

Time-Based Flow Management

Active Increments

Portfolio Overview

The Time-Based Flow Management (TBFM) portfolio enhances system efficiency by leveraging the capabilities of the TBFM decision-support tool, a system that is already deployed to all CONUS ARTCCs. Improvements in TBFM's core time-based-metering capability, an expansion of TBFM and its departure capabilities to additional locations will enhance efficiency and optimize demand and capacity management. Further, improvements will be made to enable controllers to more accurately deliver aircraft to the Terminal Radar Approach Control facility (TRACON) while providing the opportunity for aircraft to fly optimized descents. These changes will be leveraged to enable aircraft to maintain a spacing interval behind preceding aircraft, further improving capability and flight efficiency. These benefits should reduce fuel burn due to more efficient flight paths.

This portfolio focuses on scheduling and interval management tools that further expand time-based-metering benefits to safely assure the smooth flow of traffic and increase the efficient use of airspace. Point-in-Space Metering, time-based-metering in the Terminal Environment, and Improved Management of Arrival/Surface/Departure Flow extend, enhance, and proliferate metering operations; improve the accuracy of schedules and demand predictions for more efficient and predictable NAS operations; and continue the path toward trajectory-based operations. This portfolio also begins the use of Interval Management-Spacing (IM-S) operations, using a combination of ground- and flight deck-based capabilities.

Anticipated benefits are in the areas of system efficiency and predictability, as follows:
Improved efficiency through optimized descents and optimized aircraft spacing during metering operations
Increased predictability by expanding the use of time-based-metering from departure through the en route environment and ultimately to the airport.

Note: The dates and timelines included in the NAS Segment Implementation Plan (NSIP) are for planning purposes only. All capability schedules are tentative until their supporting programs are officially baselined.

Time-Based Flow Management

Portfolio Content Summary Statistics

		Increment Status				
Segment	Total by Segment	Planned	Concept Exploration & Maturation	Development	Initial Operational Availability	Completed
*Alpha (2010 - 2015)	6	0	0	0	0	6
*Bravo (2016 - 2020)	0	0	0	0	0	0
Charlie (2021 - 2025)	1	0	0	1	0	0
Delta (2026 - 2030)	1	0	1	0	0	0
Echo (2031 - 2035)	6	1	4	1	0	0
Foxtrot (2036 - 2040)	5	1	4	0	0	0
TOTAL	19	2	9	2	0	6
Segment	% by Segment	% by Segment/Increment Status				
*Alpha (2010 - 2015)	32 %	0 %	0 %	0 %	0 %	100 %
*Bravo (2016 - 2020)	0 %	0 %	0 %	0 %	0 %	0 %
Charlie (2021 - 2025)	5 %	0 %	0 %	100 %	0 %	0 %
Delta (2026 - 2030)	5 %	0 %	100 %	0 %	0 %	0 %
Echo (2031 - 2035)	32 %	17 %	67 %	17 %	0 %	0 %
Foxtrot (2036 - 2040)	26 %	20 %	80 %	0 %	0 %	0 %
TOTAL	100%	11 %	47 %	11 %	0 %	32 %

* Please see Appendix A and B for information about Alpha and Bravo Increments, respectively.

Time-Based Flow Management

Operational Improvements/Current Operations & Increments

Benefits

OI: [102118] Relative Spacing Using Interval Management (2026 - 2040)

F [102118-21] Relative Spacing Using Interval Management - Cruise (2036 - 2040)



OI: [104117] Improved Departure Scheduling into Overhead Streams (2015 - 2035)

C [104117-21] Expansion of the Integrated Departure/Arrival Capability (2021 - 2025)



OI: [104120] Enhanced Time Based Metering Operations in All Weather (2033 - 2040)

E [104120-33] OPDs to the Runway Enabled by Required Time of Arrival (RTA) Capability (2033 - 2038)



F [104120-21] Sustain Metering in Variable Operational Conditions (2036 - 2040)



F [104120-32] Rerouting During Metering Operations (2036 - 2040)



OI: [104128] Time-Based Metering in the Terminal Environment (2031 - 2037)

E [104128-24] Initial Time-Based Metering in the Terminal Environment (2031 - 2035)



E [104128-25] Expanded Time-Based Metering in the Terminal Environment (2034 - 2037)



OI: [104129] UAM Strategic Traffic De-confliction (2028 - 2035)

D [104129-01] UAM Cooperative Scheduling of Vertiport Operations (2028 - 2032)



OI: [104130] Improved Arrival/Departure Operations with Integrated Data (2036 - 2040)

F [104130-01] Improved Arrival Scheduling with Additional Data (2036 - 2040)



F [104130-02] Improved Departure Scheduling with Additional Arrival Data (2036 - 2040)



OI: [104131] Improved Arrival Metering Operations (2031 - 2039)

E [104131-01] Lateral Maneuvering for Delay Absorption (Path Stretch) (2034 - 2039)



E [104131-02] Meet TBM Constraints Using Required Time of Arrival (RTA) Capability (2034 - 2039)



E [104131-03] Enhanced Time Based Metering Operations (2031 - 2035)



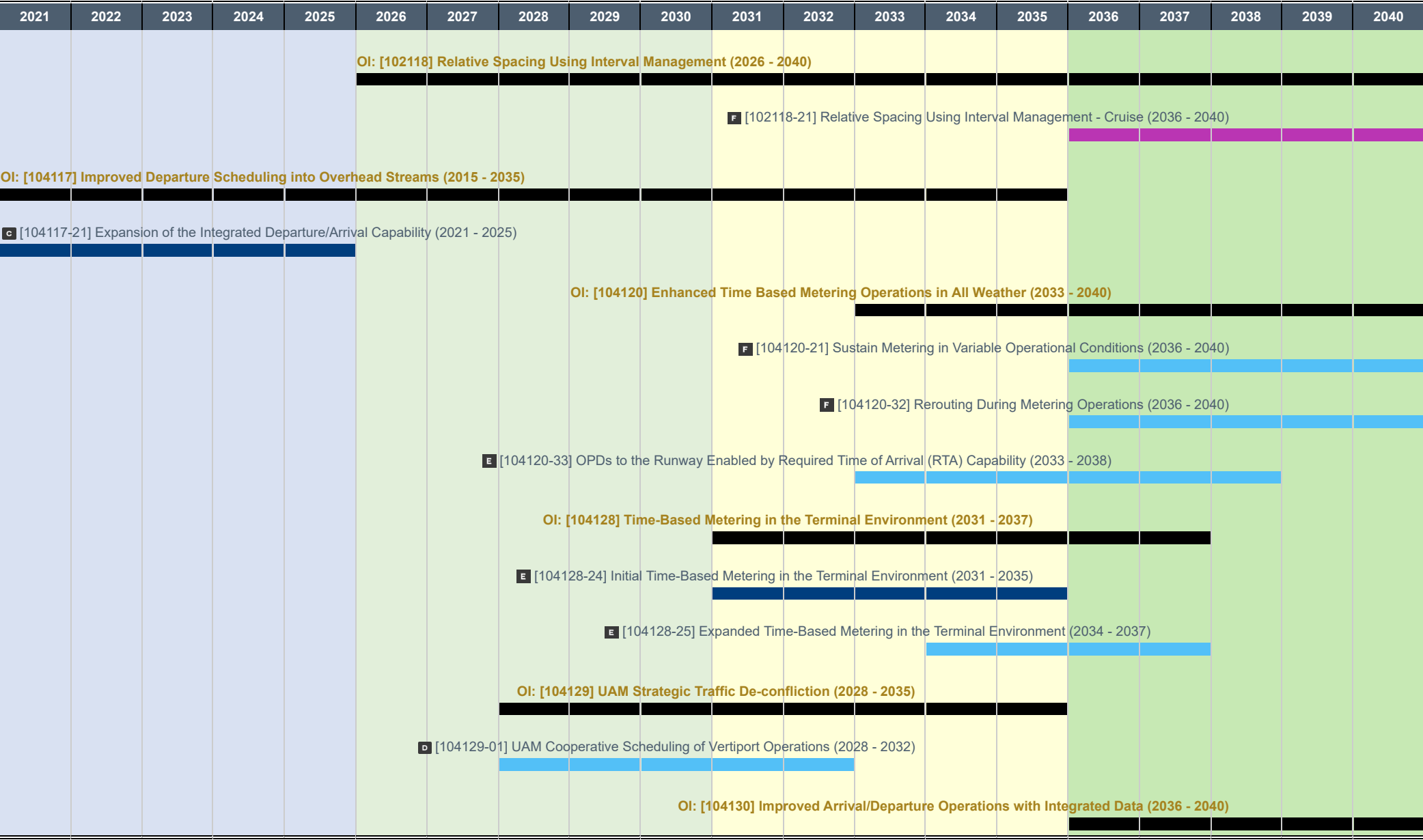
External Commitment Primary Benefit Secondary Benefit Operationally Available Complete Access & Equity Capacity Flexibility Efficiency Environment Predictability Safety **C** Charlie **D** Delta **E** Echo **F** Foxtrot



