NextGen Avionics Roadmap

JPDO Aircraft Working Group

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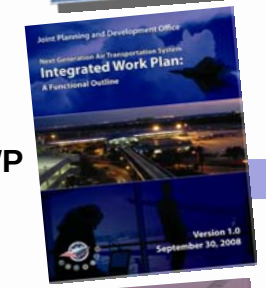
Next Generation Air Transportation System
Joint Planning and Development Office

Why is a NextGen Avionics Roadmap Needed?

CON OPS

Operational Concepts

IWP



IWP OIs, w/Aircraft Implications

Existing OIs, enablers

NIP

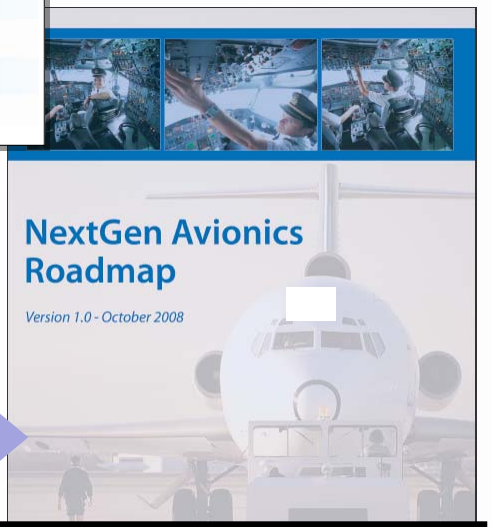
FAA Committed Changes

Other Road Maps (PBN)

Other high priority gov./ Industry efforts

Coalesce many similar improvements based on common applications, technology etc.

Six core groups of Aircraft Capabilities



NextGen Avionics Roadmap:

- Provides a missing <u>aircraft perspective</u>
- Recognizes importance of planned evolution
- Built upon operationally relevant capabilities
- Will help clarify content of other NextGen plans

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JPDO Aircraft Working Group NextGen Avionics Roadmap

- Translates many proposed NextGen improvements into aircraft-related capabilities and functions.
- Avionics-enabled improvements in the Roadmap are presented in six groups of related operational capabilities

Operational Groupings:

1. Safety Enhancement
2. Published Routes/Procedures
3. Negotiated Trajectories
4. Delegated Separation
5. Low-Visibility Approach/Departure/Taxi
6. ATM Efficiencies

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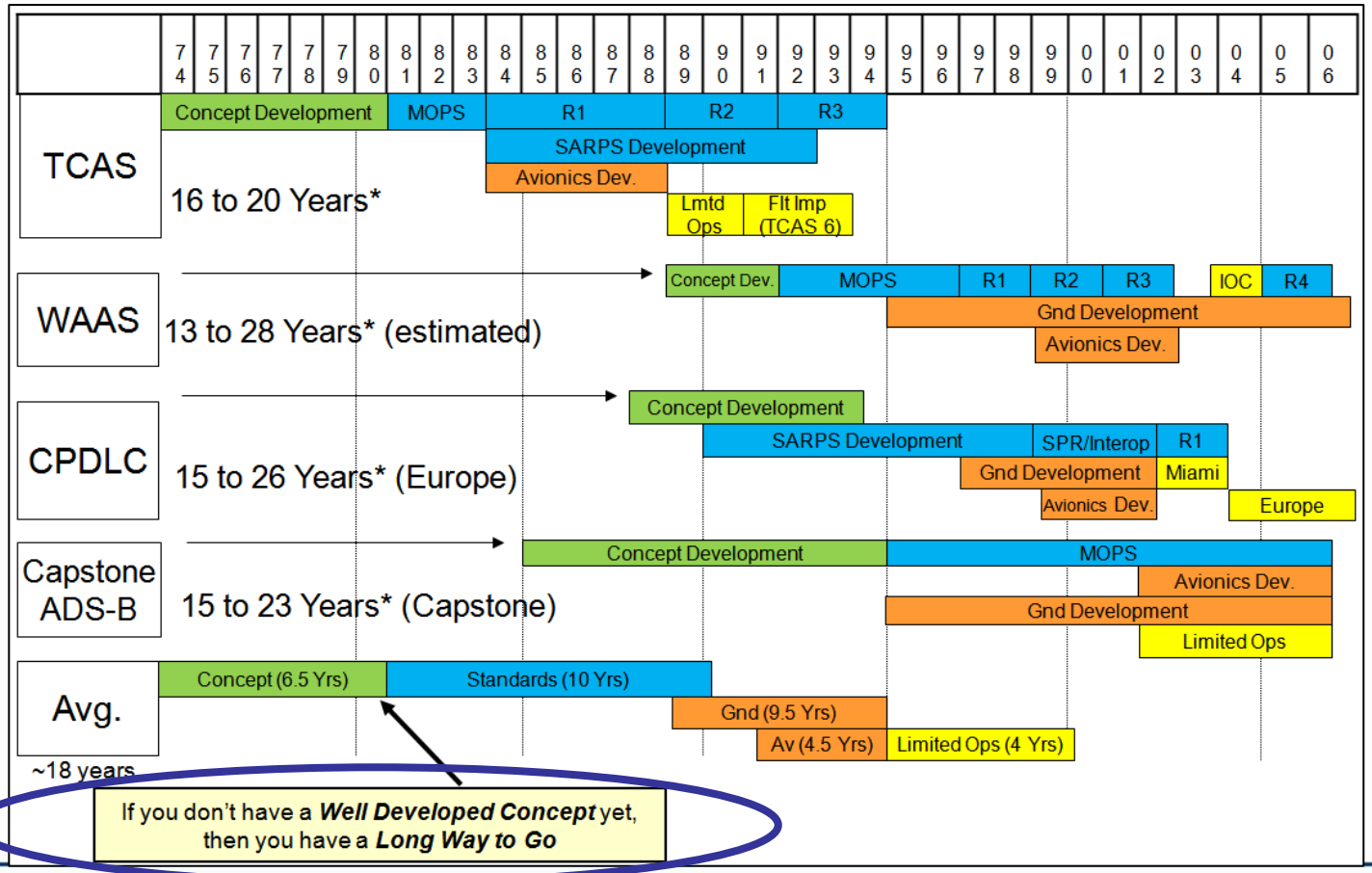
NextGen Avionics Roadmap

