Context and Background

TBO Conference
March 24, 2009

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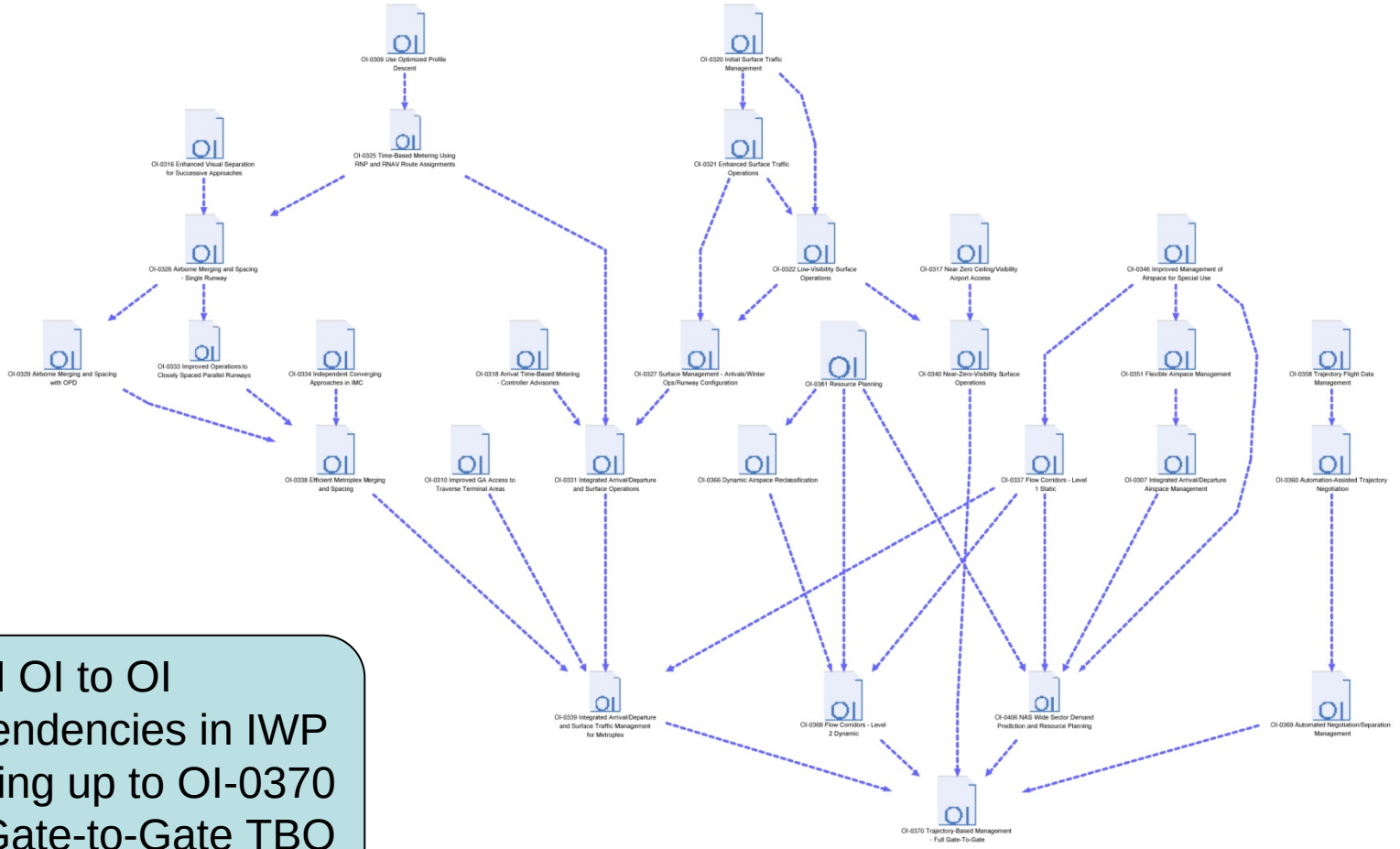
Joint Planning and Development Office