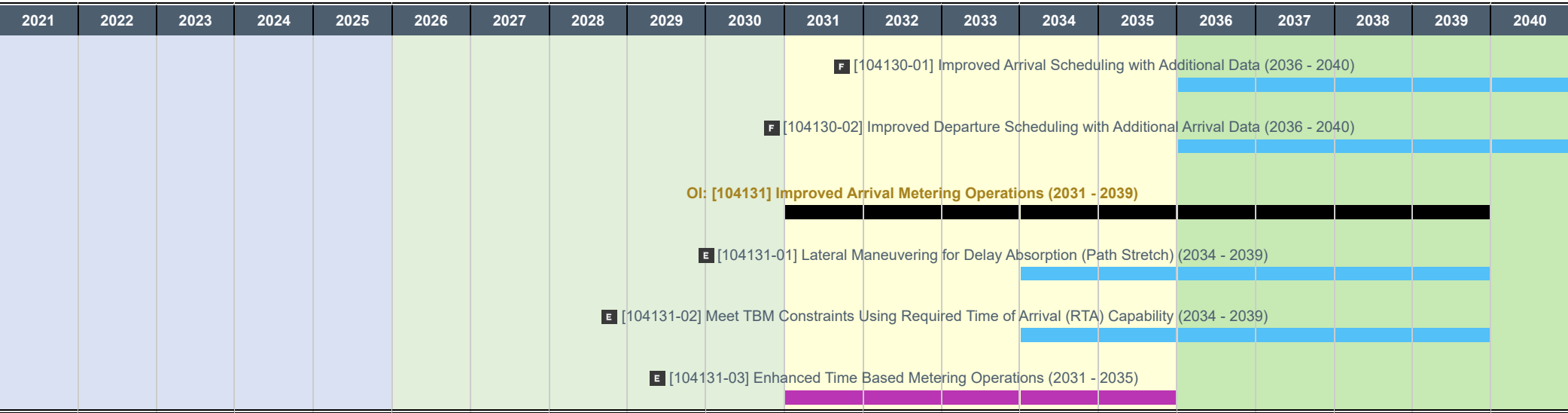
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Time-Based Flow Management



Time-Based Flow Management



Time-Based Flow Management

OI: [102118] Relative Spacing Using Interval Management (2026 - 2040)

Improved inter-aircraft spacing precision is achieved using new aircraft capabilities. This should reduce the time interval between the first and last aircraft in an overall traffic flow and help avoid some costly, low-altitude maneuvering. This should increase efficiency and throughput in capacity-constrained airspace without negatively impacting controller workload and task complexity in maintaining separation between aircraft. Increased airport throughput will also be achieved through the ability of pilots to apply visual separation in marginal VMC conditions. In addition, Interval Management operations are expected to reduce frequency congestion and the number of necessary controller traffic interventions. This capability may be used in locations where time-based metering is not in use.

The ANSP will be provided with a new set of procedures directing, for example, flight crews to establish and to maintain a given time or distance from a designated aircraft. The flight crews will perform these new tasks along defined flight paths, including RNAV paths with turns, using new aircraft functionality that includes along-track speed guidance.

Broadcast surveillance sources and improved avionics capabilities provide the ANSP and flight deck with accurate position and trajectory data. Aircraft that are equipped to receive the broadcasts and have the associated displays, avionics, and crew training are authorized to perform pair-wise Interval Management operations when assigned or approved by the controller. Controllers will determine the required relative spacing required and assign the spacing interval to the aircraft over voice. Automation will inform controllers of aircraft that are eligible to perform the operation.

OI Benefit

Efficiency (P):Improved inter-aircraft spacing precision will result in tighter separation that will reduce aircraft maneuvers needed to maintain safe separation.

Capacity (S):Aircraft throughput in capacity constrained airspace will be increased through reduced excess separation buffers.

Increments

Foxtrot
(2036 - 2040)

1

F [102118-21] Relative Spacing Using Interval Management - Cruise (2036 - 2040) (Planned)

Time-Based Flow Management

Increments/Enabling Activities

F [102118-21] Relative Spacing Using Interval Management - Cruise (2036 - 2040)

Increment Overview

More precise relative aircraft spacing is achieved in the cruise environment by enabling en route controllers to identify, initiate, and monitor Interval Management operations. Upon receipt of a verbal ATC clearance, a trailing aircraft during cruise will achieve and maintain a specified interval behind a lead aircraft. This capability may also be used at locations where time-based metering is not in use.

Increment Status

Planned

Success Criteria

2025 : Update ADS-B Operations – Advisory Circular 90-114

Implementation Approach

This capability is a candidate for Interval Management Phase 1.

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety

Efficiency (P): Increases throughput and reduces delay through improved inter-aircraft precision.


System Interactions

ERAM (P): ERAM provides IM capability indication to the controller. In a metering environment, controllers would use the Assigned Spacing Goal (ASG) from TBFM. In non-metered sites, controllers would use Miles in Trail (MIT) as the ASG .


TBFM (S): TBFM would provide the ASG during metering operations.

ADS-B In Avionics (A): ADS-B In avionics will require IM functionality.

Primary Systems












 ERAM: En Route Automation Modernization

Secondary Systems

 TBFM: Time Based Flow Management

Avionics Systems

 ADS-B In Avionics: Automatic Dependent Surveillance - Broadcast In Avionics

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety
-  Charlie
-  Delta
-  Echo
-  Foxtrot



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Time-Based Flow Management

OI: [104117] Improved Departure Scheduling into Overhead Streams (2015 - 2035)

This operational improvement provides advanced departure flow management scheduling functions to improve overall airport capacity and efficiency. New departure-scheduling automation tools assist traffic managers with improving the flow of traffic at high-density airports. These tools integrate the scheduling of departures from multiple airports into the overhead stream. Advanced capabilities will enable general and business aviation aircraft departing from smaller airports to be scheduled into congested overhead streams through mobile applications.

OI Benefit

- Capacity (P): Capacity is increased through an increased ability to properly schedule departures into the overhead stream.
- Efficiency (S): Through better time based flow management, aircraft are less likely to encounter low altitude vectoring to absorb delay waiting for a slot in the overhead stream.
- Environment (S): More efficient ascent profiles will reduce environmental impacts.
- Predictability (S): Improved planning and management of departure flows improves the predictability of meeting schedule times.

Increments

Charlie
(2021 - 2025)

1

C [104117-21] Expansion of the Integrated Departure/Arrival Capability (2021 - 2025) (Development)

Time-Based Flow Management

Increments/Enabling Activities

C [104117-21] Expansion of the Integrated Departure/Arrival Capability (2021 - 2025)

Increment Overview

Implementation of IDAC will be expanded to additional sites where the implementation will increase NAS efficiency and reduces delays by providing decision support capabilities for departure flows to controllers. It automates the process of monitoring departure demand and identification of departure slots. It also deconflicts the departure times between airports with traffic departing to common points in space and provides situational awareness to air traffic control tower personnel so they can select from available departure times and plan their operations to meet these times.

Increment Status

Development


Success Criteria

- ✓ 2022 : Operationally available at ZDV and ZMA.
- 2025 : Deployment of IDAC to one additional site.

Implementation Approach

The expansion of IDAC to additional sites is a candidate for TBFM Enhancement 1

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety

Efficiency (P): Flight efficiency is increased by enabling tower personnel to manage surface operations to meet self- scheduled, de-conflicted departure times, decreasing taxi and/or wait times prior to departure.

Capacity (S): Improving capacity because timely aircraft departures will increase the probability that these aircraft will seamlessly merge into the overhead stream and not miss assigned slots (early or late).