Recognizes the reality and challenge we face in implementing NextGen.
Examples of time spans for changes involving Avionics



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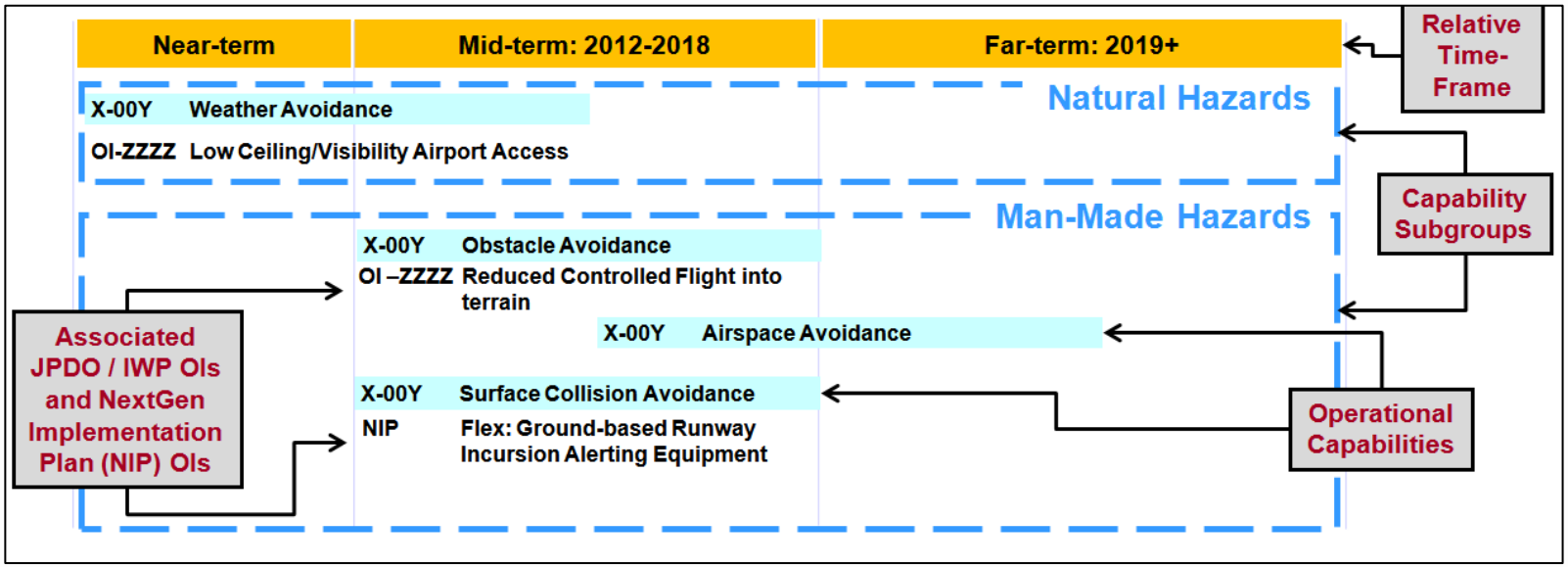
Operational capabilities time-ranges are shown and a mapping of the operational improvements (OIs) from the JPDO Integrated Work Plan (IWP), the NextGen Implementation Plan (NIP), and the Performance Based Navigation Roadmap (PBN) that support that capability.



Note: The scope of work in the Roadmap is initially limited to the near- and mid-term implementations up to 2018. Items deferred have been identified.