Overview

- Building the Far-Term
  - Assume 2018 OIs and Enablers are fully implemented
  - Accumulate OIs and ENs to 2025
- Source Materials for TBO far term baseline
  - IWP, NGIP, JPDO EA, NAS EA
- Not a review today
- Results of TBO may recommend changes to source materials
  - Submitted through existing processes

TBO Baseline



ATM OI to OI dependencies in IWP leading up to OI-0370 for Gate-to-Gate TBO

OI-0370 last step to 4DT in 2025

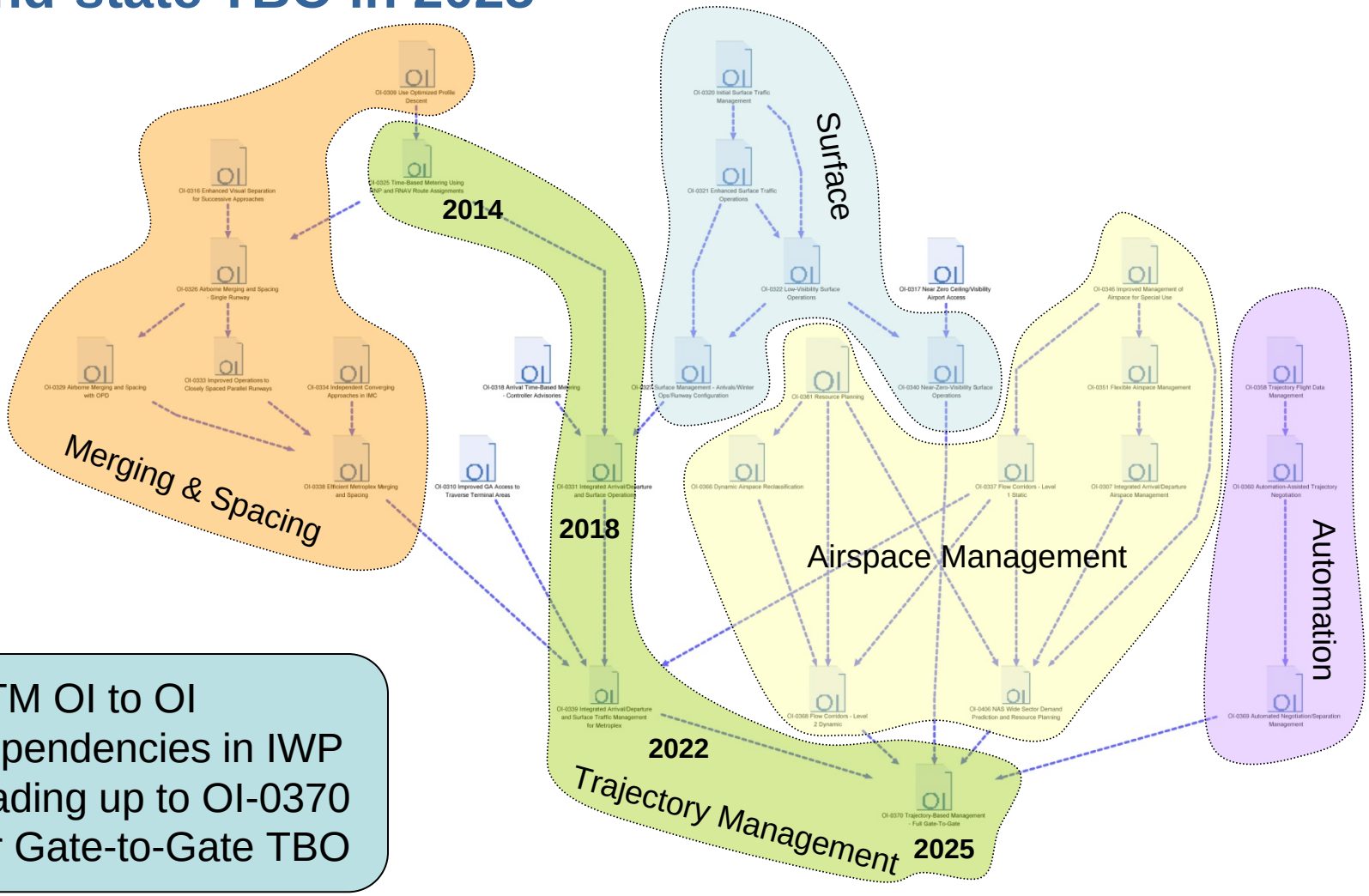
- All aircraft operating in high density airspace are managed by 4DT in en route climb, cruise, descent, and airport surface phases of the flight.
  - This would require the ability to calculate, negotiate, and perform conformance monitoring by ANSPs including the integration of separation assurance and traffic management time constraints (e.g., runway times of arrival, gate times of arrival).
  - This will be enabled by the trajectory exchange through electronic data communications, as well as many new surface automation and 3D (x, y, and time) trajectory operations.
- In high-density or high-complexity airspace, precise 4DTs will be used, dramatically reducing the uncertainty of an aircraft's future flight path, in terms of predicted spatial position (latitude, longitude, and altitude) and times along points in its path.
  - This enhances the capacity and throughput of the airspace to accommodate high levels of demand.
- In trajectory-based airspace, differing types of operations are conducted with performance-based services applied based on the anticipated traffic characteristics.
- User preferences are accommodated to the greatest extent possible, and trajectories are constrained only to the extent required to accommodate demand or other national concerns, such as security or safety.