Environment (S): This surface management improvement will provide environmental benefits while improving capacity because timely aircraft departures will increase the probability that these aircraft will seamlessly merge into the overhead stream and not miss assigned slots.

System Interactions

Time-Based Flow Management

TBFM (P): Interface changes to TFMS, enabling both systems to share data, ensuring consistent and seamless traffic flow management between the different phases of flight.


CIWS (S): Provides convective weather to TBFM.

ERAM (S): Interacts and provides track data & flight plan data to TBFM.





STARS (S): Interactions to obtain aircraft track data.

TFMS (S): Will require functional changes to TBFM and interface changes to TFMS, enabling both systems to share data, ensuring consistent and seamless traffic flow management between the different phases of flight.

Primary Systems

 TBFM: Time Based Flow Management

Secondary Systems

-  TFMS: Traffic Flow Management System
-  STARS: Standard Terminal Automation Replacement System
-  ERAM: En Route Automation Modernization
-  CIWS: Corridor Integrated Weather System

Time-Based Flow Management

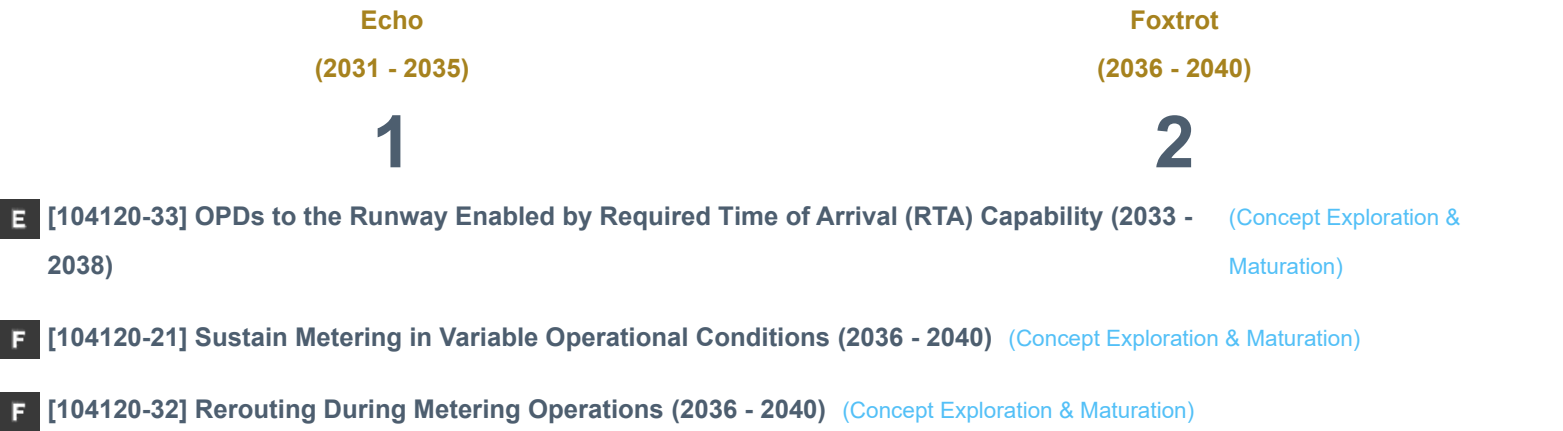
OI: [104120] Enhanced Time Based Metering Operations in All Weather (2033 - 2040)

Air traffic managers use scheduling tools to assure the smooth flow of traffic and increase the efficient use of airspace in all weather conditions. Time based metering operations can be associated with a departure fix, arrival fix, or any other point-in-space, such as airspace boundaries or other flow converging points. These enhancements will enable controllers to sustain metering in all weather conditions which will mitigate the impact of potential delay situations. Decision support tools will be enhanced to assess optimal route options that improve meter fix balancing and to allow traffic managers to develop scheduled arrival times for constrained resources in all weather conditions. Controllers will also be able to make use of aircraft avionics to provide time-based sequencing for Instrument Flight Rule flights destined for lower density airports.

OI Benefit

- Capacity (P): The ability to use time based metering in lieu of other metering techniques (e.g., miles-in-trail)) and make maximum use of available arrival capacity around an airspace constraint will increase airspace capacity.
- Efficiency (P): Improved precision during reroute operations will enable delays to be absorbed at higher and more fuel efficient altitudes and decrease the need for low altitude delay absorption maneuvers.
- Environment (P): Increased use of time-based arrival metering will lessen environmental impacts when it results in delays being absorbed at higher and more fuel efficient altitudes and decreases the need for low altitude delay absorption maneuvers.
- Predictability (S): The use of time based metering should increase the ability for users to maintain schedule integrity during reroute operations.

Increments



Time-Based Flow Management

Increments/Enabling Activities

E [104120-33] OPDs to the Runway Enabled by Required Time of Arrival (RTA) Capability (2033 - 2038)

Increment Overview

Improved arrival efficiency is achieved at lower density airports where the adaptation of time based metering controller tools is unwarranted through the use of the Required Time of Arrival (RTA) capabilities in the Flight Management Systems (FMSs). This would provide opportunities to conduct sequencing based on time intervals to lower density airports. Controllers could assign the times based on spacing needed for a given operational situation, such as arrival sequencing to a non-controlled airport. Use of RTAs in lower density locations could provide opportunities to gain increased efficiency that OPDs and time based metering afford for those airports that have a less frequent surge in arrival demand.

Increment Status

Concept Exploration & Maturation

Success Criteria

2026 : Operationally Available at designated key site

Implementation Approach

This increment will be accomplished through use of existing aircraft FMS avionics. Specific implementation plans are to be determined. This increment is identified to have an International harmonization dependency.

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety

Efficiency (P): Reduction in fuel consumption due to use of OPD

Environment (P): Reduction in noise and emissions on descent.

















System Interactions

Initial system dependencies have been identified for this capability. As this capability is further defined, future updates will be made to the associated system interaction text.

FMS (A): Utilizes RTA. Must meet RNP requirements.

Avionics Systems

-  FMS: Flight Management System

-  External Commitment
-  Primary Benefit
-  Secondary Benefit
-  Operational Availability
-  Complete
-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety
-  Charlie
-  Delta
-  Echo
-  Foxtrot



Time-Based Flow Management

Increments/Enabling Activities

F [104120-21] Sustain Metering in Variable Operational Conditions (2036 - 2040)

Increment Overview

This increment will enable traffic managers and controllers to continue to meter when reroutes are needed around congested airspace and in convective weather. Time based management automation will account for the added time associated with the updated trajectory and schedule assignments based on these alternative metering flows for subsequent delivery to controllers for execution.

Increment Status

Concept Exploration & Maturation

Success Criteria

2029 : Operationally Available at designated key site

Implementation Approach

Candidate for future TBFM Enhancement.

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety

Efficiency (S): Flight efficiency is increased by enabling metering operations to continue in the presence of convective weather or congested airspace by using dynamic routes.

Predictability (P): Metering also improves flexibility and predictability during these operations

System Interactions

TBFM (P): Receives updated routings from ERAMs and recalculates and distributes schedule.

ERAM (S): Provides updated flight plan to TBFM for schedule development. Receives updated schedule and provides to ATC for controller action.

FMDS (S): Facilitates rerouting to avoid congested airspace and convective weather and provides to ERAM for processing.


STARS (S): Receives updated schedule and provides to ATC for controller action.


Time-Based Flow Management


Primary Systems

 TBFM: Time Based Flow Management

Secondary Systems

 STARS: Standard Terminal Automation Replacement System

 FMDS: Flow Management Data & Services

 ERAM: En Route Automation Modernization

Time-Based Flow Management

Increments/Enabling Activities

F [104120-32] Rerouting During Metering Operations (2036 - 2040)

Increment Overview

Airspace throughput in a Metroplex environment will be optimized through a decision support function that will optimize airspace and route configurations in traffic management tools and procedures to assist ATM with trajectory and flow management. As NextGen provides additional route options to provide more optimal solutions to NAS arrival/departure constraints in major metropolitan areas, the current manual coordination process with different DSTs provided at different facilities will increasingly hinder realization of the greatest benefits these new routes afford. New automation functions will allow for assessment of the most efficient means of entering and exiting a Metroplex in a new, more fluid NAS that takes advantage of the new route and airspace options. This capability would provide functions for automation and/or procedural tools to assess the optimal route options, present the recommended solution to all interested stakeholders to assist with facility coordination, and facilitate implementation.