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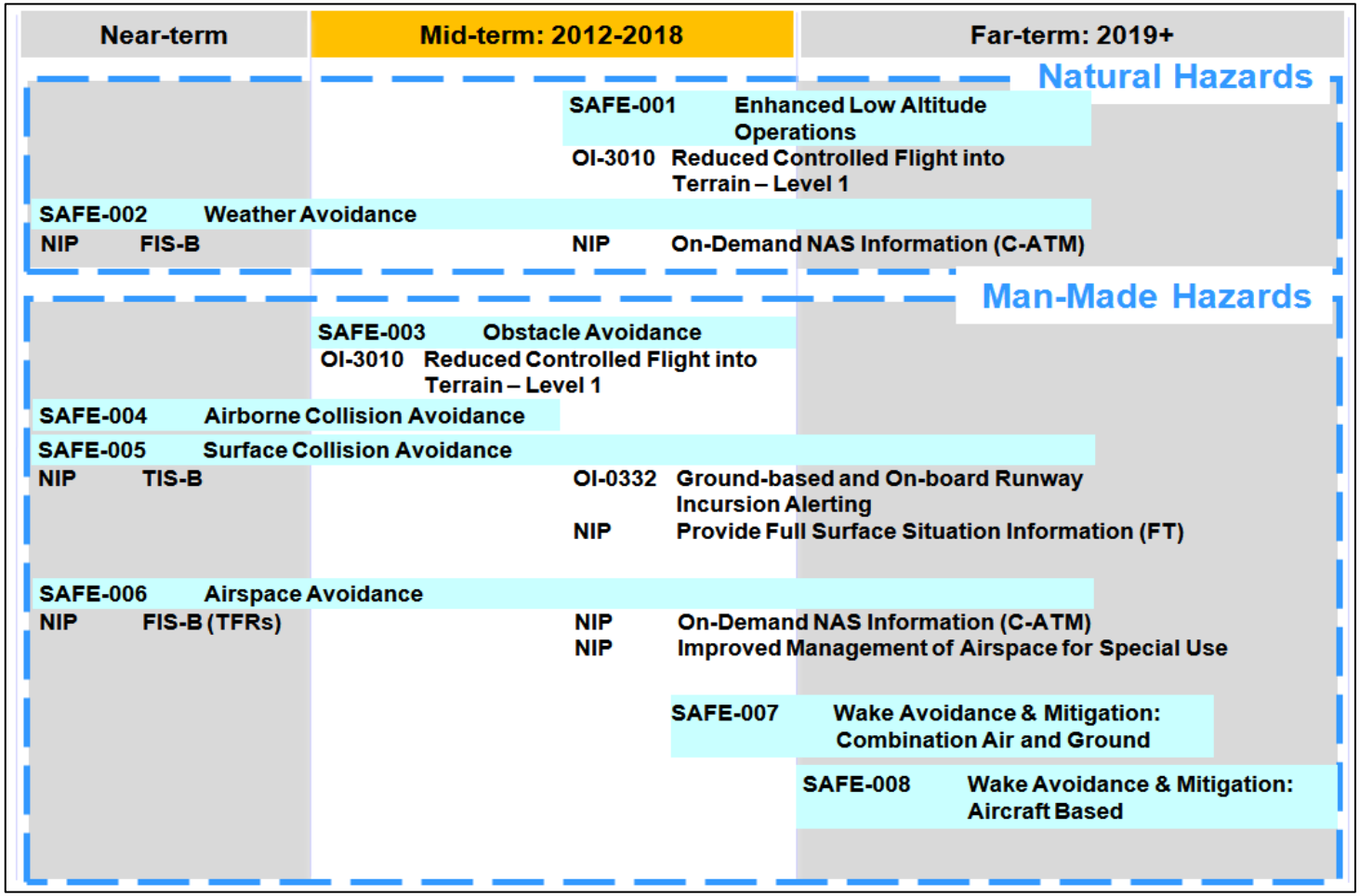
Example: Safety Enhancements