Source: OI-0370 from JPE

Evolution from Assisted to Automated

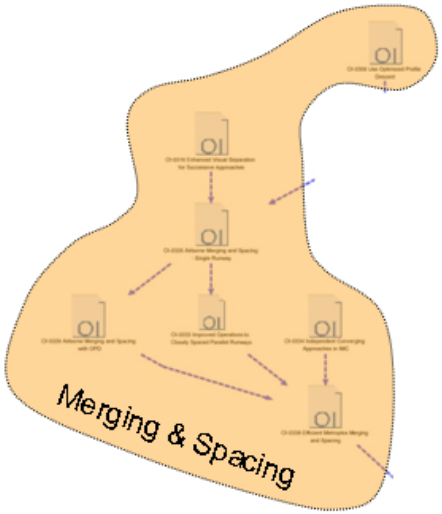
Function	OI-0360 Automation-Assisted Trajectory Negotiation	OI-0369 Automated Negotiation/Separation Management
Trajectory Management	Automated assistance to negotiate with properly equipped aircraft operators.	Automated negotiation of 4DTs between properly equipped aircraft and ground automation for separation management.
Separation Management	Human ANSPs are responsible for separation management, supported by automation.	Fully automated, and separation responsibility is delegated to automation
Negotiation	4DTs are negotiated between the ground-based automation and the operator (which may be the pilot, a UAS operator, or perhaps even FOC personnel), who would then relay information to the aircraft.	For specified operations, tasks are delegated to the flight crew to take advantage of aircraft capabilities. To manage separation, ANSP automation negotiates short-term, conflict-driven updates to the 4DT agreements with the aircraft.
IOC	2020	2024

Several groupings of ATM-related OIs contribute to end-state TBO in 2025



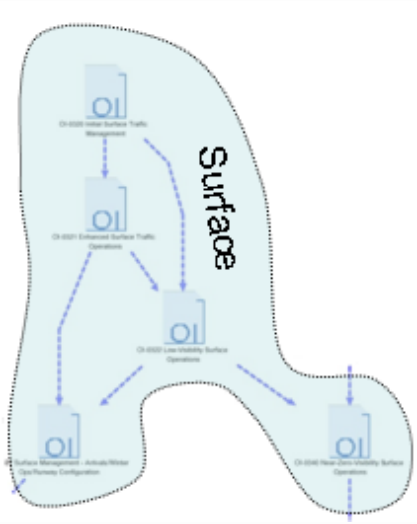
ATM OI to OI dependencies in IWP leading up to OI-0370 for Gate-to-Gate TBO

Merging & Spacing includes mid-term OIs related primarily to approach procedures, with availability of complex, multiple-runway Metroplex procedures in high-density airspace by 2018



