4D Trajectory Based Operations (TBO)

REDAC March 27, 2018

What is TBO

- TBO is an ATM method for strategically planning, managing, and optimizing flights throughout the operation by using time-based management (TBM), information exchange between air and ground systems, and the aircraft's ability to fly precise paths in time and space
- TBO will use more precise and shared information on constraints (weather, SAAs, airspace congestion) and demand (current and future aircraft location and flight planning preferences) to maximize airspace access with minimal deviation or delay
- Vast number of "to-go" operational changes for NextGen relate to TBO
- **To achieve the full benefits of TBO (PBN and TBM), the way we research, develop, acquire, test, implement, and train the workforce may need to evolve**

Trajectory Based Operations (TBO) Has Always Been The Target of NextGen

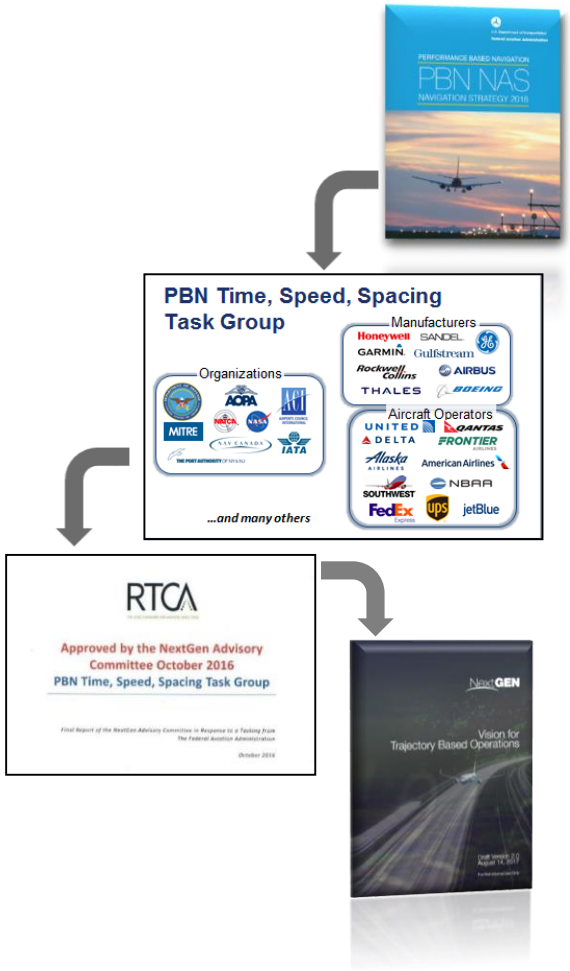
- Important element of NextGen since the original NextGen concept
- Major operational concept in the Future of the NAS (June 2016)
- International ATM Concept contained in Global Air Traffic Management (ATM) Operational Concept (ICAO Doc. 9854)
- Performance Based Navigation (PBN) NAS Navigation Strategy (Sept 2016) identified TBM as important enabler for full realization of NextGen Benefits

FAA

NextGEN

PBN Time, Speed, Spacing Work Group

- **PBN NAS Navigation Strategy**
  - Collaborative FAA and Industry Effort
  - Key Strategic Commitments include “Shifting To Time- and Speed-Based Air Traffic Management”
- **FAA asked RTCA to recommend T/S/S Capabilities needed for PBN NAS Nav Strategy**
- **RTCA T/S/S Task Group provided recommendations**
  - Shift to Time-Based Management (TBM)
  - Continue deployment of enabling NextGen capabilities, Address Operations Culture, Training, and Integrate Aircraft Data with Ground Systems
  - Clarify Vision
- **FAA developed Vision for TBO**