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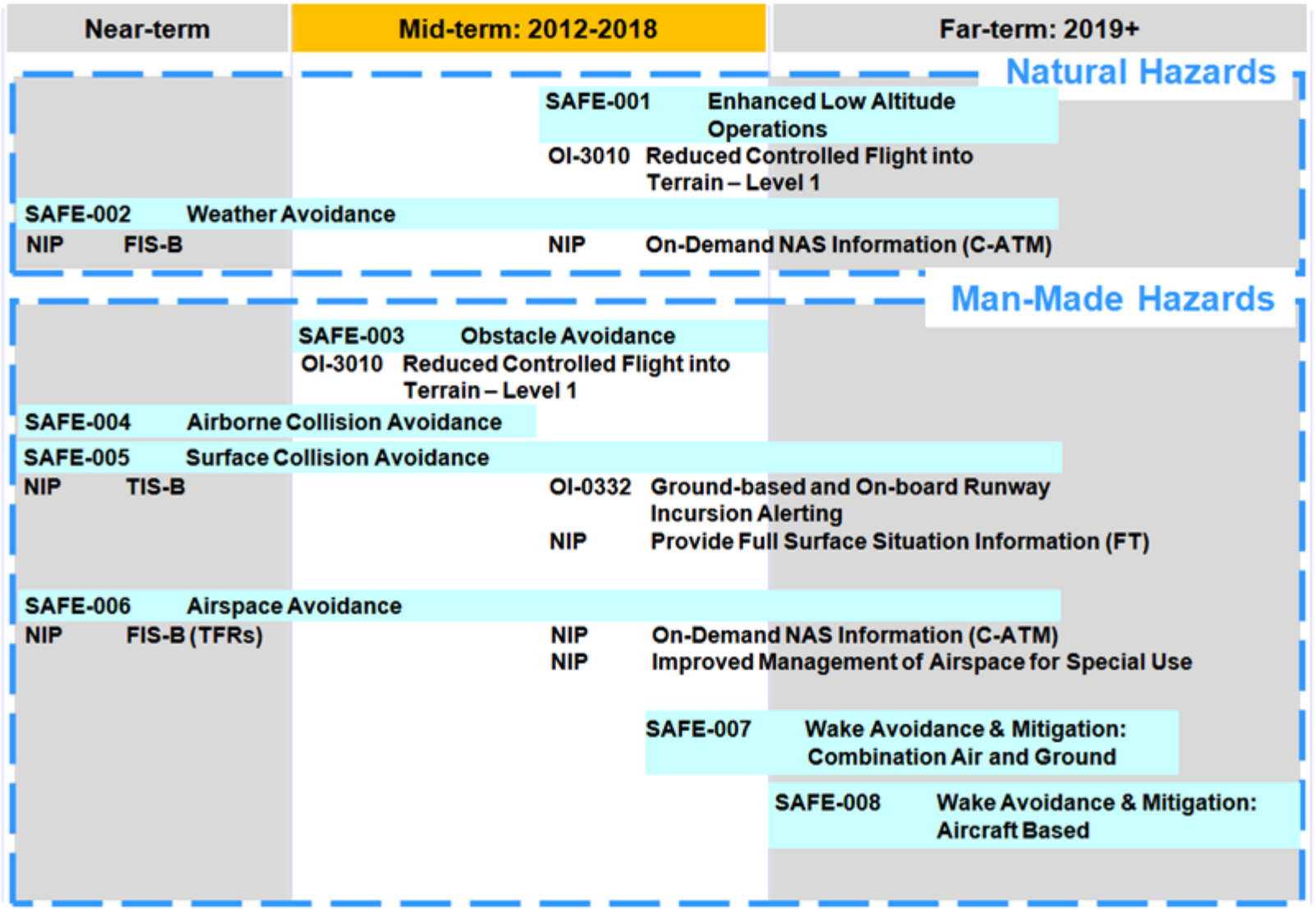
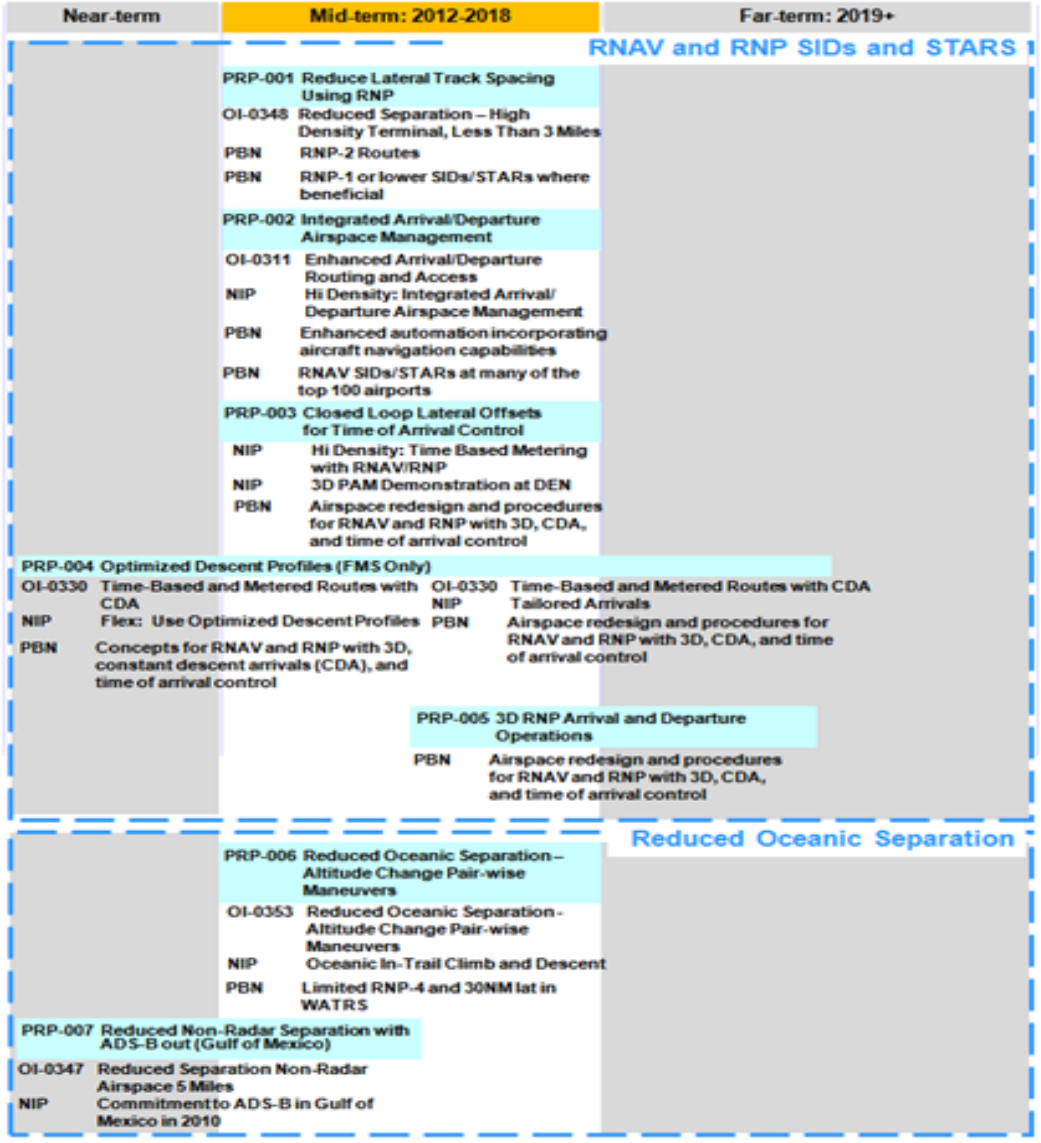
Initially identifying the current key enablers for each operational change. Follow on activity will provide information on equipage evolution and functional changes.