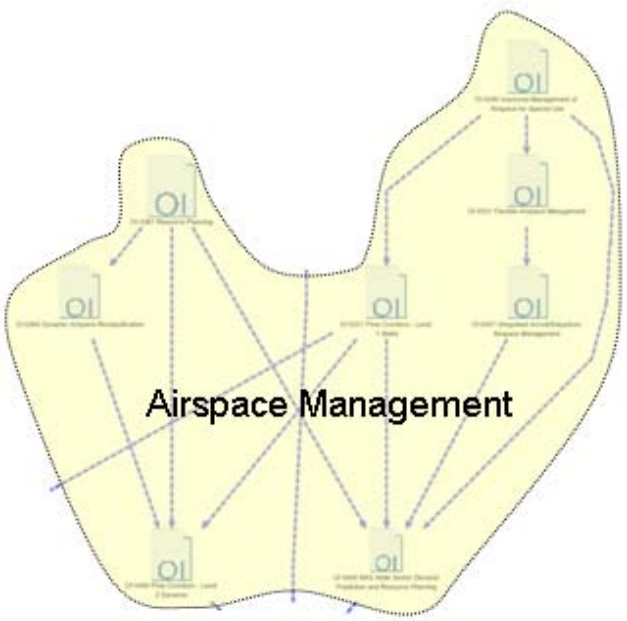
IWP OI	Name	IOC
OI-0309	Use Optimized Profile Descent	2010
OI-0316	Enhanced Visual Separation for Successive Approaches	2012
OI-0326	Airborne Merging and Spacing – Single Runway	2014
OI-0329	Airborne Merging and Spacing with OPD	2015
OI-0333	Improved Operations to Closely Spaced Parallel Runways	2016
OI-0334	Independent Converging Approaches in IMC	2017
OI-0338	Efficient Metroplex Merging and Spacing	2018

Surface automation is fully integrated with airborne operations in 2018, with data link of taxi instructions to arriving aircraft -- low/near-zero visibility operations are available for TBO in 2025



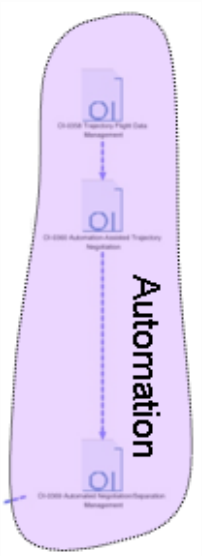
IWP OI	Name	IOC
OI-0320	Initial Surface Traffic Management	2012
OI-0321	Enhanced Surface Traffic Operations	2014
OI-0322	Low-Visibility Surface Operations	2017
OI-0327	Surface Management – Arrivals/Winter Ops/Runway Configuration	2018
OI-0340	Near-Zero Visibility Surface Operations	2025

Airspace Management includes improvements for static (2017) and dynamic (2024) use of Flow Corridors, and integrated decision support for NAS and CDM data in 2019



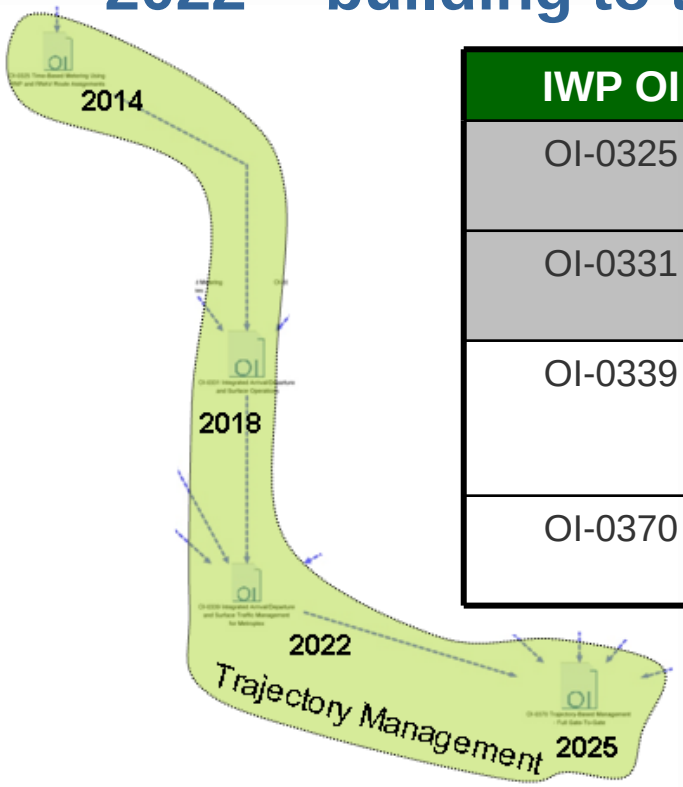
IWP OI	Name	IOC
OI-0346	Improved Management of Airspace for Special Use	2012
OI-0351	Flexible Airspace Management	2015
OI-0307	Integrated Arrival/Departure Airspace Management	2015
OI-0361	Resource Planning	2015
OI-0337	Flow Corridors – Level 1 Static	2017
OI-0406	NAS Wide Sector Demand Prediction and Resource Planning	2019
OI-0366	Dynamic Airspace Reclassification	2023
OI-0368	Flow Corridors – Level 2 Dynamic	2024