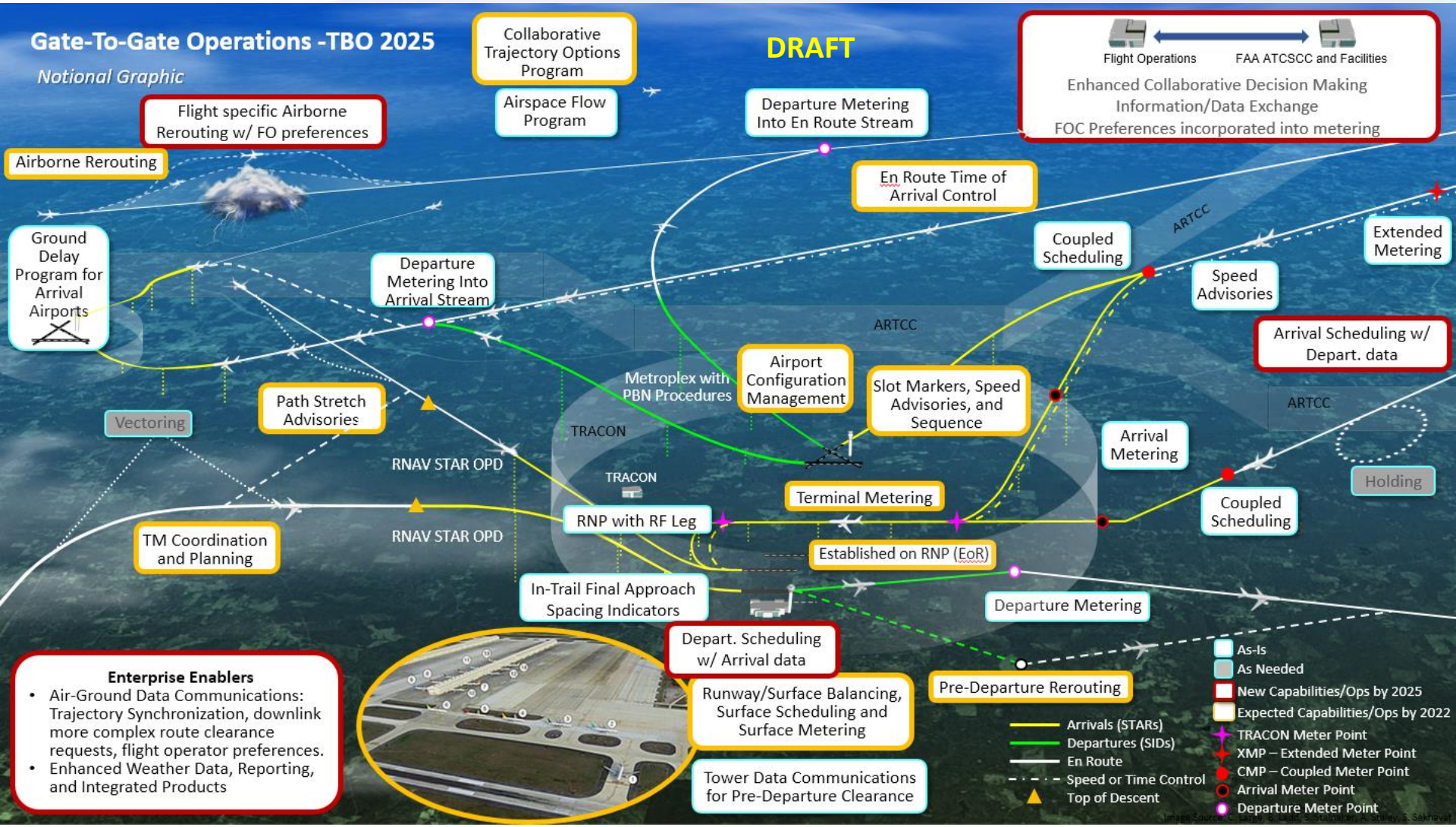
Vision for Trajectory Based Operations

- Written to address industry request
- Provides a framework with which the FAA and the user community can work together to prioritize specific implementation plans for TBO
- Provides lower level concept descriptions than the *Future of the NAS* document in order to improve the understanding of TBO across stakeholder groups
  - Does not contain any new operational concepts or technology solutions