Capability	Key Enablers
SAFE-001: Enhanced Low Altitude Operations – Leverage enhancements to TAWS along with higher integrity and resolution terrain databases to reduce CFIT.	RNP (As required by specific procedure), *Improved Terrain Database, TAWS Enhancements*
SAFE-002: Weather Avoidance – Reduce impact of hazardous weather through broadcast of text and graphical weather information to aircraft.	**FIS-B, Moving Map**
Reduce impact of hazardous weather through data link of enhanced weather and turbulence forecasts to aircraft.	**FIS-B, Moving Map, and** **For text only weather information: Initial Data Link (FANS 1/A+,** FANS 2/B, ATN Baseline 1 LINK Post Pioneer **)** **For text and graphical weather information:** *Data Link (Not supported by initial data link enablers)*
SAFE-003: Obstacle Avoidance – CFIT is further reduced through availability of higher-frequency updates related to the position of temporary and permanent (fixed) man-made obstacles.	*Improved Terrain Database, Improved Obstacle Database*, Moving Map

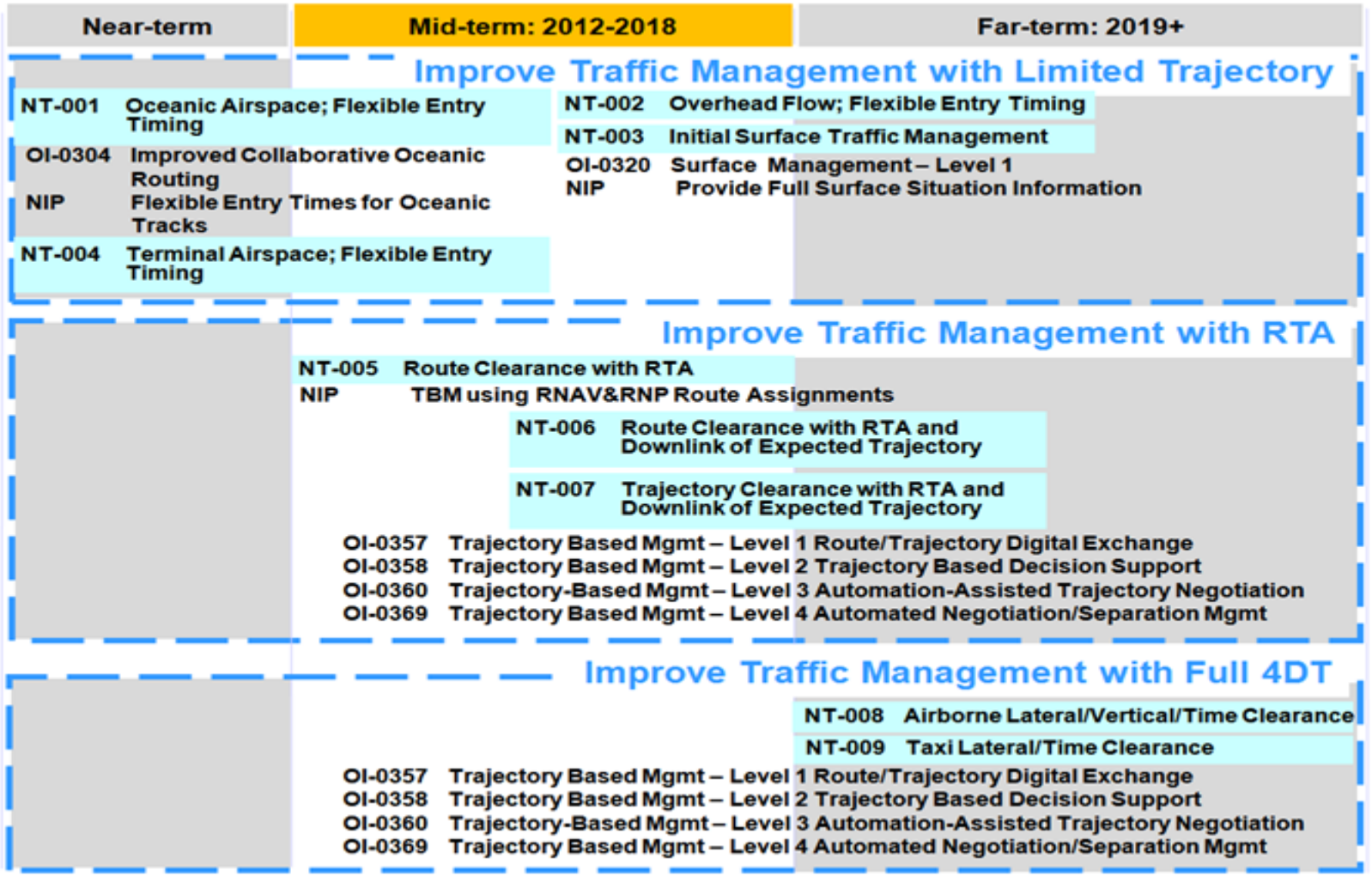
Safety Enhancements/Hazard Avoidance & Mitigation Capabilities



