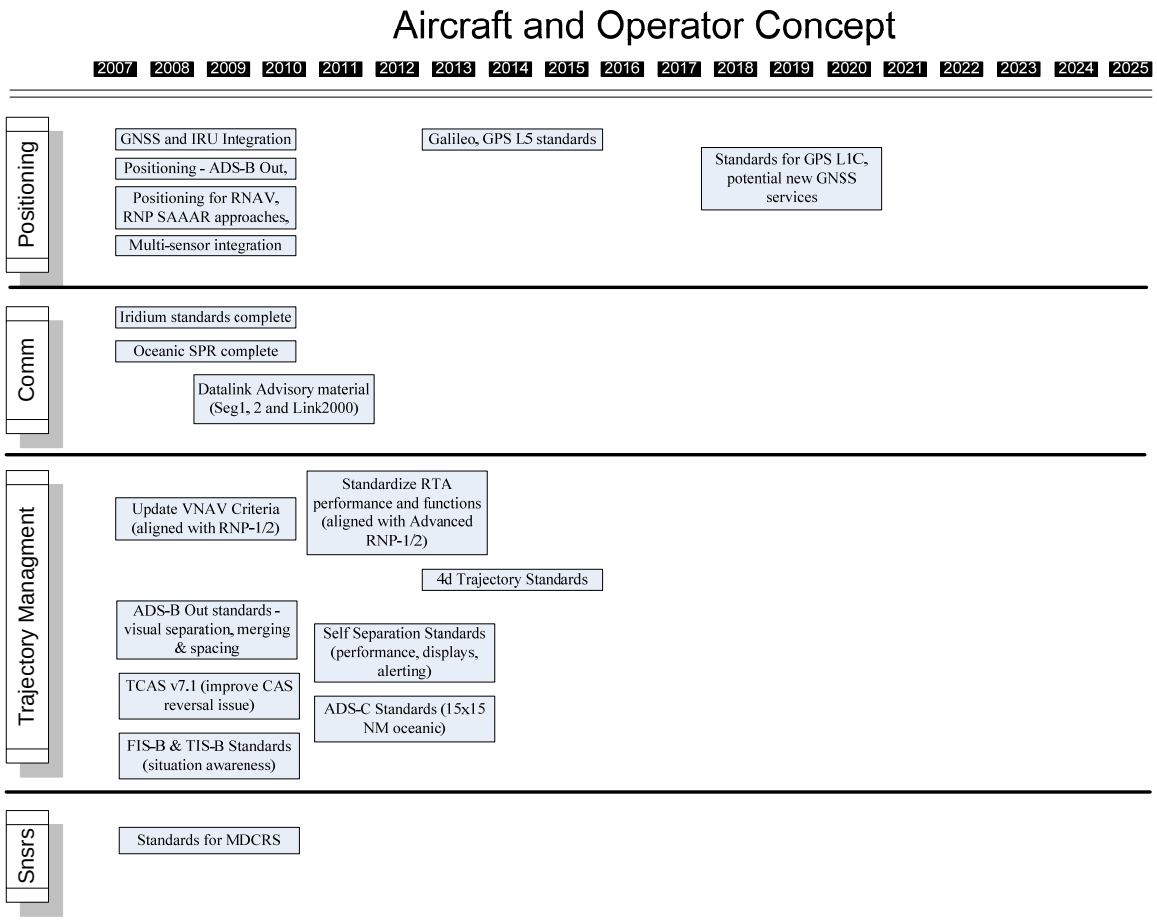
NextGen Aircraft Functions



Aircraft Function Dependency

Solution Sets	Avionics Function	Near-Term	Far-Term
Trajectory Based Operations (TBO)	**All**	**X**	**X**
High Density Arrivals/Departures Terminals and Airports	**All**	**X**	**X**
Flexible Terminal and Airports	**All**	**X**	**X**
Collaborative ATM	**Comm**	**X**	**X**
Reduce Weather Impact	**All**	**X**	**X**
Safety	**TM, Sensor, Comm,Pos**	**X**	**X**
Security	**All**	**X**	**X**
Environment	**All**	**X**	**X**
Facilities and Cost Effectiveness	**Nav**	**X**	**X**
Airports	**Display**	**X**	**X**