FAA

NextGEN

TBO 2025 Operational Picture



FAA

NextGEN

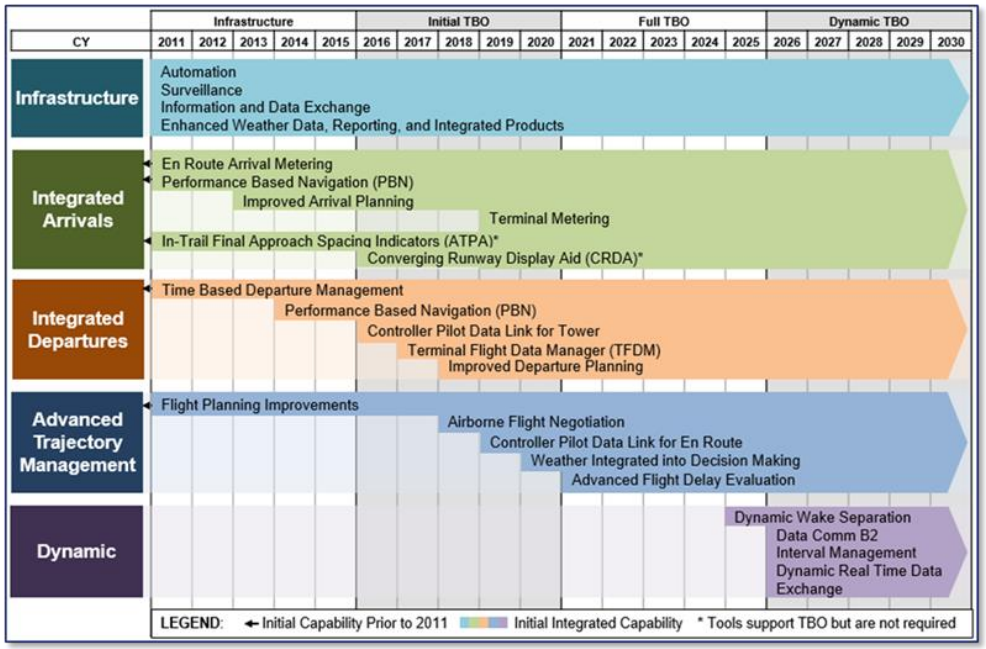
TBO Evolution

	Infrastructure					Initial TBO					Full TBO					Dynamic TBO				
CY	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030

- Initial TBO 2016-2020 capabilities are being deployed for use domain by domain with integration of the capabilities left to the human operator
- Full TBO 2021-2025 capabilities delivered to all domains providing the ability to automate the integration of time based management data and tools in order to greatly improve strategic planning and execution
- Dynamic TBO 2026-2030 capabilities will use advanced aircraft and ground automation to enable flight specific time based solutions for both reroutes and aircraft sequencing and advanced aircraft based pairwise trajectory solutions. Information will be integrated and shared to further improve NAS operations.

Relationship to Deployment Plans

- Deployment plans will focus on improving the human integration challenges while delivering Initial TBO plus any Full TBO capabilities that are available at that time.
- ATO looking at opportunities for integrated TBO implementation for NEC NIWG and other operational areas



- Based on the year of implementation, the ATO will be able to choose from the capabilities that will be available in that year.
- NextGen is developing a work plan to better align the existing or current research, acquisition, and deployment activities.

FAA

NextGEN

Summary

- Current TBO efforts focused on better integration of the research, development, acquisition, testing, implementation, and training of the workforce
- Concept has remained consistent throughout NextGen
  - Use of TBO to assist with more consistent delivery of PBN procedures has led to increased discussion of PBN
- All identified TBO Capabilities are already contained in the NSIP
  - A good number have already achieved initial availability
  - Deployment of TFDM, En Route Data Comm and CSS/NWP will see the TBO infrastructure in place
  - Most to-go capabilities are additional software applications and interfaces between systems.
  - All capabilities not already in development are in the planning and concept exploration and maturation phases