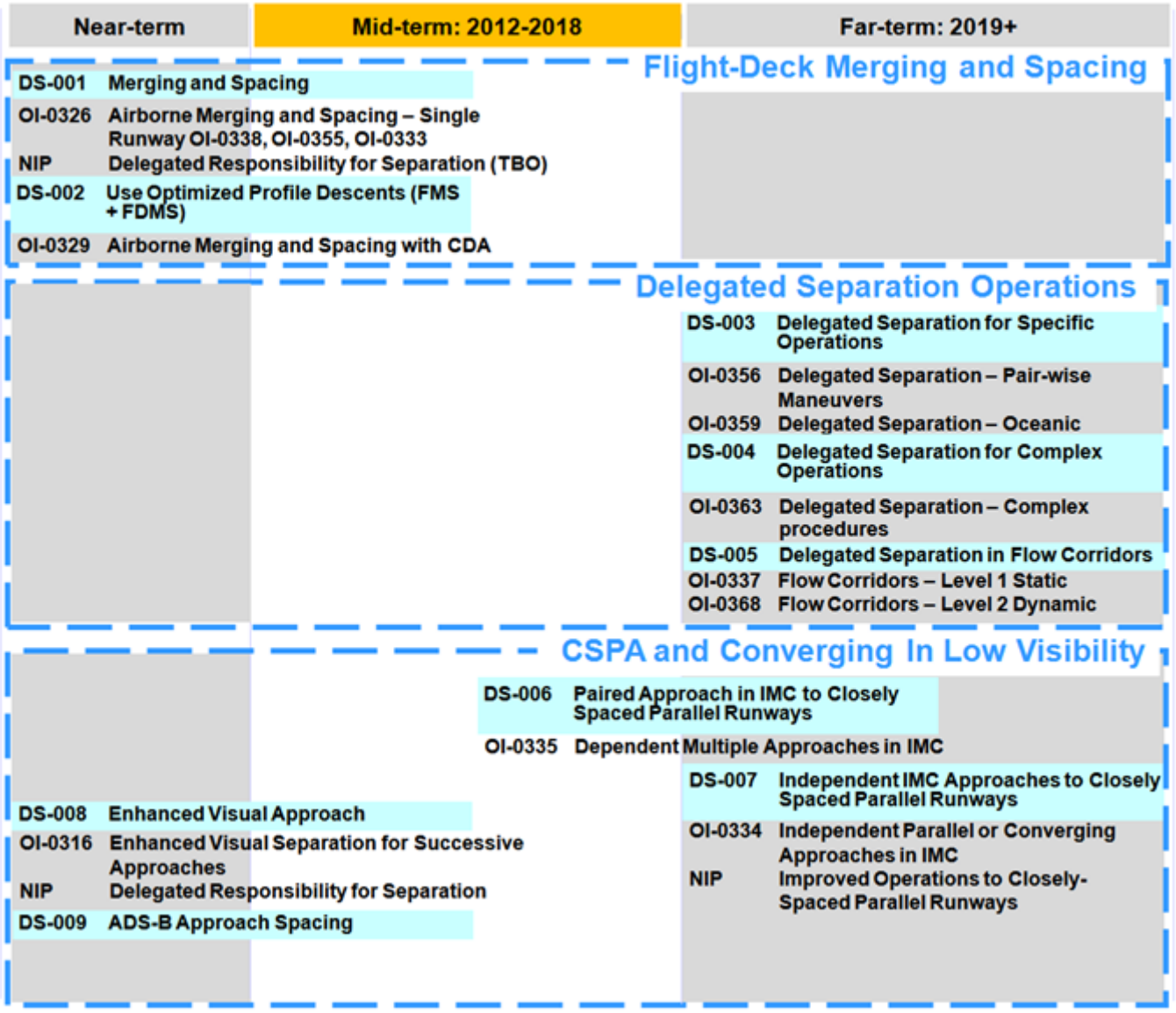
Publish Routes and Procedures Capabilities