Increment Status

Concept Exploration & Maturation


Success Criteria


2029 : Operationally Available at designated key site


Implementation Approach


The ORC algorithm will be incorporated into NASA's Air Space Technical Demonstration-3 study that will demonstrate Traffic Flow Management technologies for domestic en route and oceanic flight domains.


Benefits


 Access & Equity


 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

Efficiency (P): ORC data-driven algorithms will, through more timely and seamless reroutes, enable both better use of resources to provide net efficiency gains for individual flights and the system as a whole. ORC automation will also support coordination of necessary rerouting.

Capacity (S): Enables NAS ANSPs, on a site-specific basis, to respond to shifts in demand by strategically and on a pro-active basis moving air traffic from over-utilized NAS resources to alternate resources with available capacity.

Environment (S): More efficient use of resources results in overall reduction in fuel burn and associated emissions in en route airspace.

System Interactions

 External Commitment

 Primary Benefit

 Secondary Benefit

 Operationally Available

 Complete

 Access & Equity

 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

 Charlie

 Delta

 Echo

 Foxtrot



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Time-Based Flow Management

FMDS (P): DSTs and related demand and capacity capabilities are expected to reside on the FMDS platform.


STARS (S): STARS provides TMCs with status of TRACON arrival operations by focusing on indicators such as the length of the final approach, number of arrivals in TRACON airspace, and whether flights are deviating from standard traffic patterns due to convective weather.

ERAM (T): ERAM to provide updated flight plan to TBFM for schedule development. Receives updated schedule and provides to ATC for controller action.


Primary Systems

 FMDS: Flow Management Data & Services

Secondary Systems

 STARS: Standard Terminal Automation Replacement System

Tertiary Systems

 ERAM: En Route Automation Modernization

Time-Based Flow Management

OI: [104128] Time-Based Metering in the Terminal Environment (2031 - 2037)

Aircraft are time-based metered inside the terminal environment, enhancing efficiency through the optimal use of terminal airspace and surface capacity. ANSP automation develops trajectories and allocates time-based slots for various points (as needed) within the terminal environment, applying RNAV route data and leveraging enhanced surveillance, and closely spaced parallel, converging, and intersecting runway capabilities (where applicable).

This OI extends current metering capabilities into the terminal environment and furthers the pursuit of end-to-end metering and trajectory-based operations. It also supports capabilities designed to expand the use of terminal separation standards in transition airspace, and solidifies the foundation for future advanced airborne-based applications that will depend upon ground-based automation to maintain the complete sequence of aircraft into and out of high density terminal locations.

OI Benefit

Efficiency (P): Improved inter-aircraft spacing precision will result in more precise aircraft spacing that will reduce low altitude aircraft maneuvers needed to achieve arrival spacing and push needed delay more consistently into higher altitude airspace which is more fuel efficient.

Access and Equity (P): Aircraft throughput in capacity constrained airspace will be increased through more precise aircraft spacing and the integration of en route and terminal sequencing and spacing applications.

Increments

Echo
(2031 - 2035)

2

E [104128-24] Initial Time-Based Metering in the Terminal Environment (2031 - 2035) (Development)

E [104128-25] Expanded Time-Based Metering in the Terminal Environment (2034 - 2037) (Concept Exploration & Maturation)

Time-Based Flow Management

Increments/Enabling Activities

E [104128-24] Initial Time-Based Metering in the Terminal Environment (2031 - 2035)

Increment Overview

This increment provides for optimal flow into the terminal domain at a few initial airports that currently use arrival metering by facilitating the use of Performance-Based Navigation (PBN), expanded metering, and the capability to merge multiple streams when metering for closely spaced parallel runway operations. By synchronizing with en route metering, this capability increases predictability and reduces the distance flown by allowing runway assignments and sequencing information to be displayed to terminal controllers. Real-time updates consider factors such as meter points inside terminal airspace, previous arrival runway and sequence assignment, traffic, weather conditions, and runway spacing constraints.

Increment Status

Development

Success Criteria

To Be Defined

Implementation Approach

To Be Defined

Benefits


-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety

Efficiency (P): Aircraft are time-based metered inside the terminal environment, enhancing efficiency and reducing emissions through the optimal use of terminal airspace.

















System Interactions

- TBFM (P): TBFM will utilize STARS data to continue metering into the terminal environment similar to the ERAM data exchange in the en route environment
- ERAM (S): Interacts and will provide track data & flight plan data to TBFM
- STARS (S): Standard Terminal Automation Replacement System (STARS) will be used to provide terminal controllers with display of the TBFM schedule and Terminal Sequencing and Spacing (TSAS) tools.

Primary Systems

-  TBFM: Time Based Flow Management

Secondary Systems

-  External Commitment
-  Primary Benefit
-  Secondary Benefit
-  Operationally Available
-  Complete
-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety
-  Charlie
-  Delta
-  Echo
-  Foxtrot



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Time-Based Flow Management

Increments/Enabling Activities

E [104128-25] Expanded Time-Based Metering in the Terminal Environment (2034 - 2037)

Increment Overview

This increment will expand the use of terminal metering to additional airports with high operations counts where terminal metering will enhance PBN use. The capability will foster more optimal flows into the terminal domain by facilitating the use of Performance-Based Navigation (PBN), expanded metering, and the capability to merge multiple streams when metering for closely spaced parallel runway operations. By synchronizing with en route metering, this capability increases predictability and reduces the distance flown by allowing runway assignments and sequencing information to be displayed to terminal controllers. Real-time updates consider factors such as meter points inside terminal airspace, previous arrival runway and sequence assignment, traffic, weather conditions, and runway spacing constraints.

Increment Status

Concept Exploration & Maturation

Success Criteria

To Be Defined

Implementation Approach

TBD

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety

Efficiency (P): Aircraft are time-based metered inside the terminal environment, enhancing efficiency and reducing emissions through the optimal use of terminal airspace.

System Interactions


TBFM (P): TBFM will utilize STARS data to continue metering into the terminal environment similar to the ERAM data exchange in the en route environment.

ERAM (S): Interacts and will provide track data & flight plan data to TBFM.


STARS (S): STARS will be used to provide terminal controllers with display of the TBFM schedule and Terminal Sequencing and Spacing (TSAS) tools.


Time-Based Flow Management

Primary Systems

 TBFM: Time Based Flow Management

Secondary Systems

 ERAM: En Route Automation Modernization

 STARS: Standard Terminal Automation Replacement System

Time-Based Flow Management

OI: [104129] UAM Strategic Traffic De-confliction (2028 - 2035)

Increasing demand for operations by Urban Air Mobility (UAM) vehicles will be met through novel operating methods that will mitigate the need for FAA air traffic services for individual flights. UAM vehicles operating in designated corridors will operate based on established standard cooperative operating practices approved by the FAA. These practices delineate the methods for strategic de-confliction between operators. As part of flight planning, operators will share flight intent data with each other via service providers and the strategically de-conflicted flight plans will establish the flow within the corridor and plan arrival and departure times based on vertiport availability. Traffic management synchronization of these flights is thus automated with data analytics assessing each intended flight against each other and vertiport availability based on agreed upon cooperative operating practices and the FAA operating rules associated with the corridor.

OI Benefit

Access and Equity (P): UAM airspace access will be met through the establishment of designated corridors where vehicles strategically de-conflict their intended flight paths based on established cooperative operating practices. The corridors will eliminate direct ATC interaction allowing access in what otherwise would be demand limited airspace.

Capacity (S): The establishment of new mechanisms for strategic de-confliction in designated corridors provides increased capacity for inclusion of UAM operations.

Increments

Delta
(2026 - 2030)

1

D [104129-01] UAM Cooperative Scheduling of Vertiport Operations (2028 - 2032) (Concept Exploration & Maturation)

Time-Based Flow Management

Increments/Enabling Activities

D [104129-01] UAM Cooperative Scheduling of Vertiport Operations (2028 - 2032)

Increment Overview

UAM operators will be able to plan their arrival and departure times using shared flight intent data and information pertaining to current and future vertiport resource availability for UAM operations (e.g., open/closed, pad availability). Vertiports will exchange resource information with the federated service network. UAM operators will access this information through UAM providers of service enabling them to conduct time based flow management of vertiport operations.