Aircraft Roadmap – Near-term



Current Parallel Approach Operations

Independent Parallels (IFR): ILS, SSR, Automation

Independent Parallels (IFR): ILS, PRM, Automation

Dependent Parallels (IFR): ILS, SSR, Automation

2500’

Adjacent wake vortex and blunder are controlling factors. Aircraft must be spaced at least 1.5 NM in-trail on adjacent tracks.

Future Parallel Approaches

- **Near-Term Evolution of Capability**
  - Authorize RNP-0.3 approaches (using GNSS), GBAS GLS and SBAS LPV under same conditions as ILS
  - Authorize use of ADS-B under same conditions as SSR

Future Parallel Approaches

Mid-Term Potential Strategies

- Blunder Strategies
  - **Prevention**: Requirements for autopilot-coupled operation, data link of clearances and RNP approach to ensure path compliance
  - **Controller intervention**: Precision GNSS (RNP SAAAR, GBAS GLS or SBAS LPV) and precise ADS-B Out
  - **Pilot intervention**: Precision GNSS, ADS-B Out & In with sufficient displays to enable pilot to recognize and resolve blunder of other aircraft
  - **VMC-like capability:** Enhanced vision system (EVS) to conduct IMC-as-VMC approach
- Wake Vortex Strategies
  - **Along-track and vertical navigation**: Precise along-track and vertical performance requirements (adjacent aircraft not vulnerable to wake)
  - **Wake vortex prediction and monitoring**: Sensors, modeling and synthetic vision system to depict and avoid wake of other aircraft
  - **VMC-like capability:** Enhanced vision system (EVS) to conduct IMC-as-VMC approach

Derived Aircraft Functions

Required capabilities depend on strategy:

- **Near-term** *(standards complete)*
  - RNP approach, GBAS GLS, SBAS LPV
  - ADS-B Out
- **Mid-term**
  - Precise ADS-B Out
  - ADS-B In – Simultaneous Approach conformance monitoring
  - Enhanced Vision System (EVS)
  - Data link approach clearance
  - Along-track navigation (velocity control, required time of arrival or navigation relative to other traffic)
  - Wake vortex prediction and monitoring
  - Synthetic Vision system (SVS)

Standards Maturity

Code	Description	GPS	RNP	SBAS	GBAS	ADS-B Out	Precise ADS-B Out	App moni-tor	EVS	Data link	ATK nav	Wake sensor	SVS	TCAS
RS-PR-2	Parallel Approaches in IMC with reduced lateral spacing	●	●	●	●	●	⊗	⊗	X	⊗	X	X	X	X

Near-term applications have complete standards

Precise ADS-B Out: Performance requirements as function of runway spacing and intervention strategy

Approach Monitor (ADS-B In): Required parameters (selected approach, flight control mode?), displays

EVS: Suitability of EVS image, reliability of acquisition

Datalink: Approach clearance, aircraft automatic loading of approach, confirmation of loaded approach

ATK nav: RTA and velocity, or relative nav?

Wake sensing: Feasibility, performance, displays

SVS: Display of other traffic, display of wake?

TCAS – Current TCAS logic may not be able to deal with reduced separation requirements implied by high-density

LEGEND

● Standards complete

⊗ Standards in progress

X No Standard

Conclusion

- **Refining Aircraft Roadmap (Aircraft Infrastructure and Operations)**
  - Need to coordinate with all stakeholders
  - Will be impacted by NextGen planning
    - JPDO expected to refine the functions of the NextGen aircraft
    - “Standards Maturity” will support standards planning and research coordination
  - Discrepancies currently exist between Roadmaps
- **Policy, standards and guidance material should be considered from inception of project**