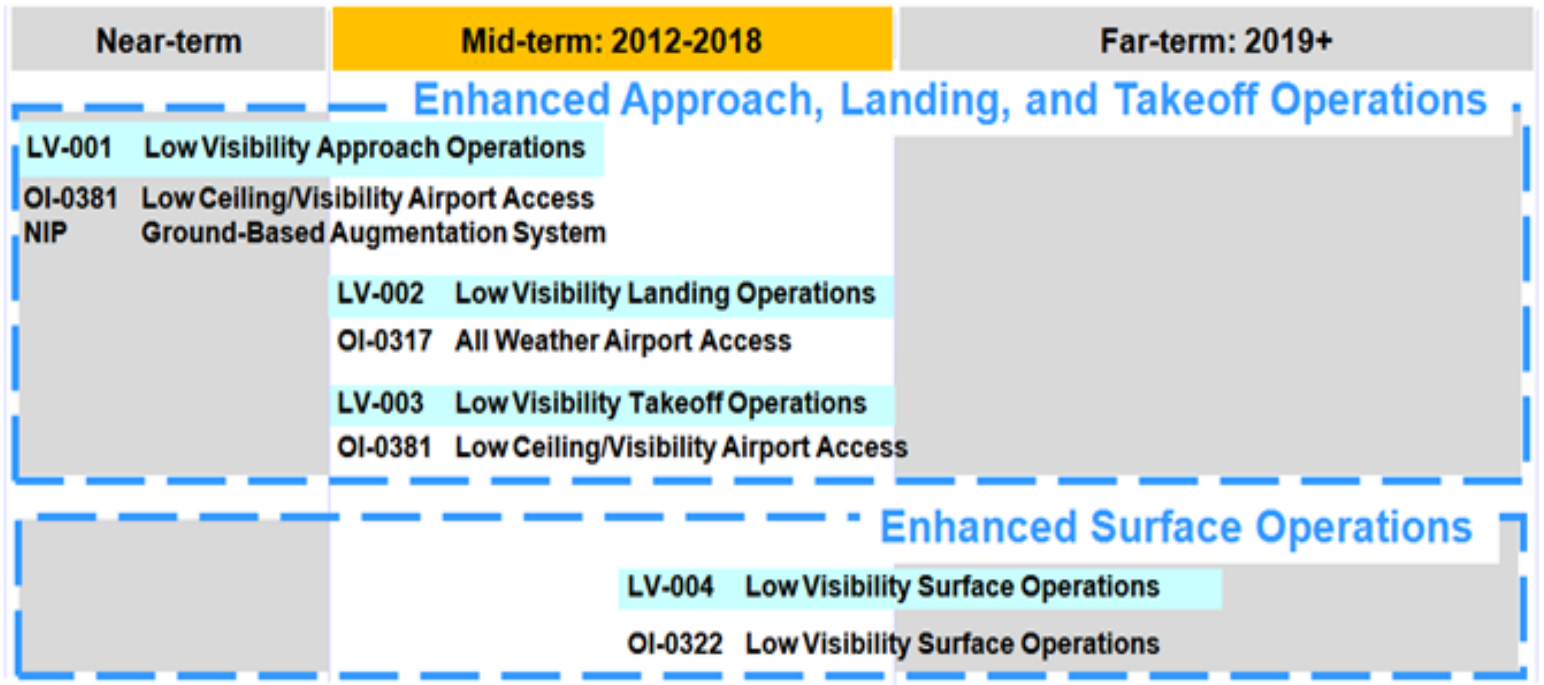
Negotiated Trajectories Capabilities



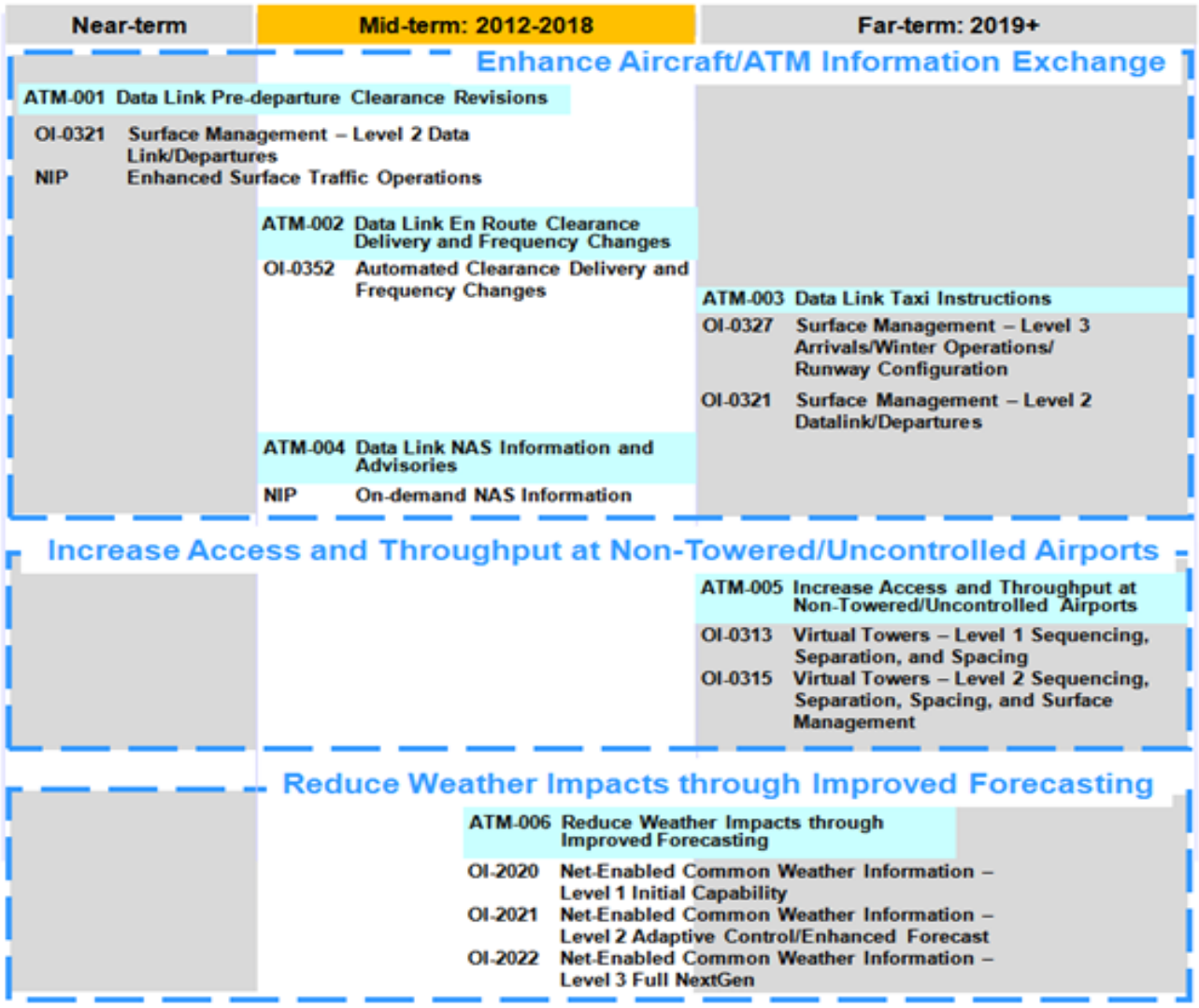
Delegated Separation Capabilities



Low-Visibility Approach/Departure/Taxi Capabilities



ATM Efficiency Capabilities



Avionics Roadmap: Appendix 1 -- TBO

- Direct mapping from JPDO Conops and further detailed work
- Subject of the vast majority of Roadmap v.1 comments
- We need to have greater outreach and concurrence on the concepts and detail objectives for TBO
- Current work in AWG-ANS, as well as internal to FAA

TBO Framework

- Mixed-capability TBO forms an inclusionary basis everywhere in the NAS
- All aircraft have an associated 4DT
  - ATM systems are repositories of 4DT
- Transition to 4DT begins with ATM supporting conops, and data communications
- 4DT is negotiated prior to flight, ATM tools set performance, windows, constraints
- Clearances modify trajectories

Avionics Road Map
Aircraft-Centric Capabilities

1. Safety Enhancement

2. Published Routes/Procedures

3. Negotiated Trajectories

4. Delegated Separation

5. Low-Visibility Approach/Departure/Taxi

6. ATM Efficiencies

Affected by TBO

NAV

+COMM

+ADS-B In

Spacing and Delegated Separation

- Spacing Applications
  - No change in roles and responsibilities for flight crew or controller
  - Enables precise navigation to be relative to another aircraft
    - Particularly valuable for in-trail and merging – dealing with fourth dimension of time or along-track
- Delegated Separation
  - Ability to delegate separation to flight crew for specific instances
    - Particularly valuable in approach operations, as in visual approaches today

Potential Interaction? Precision on 4D Trajectory Clearance Eliminates Flexibility for Aircraft-Based Spacing/Separation

Unifying TBO and Spacing/Separation

- TBO Concepts must allow aircraft operator some (predetermined) flexibility in the trajectory: a trajectory window
  - For flight optimization, when practical (e.g., Continuous Descent Arrival)
  - For maintaining spacing to another aircraft
- Improved efficiency under some conditions will occur with less-specific trajectory clearance
  - Larger window
  - Also enables flight-specific efficiencies where there is excess capacity