Increment Status





Concept Exploration & Maturation

Success Criteria

To Be Defined

Implementation Approach

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety

Access and Equity (P): UAM airspace access will be met through the establishment of designated corridors where vehicles strategically de-conflict their intended flight paths based on established cooperative operating practices. The corridors will eliminate direct ATC interaction allowing access in what otherwise would be demand limited airspace.

Capacity (S): The establishment of new mechanisms for strategic de-confliction in designated corridors provides increased capacity for inclusion of UAM operations.

System Interactions

To be determined

Time-Based Flow Management

OI: [104130] Improved Arrival/Departure Operations with Integrated Data (2036 - 2040)

This operational improvement integrates advanced Arrival/Departure flow management with advanced surface operation functions to improve overall airport capacity and efficiency. Arrival and departure flows and surface operations are more effectively planned and managed through the integration of current flight plans as well as real-time airborne and surface trajectory information into air traffic management decision support automation tools. These decision support tools enable traffic flow managers to effectively manage high-capacity arrival and departure flows in the presence of various weather conditions. The integration of data improves the balancing between arrival and departure scheduling and management of shared airport resources.

OI Benefit

- Capacity (P): Total airport and terminal throughput is increased through improved demand predictions of arrival and departures and the integration of this information across decision support tools.
- Efficiency (S): Efficiencies are gained through more efficient planning and balancing of arrival and departure operations.
- Predictability (S): Improved planning and management of arrival, departure, and surface flows improves the predictability of meeting schedule times.

Increments

Foxtrot
(2036 - 2040)

2

F [104130-01] Improved Arrival Scheduling with Additional Data (2036 - 2040) (Concept Exploration & Maturation)

F [104130-02] Improved Departure Scheduling with Additional Arrival Data (2036 - 2040) (Concept Exploration & Maturation)

Time-Based Flow Management

Increments/Enabling Activities

F [104130-01] Improved Arrival Scheduling with Additional Data (2036 - 2040)

Increment Overview

Improved aircraft efficiency is achieved by more accurate and timely arrival schedules that better match demand to meet available capacity. More detailed information regarding departure and surface operations (e.g., departure times from nearby airports, airport configurations, runway assignments, taxi-in times, arrival gates) as well as the integration of improved wind data and other weather information (e.g., advanced observational and forecast capabilities including tailored convective weather products) into the arrival scheduling decision support tools will improve the accuracy of the arrival schedule. The integration of additional data improves the balancing between arrival and departure scheduling and management of shared resources (e.g., gates, taxiways, runways). The arrival scheduling automation uses this information to calculate achievable arrival rates and notifies traffic management personnel when a change in arrival parameter settings may be needed.

Increment Status

Concept Exploration & Maturation


Success Criteria

2036 : Operationally Available at designated key site.

Implementation Approach

This is a candidate for a future TBFM Enhancement,

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety

Efficiency (S): Improved time of switching operation and improved runway assignments.

Predictability (P): Integrating departure and surface data into arrival scheduling decision support tools creates a more predictable environment to build the arrival schedule around.

System Interactions

Time-Based Flow Management

- TBFM (P): Develops schedule to the runway and departure schedules. Receives inputs from TFDM and TMC to adjust arrival schedules.
- ERAM (S): Provides aircraft data to support arrival scheduling and accepts departure data
- TFDM (S): Integrates surface and arrival data to support TMC management of airport resources.
- TFMS (S): Sets departure times and generates EDCs/EDCTs as needed to TFDM.
- STARS(S): Provides aircraft data and accepts departure data
- SWIM (T): Provides connectivity between systems and to FAA/Aircraft Operator stakeholders

Primary Systems

- TBFM: Time Based Flow Management

Secondary Systems

- TFDM: Terminal Flight Data Manager
- STARS: Standard Terminal Automation Replacement System
- ERAM: En Route Automation Modernization
- TFMS: Traffic Flow Management System

Tertiary Systems

- SWIM: System Wide Information Management

Time-Based Flow Management

Increments/Enabling Activities

F [104130-02] Improved Departure Scheduling with Additional Arrival Data (2036 - 2040)

Increment Overview

Improved airport efficiency and reduced emissions result when additional data (e.g., predicted arrival demand, estimated arrival times, runway assignments, arrival rates, and impact of arrival delays on estimated departure times) is available to departure and surface scheduling decision support tools. This data integration improves the balancing between departure and arrival scheduling and management of shared resources (e.g., gates, taxiways, runways). Improved departure scheduling will also result from the integration of enhanced weather forecasts including icing and wind forecasts. The departure and surface automation uses this information to calculate achievable departure schedules based on runway occupancy times and other inputs, and notifies the TRACON and/or tower traffic management personnel when a change in departure parameters settings may be needed.

Increment Status

Concept Exploration & Maturation

Success Criteria

2036 : Operationally Available at designated key site.

Implementation Approach

Candidate for future TBFM Enhancement, TFDM Build 2 and FMDS

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety

Efficiency (S): Improved efficiency when timing a airport configuration change, improved departure runway assignments and departure scheduling.

Predictability (P): Integrating arrival data with departure scheduling decision support tools creates a more predictable environment to build the departure schedule around.

System Interactions

Time-Based Flow Management

TFDM (P): Integrates departure, arrival, and airport resource data to provide surface status and runway schedules for use by TMC and other decision support systems.

ERAM (S): Provides aircraft data to support TBFM arrival scheduling and accepts departure data

FMDS (S): Provides flight plan information, intent data, departure and arrival information, and TMI information to TFDM and TBFM.

STARS (S): Provides aircraft data and accepts departure data

TBFM (S): Develops arrival schedule to the runway, develops departure flow schedule, and assigns call for release times for departure metering.

SWIM (T): Provides connectivity between systems and to FAA/Aircraft Operator stakeholders

Primary Systems

TFDM: Terminal Flight Data Manager

Secondary Systems

- FMDS: Flow Management Data & Services
- STARS: Standard Terminal Automation Replacement System
- TBFM: Time Based Flow Management
- ERAM: En Route Automation Modernization

Tertiary Systems

SWIM: System Wide Information Management

Time-Based Flow Management

OI: [104131] Improved Arrival Metering Operations (2031 - 2039)

Arrival metering operations in high density airspace will be improved through additional automation capabilities that enhance the performance of time based metering operations resulting in more efficient aircraft flows. These enhancements will improve the use of time based metering with other Trajectory Based Operations initiatives in order to address any shortfalls uncovered during initial implementation. New capabilities will also provide increased efficiency benefits from optimized profile descents by assisting controllers in meeting time based metering schedule assignments in a more optimal manner.

OI Benefit

Capacity (P): The ability to use time based metering in lieu of other metering techniques (e.g., miles-in-trail) around a constraint or merge point will increase airspace capacity.

Efficiency (P): Enhancements to time based metering tools will enable delays to be absorbed at higher and more fuel efficient altitudes and decrease the need for low altitude delay absorption maneuvers.

Environment (S): Environmental impacts are reduced by transferring delays needed for sequencing and spacing to higher altitude airspace where the impacts are less.

Increments

Echo
(2031 - 2035)

3

- E

[104131-01] Lateral Maneuvering for Delay Absorption (Path Stretch) (2034 - 2039)

(Concept Exploration & Maturation)
- E

[104131-02] Meet TBM Constraints Using Required Time of Arrival (RTA) Capability (2034 - 2039)

(Concept Exploration & Maturation)
- E

[104131-03] Enhanced Time Based Metering Operations (2031 - 2035)

(Planned)

Time-Based Flow Management

Increments/Enabling Activities

E [104131-01] Lateral Maneuvering for Delay Absorption (Path Stretch) (2034 - 2039)

Increment Overview

This capability provides automation that will enable en route controllers to maneuver aircraft laterally to meet metering times while providing the opportunity for aircraft to fly optimized descents to the meter fix (e. g. TRACON boundary). If lateral maneuvering is required to meet the scheduled time of arrival (STA), the lateral route contained in the advisory would consist of information defining the route to be flown, which includes the turn-out (starting) point, a Place-Bearing-Distance (PBD) defined waypoint to fly to, and a return point on the original trajectory to turn back to once the PBD waypoint has been reached. The DST then updates the aircraft's flight plan information to reflect the clearance issued.