In 2024, Automation supports the end-state gate-to-gate TBO with automated negotiation of 4DTs between properly equipped aircraft and ground automation for separation management



IWP OI	Name	IOC
OI-0358	Trajectory Flight Data Management	2018
OI-0360	Automation-Assisted Trajectory Negotiation	2020
OI-0369	Automated Negotiation/Separation Management	2024

Effectively, much of the trajectory management improvements are achieved in the far-term, with arrival/departure flow management and surface functions achieved in 2018 and Metroplex traffic management in 2022 -- building to the end-state TBO in 2025



IWP OI	Name	IOC
OI-0325	Time-Based Metering Using RNP and RNAV Route Assignments	2014
OI-0331	Integrated Arrival/Departure and Surface Operations	2018
OI-0339	Integrated Arrival/Departure and Surface Traffic Management for Metroplex	2022
OI-0370	Trajectory-Based Management – Full Gate-To-Gate	2025

Discussions and work are ongoing to update the Far-Term IWP OIs for alignment with the NAS OIs

IWP OI	Working Status with NAS OI
OI-0338 and OI-0339	Combine OIs with IOC of 2022; propose as new NAS OI
OI-0327	Combine with NAS OI 104206 - Full Surface Traffic Management with Conformance Monitoring
OI-0340	Combine with NAS OI 102409 - Provide Surface Situation to Pilots, Service Providers and Vehicle Operators for All-weather Operations, keep IOC date of 2025
OI-0366	JPDO Action to further evaluate if this should remain as OI or be deleted
OI-0368	Propose as new NAS OI
OI-0358	Since the NAS OI aligned to this IWP OI has been changed to an EN, the IWP OI may be deleted or changed to an EN
OI-0360	Combine with NAS OI 104105 - Expanded Conflict Resolution via Data Communication
OI-0369	Propose as new NAS OI, and consider changing date to 2025
OI-0331	Combine with NAS OI 104117 - Optimize Runway Assignments, keep IOC date of 2018
OI-0370	Combine with NAS OI 104121 - Tactical Trajectory Management

NextGen Implementation Plan (NGIP) provides a summary of mid-term TBO capabilities through 2018, as a foundation for long-term evolution of the system

TBO solution set represents a shift from clearance based to trajectory based control. Aircraft will fly negotiated trajectories and ATC moves to trajectory management. The roles of pilots/controllers will evolve due to the increase in automation support. The focus of TBO is primarily en route cruise.