Phases of Trajectory Operations

Pre-Negotiation

- ANSP identifies constraints (airspace, airport, weather, minimum acceptable performance)
- Operator identifies objectives and constraints (performance capability, weather)

Negotiation

- Use all available data to define desired trajectory and resolve likely conflicts
- Can occur between ANSP & Flight Crew or ANSP and Flight Ops Center
- Can occur pre-flight or in-flight

Contract

- Trajectory window and performance, request and acceptance
- Window can collapse to single trajectory
- ANSP verifies trajectory is acceptable
- Flight crew verifies trajectory is acceptable

Execution

- Aircraft operator is responsible for compliance to clearance
- ANSP maintains separation except where delegated

System-Wide Information Management

Data Commun-ication

ADS-B, Data Comm.

NextGen Challenges

- End-to-end safety analysis & performance allocation
  - Integrating actions and responsibilities across the agency (AVS, ATO, Airports) to support NAS level changes
- Integration of NextGen into agency wide planning
  - Avionics Roadmap provides a foundation to move forward
    - Roadmap aimed at providing a clear aircraft perspective that must be carried into other permanent NextGen planning work
  - Considerable work still needed to clearly define roles and where work should reside (FAA, JPDO, RTCA, PARC,…) to avoid duplication
- Equipage strategy
  - Complex issues and significant policy considerations involved
- Migration of avionics architecture
  - Air/ground functional allocation – major questions and differing view points

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Next Steps

1. Develop mature content for the far term 2019 – 2025
2. Develop specific functional and performance requirements enabling change, design, development and/or implementation
3. Outreach within JPDO and external Stakeholders
4. Expand scope of work to address GA, Military, UAS, etc communities
5. Determine aircraft related operational improvements from the deferred items.
6. Coordinate with JPDO to develop the cost, risk and benefits assessments to support the roadmap and guide future work
7. Find a place for the Avionics Roadmap in JPDO documents.

Questions?