Increment Status

Concept Exploration & Maturation



Success Criteria

2034 : Operationally Available at designated key site.

Implementation Approach

Candidate for future TBFM Enhancement.

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety

Efficiency (P): En Route delay reduction from improved meter fix delivery accuracy.

Environment (S): Reduction in fuel consumed from more optimal trajectory from freeze horizon to the meter fix.

System Interactions


ERAM (P): ERAM generates and provides to the controller lateral maneuvers to meet the delay provided by TBFM. The path stretch can be delivered via Data Comm to equipped aircraft.

TBFM (S): TBFM creates and maintains the schedule and determines the delay for the flight to absorb.


Data Comm Avionics (A): Lateral path stretch maneuvers are communicated to the aircraft via Data Comm

Time-Based Flow Management

Primary Systems

 ERAM: En Route Automation Modernization

Secondary Systems

 TBFM: Time Based Flow Management

Avionics Systems

 Data Comm Avionics: Data Communication Avionics

Time-Based Flow Management

Increments/Enabling Activities

E [104131-02] Meet TBM Constraints Using Required Time of Arrival (RTA) Capability (2034 - 2039)

Increment Overview

This increment improves efficiency by allowing Required Time of Arrival (RTA) capabilities of Flight Management Systems (FMSs) to assist the pilot in meeting a trajectory crossing time over an airborne time based management metering point, in support of flow management objectives (meeting an en route or arrival flow management objective). This would be used in high density airspace to provide additional precision in the delivery of aircraft over metering points. Trajectory intent information from the aircraft would be shared with the ground automation to inform the controller of the aircraft's planned trajectory between the current location and the metering point. In the event the aircraft's trajectory must change to meet the meter time, the revised intent data will be sent to the ground automation to inform the controller of the change, and the controller may terminate the procedure if needed to ensure separation or overall flow objectives.

Increment Status

Concept Exploration & Maturation


Success Criteria


2034 : Operationally Available at designated key site.


Implementation Approach


Candidate for TBFM Enhancement 3. This increment is identified to have an International harmonization dependency.


Benefits


 Access & Equity


 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

Efficiency (S): Improved meter fix delivery accuracy, greater use of speed control, improved capacity in transition sectors due to reduced metering workload.

System Interactions

ERAM (P): ERAM will deliver RTA to the aircraft

TBFM (S): TBFM creates and maintains schedule and determines the delay for the flight to absorb

FMS (A): FMS to provide trajectory intent information to ground automation.

Time-Based Flow Management

Primary Systems

● ERAM: En Route Automation Modernization

Secondary Systems

● TBFM: Time Based Flow Management

Avionics Systems

● FMS: Flight Management System

Time-Based Flow Management

Increments/Enabling Activities

E [104131-03] Enhanced Time Based Metering Operations (2031 - 2035)

Increment Overview

Enhancements to time based metering capabilities will further improve the smooth flow of traffic and increase the efficient use of airspace. Time based metering operations will be made more efficient through enhanced capabilities that improve the interaction of time based metering with other traffic management initiatives.

Increment Status

Planned



Success Criteria

To Be Defined

Implementation Approach

This capability will be provided through upgrades and integration of ATM decision support tools in line with the FAA's automation evolution strategy. Specific implementation plans are to be determined.

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety


To be determined.

System Interactions

Initial system dependencies have been identified for this capability. As the capability is further defined, future updates will include the associated system interaction text.

TBFM (P): To be determined

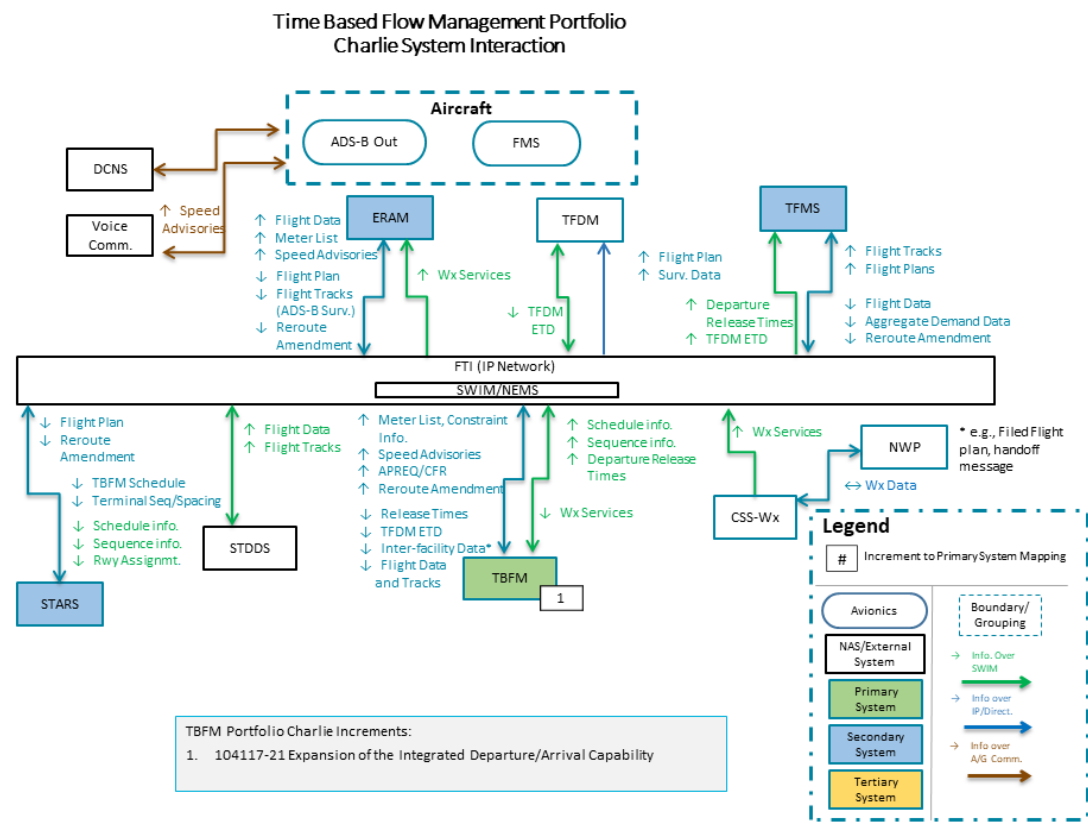
Primary Systems

-  TBFM: Time Based Flow Management

Time-Based Flow Management

Systems Interactions

Though TBFM is the principal system that will host and deliver the increments within this portfolio, a number of other system changes are necessary for their implementation. Additionally, external system improvements will require the migration of certain TMA interfaces from existing services to new NAS Infrastructure services such as Weather and Surveillance.



Time-Based Flow Management

Increment	CIWS	ERAM	STARS	TBFM	TFMS
<div><div></div>[104117-21] Expansion of the Integrated Departure/Arrival Capability</div>	S	S	S	P	S

 Operationally Available

P Primary Systems

 Complete

S Secondary Systems

 In Service System

T Tertiary Systems

 Planned System

A Avionics Systems

Charlie

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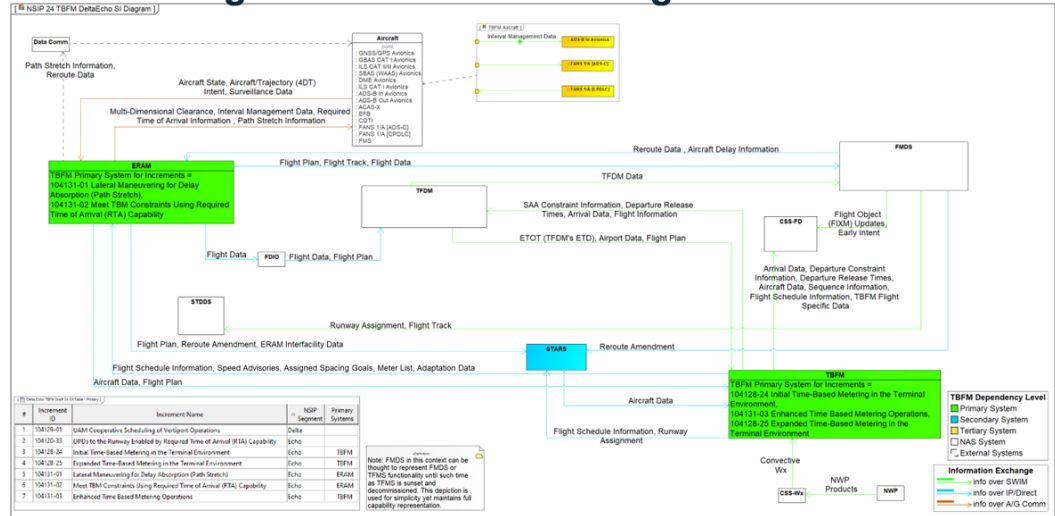


Time-Based Flow Management

Systems Interactions

Though TBFM is the principal system that will host and deliver the increments within this portfolio, a number of other system changes are necessary for their implementation. Additionally, external system improvements will require the migration of certain TMA interfaces from existing services to new NAS Infrastructure services such as Weather and Surveillance.