Scheduled Implementation Commitments

- ERAM thru FY11+
- TMA in FY08

FY09 Solution Set Work Plan

- Separation Management – Modern Procedures
- Separation Management – High Altitude
- Trajectory Management – Oceanic
- Flight and State Data Management – Flight Object
- Capacity Management – NextGen DME

Mid-term Operational Capabilities

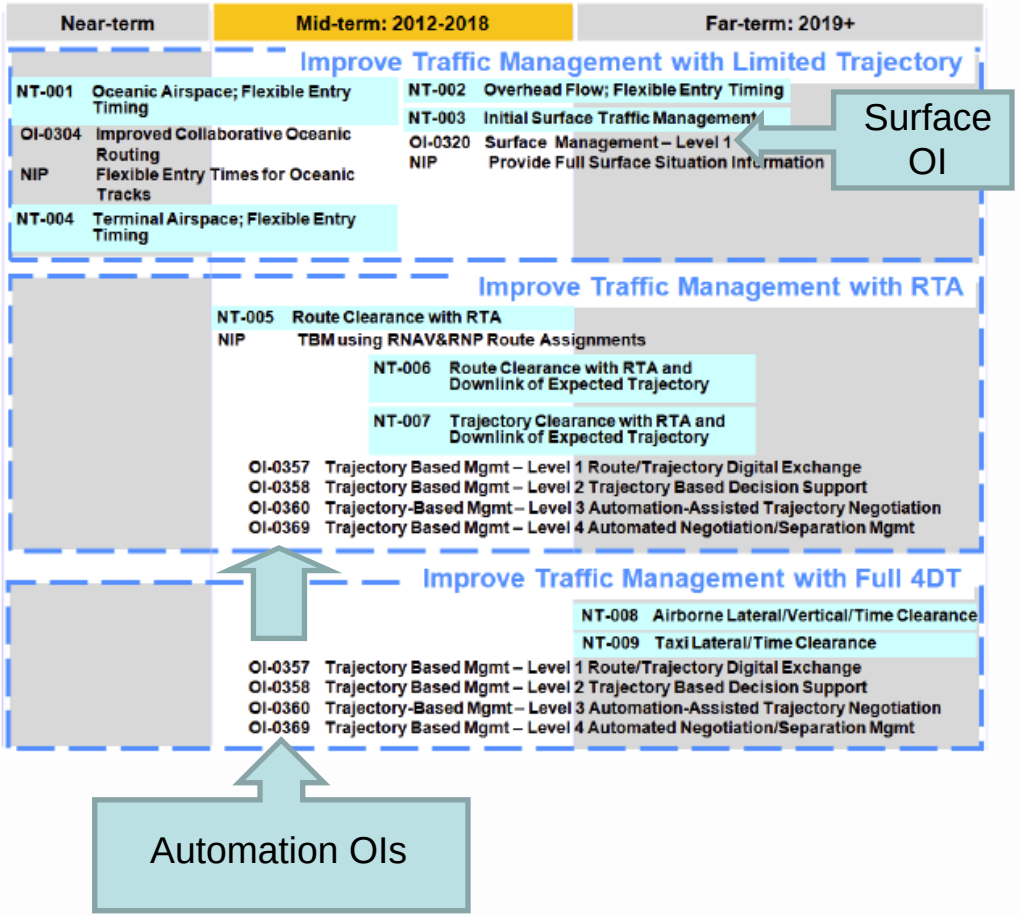
- Delegated Responsibility for Separation
- Oceanic In-Trail Climb and Descent
- Automation Support for Mixed Environment
- Initial Conflict Resolution Advisories
- Flexible Entry Times for Oceanic Tracks
- Point-in-Space Metering
- Flexible Airspace Management
- Increase Capacity and Efficiency Using RNAV and RNP

Source: FAA NGIP, January 2009, pp. 40-41

Avionics Roadmap provides a conceptual framework for TBO as related to 4DT integration with avionics capabilities, with TBO specificity identified as a need for consideration of data link and air/ground levels of capability

TBO Conceptual Framework

- Mixed-capability, trajectory based operations form an inclusionary basis for ATM everywhere in the NAS
- All aircraft have an associated 4DT
- ATM systems should accommodate a heterogeneous aircraft capability in the same operational concept and with the same tools, wherever possible
- ATM tools set the required performance
- ATM clearances that modify trajectories for managing the traffic may be voice or data, depending on the aircraft and the operation.



Source: Avionics Roadmap v1.0, Oct-2008, pp.12-13 and Appendix1

NAS 6 EA Infrastructure Roadmaps provide baseline thru 2018

- TBO updates will be incorporated into EA