TBFM SI Diagram – Delta & Echo Segments



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27



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Time-Based Flow Management


Increment

D


[104129-01] UAM Cooperative Scheduling of Vertiport Operations

 Operationally Available


P Primary Systems

 Complete

S Secondary Systems

 In Service System

T Tertiary Systems

 Planned System

A Avionics Systems

D

Delta

Time-Based Flow Management

Stakeholders

All stakeholder organizations involved in the delivery of Segment Alpha capabilities are listed across the top. Portfolio capabilities are listed on the left side of the table, organized by OI and increment. AJM-23 is the accountable office for the increments Extended Metering and Arrival Interval Management Using Ground Automation. AJM-22 is responsible for implementing the necessary changes in TBFM. AJM-21 is responsible for making the necessary changes in ERAM for Arrival Interval Management Using Ground Automation. AJM-21 is responsible for the changes to ERAM to facilitate multiple metering operations. AJE and AJT will provide operational support in the form of procedural guidance, training support, and safety analysis/documentation. AEE will provide support for Extended Metering in the form of subject matter expertise, guidance, and tools. AJM-22 is the accountable and responsible office for modifying TBFM to enable the use of RNAV data to calculate trajectories. AIR and AFS have responsible roles for this increment. AEE will provide support in the form of subject matter expertise, guidance, and tools. AJM-22 is the accountable office for IDAC, and is responsible for making changes to TBFM to host this capability. AJM-22 is also responsible for making the changes to TFMS necessary to interface with TBFM to support IDAC. Finally, AJT will provide the operations support needed to implement IDAC. AEE will provide support in the form of subject matter expertise, guidance, and tools. AJM-22 is the accountable and responsible office for modifying TBFM to implement ACM at additional locations and implement TMA at additional airports, while AJT will provide the operations support needed to implement these two increments. AEE will provide support in the form of subject matter expertise, guidance, and tools. AOV also provides support and AFS is informed on these increments.

- A** Accountable for the completion of NextGen capability. The highest level within the RASCI matrix, this office is charged by the FAA to deliver a particular capability. Typically, this designation is provided via an Acquisition Program Baseline. To foster a clear line of accountability, two different offices can never be Accountable for the same increment, and Accountability can never be delegated to another office.
- R** Responsible for the successful completion of NextGen capability or a critical component of the capability. This office is responsible to the Accountable office. The Responsible office is responsible for initiating an actual change to the NAS such as automation changes, and is often also designated as the Accountable office for that increment. However, there are examples in the NSIP where one office is Accountable for an increment while another office (or offices) is actually making a change in the NAS on behalf of the Accountable office.
- A/R** Accountable for the completion of NextGen capability as well as Responsible for its implementation.
- S** Supports the Responsible office in the implementation of NextGen capability. Typically, this support is in the form of subject matter expertise, procedural guidance, or training activities.
- C** Consulted for input during the implementation of NextGen capability. Provides input on a specific aspect in the development and implementation of a capability, such as safety analysis or approval. Input may or may not be used as determined by the Responsible and Accountable offices.
- I** Informed about the progress of implementation.

Time-Based Flow Management

RASCI Matrix	ANG		AOV	AJR	AJT		AFS	AJM					AJI			AAE	AIR	AJV
	B	C7	001	1	2	0	001	2100	22	23	25	0	1	2	3	001	001	0
• C [104117-21] Expansion of the Integrated Departure/Arrival Capability (2021 - 2025)		C																
• D [104129-01] UAM Cooperative Scheduling of Vertiport Operations (2028 - 2032)																		
• E [104120-33] OPDs to the Runway Enabled by Required Time of Arrival (RTA) Capability (2033 - 2038)	R	A																
• E [104128-24] Initial Time-Based Metering in the Terminal Environment (2031 - 2035)		C		S	S		I	S	A/R				S	S	S	S		S
• E [104128-25] Expanded Time-Based Metering in the Terminal Environment (2034 - 2037)		C						S	A/R									
• E [104131-01] Lateral Maneuvering for Delay Absorption (Path Stretch) (2034 - 2039)		C							A/R									
• E [104131-02] Meet TBM Constraints Using Required Time of Arrival (RTA) Capability (2034 - 2039)		C							A/R									
• E [104131-03] Enhanced Time Based Metering Operations (2031 - 2035)	R	A																
• F [102118-21] Relative Spacing Using Interval Management - Cruise (2036 - 2040)		C			S	S	S		R		S	A/R	S	S	S		S	S

Time-Based Flow Management

RASCI Matrix	ANG		AOV	AJR	AJT		AFS	AJM					AJI			AAE	AIR	AJV
	B	C7	001	1	2	0	001	2100	22	23	25	0	1	2	3	001	001	0
• F [104120-21] Sustain Metering in Variable Operational Conditions (2036 - 2040)	<div>R</div>	<div>A</div>																
• F [104120-32] Rerouting During Metering Operations (2036 - 2040)	<div>R</div>	<div>A</div>																
• F [104130-01] Improved Arrival Scheduling with Additional Data (2036 - 2040)	<div>R</div>	<div>A</div>																
• F [104130-02] Improved Departure Scheduling with Additional Arrival Data (2036 - 2040)	<div>R</div>	<div>A</div>																

Time-Based Flow Management

Appendix A

Alpha Increments

Portfolio Overview

The Time-Based Flow Management (TBFM) portfolio enhances system efficiency by leveraging the capabilities of the TBFM decision-support tool, a system that is already deployed to all CONUS ARTCCs. Improvements in TBFM's core time-based-metering capability, an expansion of TBFM and its departure capabilities to additional locations will enhance efficiency and optimize demand and capacity management. Further, improvements will be made to enable controllers to more accurately deliver aircraft to the Terminal Radar Approach Control facility (TRACON) while providing the opportunity for aircraft to fly optimized descents. These changes will be leveraged to enable aircraft to maintain a spacing interval behind preceding aircraft, further improving capability and flight efficiency. These benefits should reduce fuel burn due to more efficient flight paths.

This portfolio focuses on scheduling and interval management tools that further expand time-based-metering benefits to safely assure the smooth flow of traffic and increase the efficient use of airspace. Point-in-Space Metering, time-based-metering in the Terminal Environment, and Improved Management of Arrival/Surface/Departure Flow extend, enhance, and proliferate metering operations; improve the accuracy of schedules and demand predictions for more efficient and predictable NAS operations; and continue the path toward trajectory-based operations. This portfolio also begins the use of Interval Management-Spacing (IM-S) operations, using a combination of ground- and flight deck-based capabilities.

Anticipated benefits are in the areas of system efficiency and predictability, as follows:
Improved efficiency through optimized descents and optimized aircraft spacing during metering operations
Increased predictability by expanding the use of time-based-metering from departure through the en route environment and ultimately to the airport.

Note: The dates and timelines included in the NAS Segment Implementation Plan (NSIP) are for planning purposes only. All capability schedules are tentative until their supporting programs are officially baselined.

Portfolio Content Summary Statistics

		Increment Status				
Segment	Total by Segment	Planned	Concept Exploration & Maturation	Development	Initial Operational Availability	Completed
*Alpha (2010 - 2015)	6	0	0	0	0	6
TOTAL	6	0	0	0	0	6
Segment	% by Segment	% by Segment/Increment Status				
*Alpha (2010 - 2015)	100%	0 %	0 %	0 %	0 %	100 %
TOTAL	100%	0 %	0 %	0 %	0 %	100 %

Time-Based Flow Management

Operational Improvements/Current Operations & Increments

Benefits

OI: [104117] Improved Departure Scheduling into Overhead Streams (2015 - 2035)

A [104117-11] Integrated Departure/Arrival Capability (2014 - 2019)  



CO: [104123] Time-Based Metering Using RNAV and RNP Route Assignments (2014 - 2014)



A [104123-11] Use Area Navigation (RNAV) Route Data to Calculate Trajectories Used to Conduct TBM Operations (2014 - 2014)  





A [104123-12] Ground-based Interval Management - Spacing (2014 - 2014)  





COE: [104115] Current Tactical Management of Flow in En Route for Arrivals and Departures (N/A)

A [104115-11] Implement TMA's Adjacent Center Metering Capability at Additional Locations (2014 - 2014)  



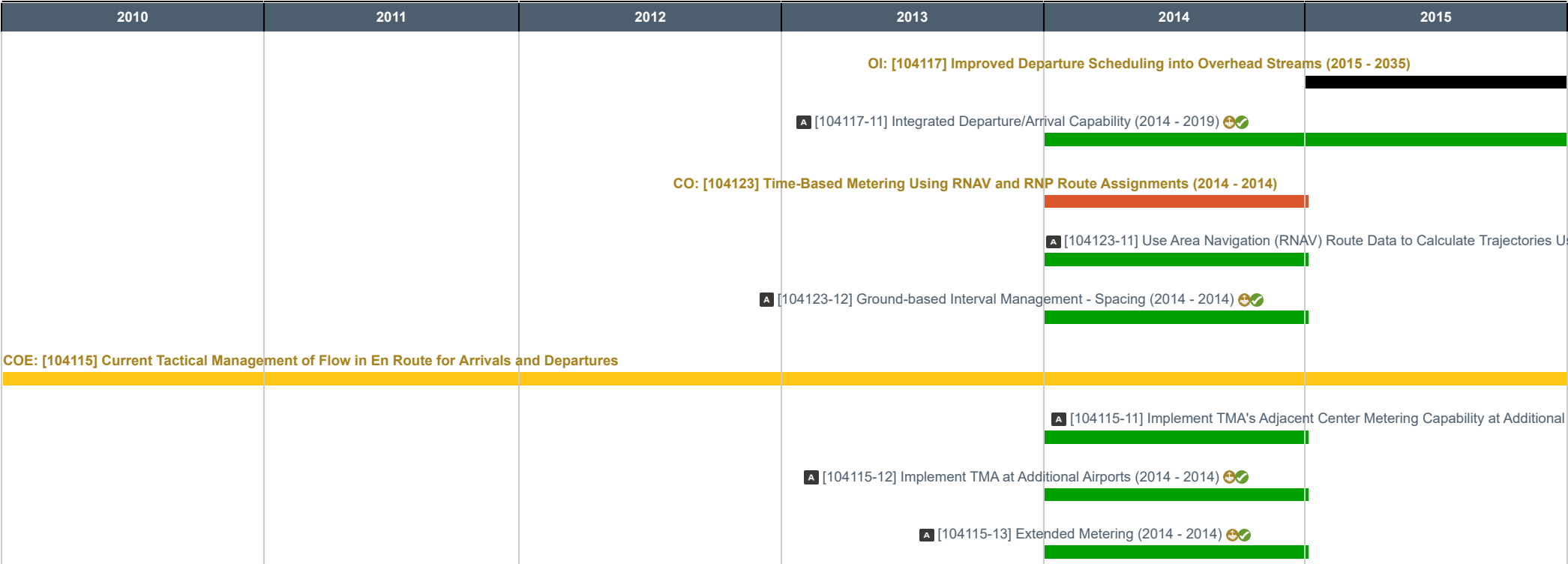
A [104115-12] Implement TMA at Additional Airports (2014 - 2014)  



A [104115-13] Extended Metering (2014 - 2014)  



Time-Based Flow Management



Time-Based Flow Management

OI: [104117] Improved Departure Scheduling into Overhead Streams (2015 - 2035)

This operational improvement provides advanced departure flow management scheduling functions to improve overall airport capacity and efficiency. New departure-scheduling automation tools assist traffic managers with improving the flow of traffic at high-density airports. These tools integrate the scheduling of departures from multiple airports into the overhead stream. Advanced capabilities will enable general and business aviation aircraft departing from smaller airports to be scheduled into congested overhead streams through mobile applications.

OI Benefit

- Capacity (P): Capacity is increased through an increased ability to properly schedule departures into the overhead stream.
- Efficiency (S): Through better time based flow management, aircraft are less likely to encounter low altitude vectoring to absorb delay waiting for a slot in the overhead stream.
- Environment (S): More efficient ascent profiles will reduce environmental impacts.
- Predictability (S): Improved planning and management of departure flows improves the predictability of meeting schedule times.

Increments

Alpha
(2010 - 2015)

1

A [104117-11] Integrated Departure/Arrival Capability (2014 - 2019)  (Complete)

Time-Based Flow Management

Increments/Enabling Activities

A [104117-11] Integrated Departure/Arrival Capability (2014 - 2019)

Increment Overview

IDAC increases NAS efficiency and reduces delays by providing decision support capabilities for departure flows to controllers. It automates the process of monitoring departure demand and identification of departure slots. It also de-conflicts the departure times between airports with traffic departing to common points in space and provides situational awareness to air traffic control tower personnel so they can select from available departure times and plan their operations to meet these times. IDAC will initially be implemented at sites that have the highest operational benefit based on use of call for release procedures and traffic volume.

Increment Status

Complete






Success Criteria

- ✓ 2014 : Operationally available at ZLA ARTCC and LAX airport. Phase I. This has satisfied a NAC/NIWG Commitment.
- ✓ 2018 : Operationally available at ZOA and select Metropolitan New York Airports. This will satisfy a NAC/NIWG commitment.
- ✓ 2019 : Operationally available at ZAB, ZJX, ZME, and ZTL. This will satisfy a NAC/NIWG commitment.

Implementation Approach

The Integrated Departure/Arrival Capability (IDAC) is part of TBFM WP2, and operationally available at ZLA ARTCC and LAX airport in 2014. TBFM Enhancement 1 will expand deployment of IDAC to additional ATCTs and TRACONS, and to five additional ARTCCs.

Benefits

 Access & Equity  Capacity  Flexibility  Efficiency  Environment  Predictability  Safety

Capacity (S): Improving capacity because timely aircraft departures will increase the probability that these aircraft will seamlessly merge into the overhead stream and not miss assigned slots (early or late)

Efficiency (P): Flight efficiency is increased by enabling tower personnel to manage surface operations to meet self-scheduled, de-conflicted departure times, decreasing taxi and/or wait times prior to departure

Environment (S): This surface management improvement will provide environmental benefits while improving capacity because timely aircraft departures will increase the probability that these aircraft will seamlessly merge into the overhead stream and not miss assigned slots

System Interactions

 External Commitment  Primary Benefit  Secondary Benefit  Operational Available  Complete 

 Access & Equity  Capacity  Flexibility  Efficiency  Environment  Predictability  Safety  Alpha

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Time-Based Flow Management

TBFM: (P) Interface changes to TFMS, enabling both systems to share data, ensuring consistent and seamless traffic flow management between the different phases of flight

CIWS: (S) Provides convective weather to TBFM in the Segment Alpha timeframe

ERAM: (S) Interacts and will provide track data & flight plan data to TBFM

STARS: (S) ARTS/STARS - interactions to obtain aircraft track data

TFMS: (S) Will require functional changes to TBFM and interface changes to TFMS, enabling both systems to share data, ensuring consistent and seamless traffic flow management between the different phases of flight

Primary Systems

TBFM: Time Based Flow Management

Secondary Systems

- CIWS: Corridor Integrated Weather System
- ERAM: En Route Automation Modernization
- STARS: Standard Terminal Automation Replacement System
- TFMS: Traffic Flow Management System

Time-Based Flow Management

CO: [104123] Time-Based Metering Using RNAV and RNP Route Assignments (2014 - 2014)

RNAV, RNP, and time-based metering provide efficient use of runways and airspace in high-density airport environments. RNAV and RNP provide users with more efficient and consistent arrival and departure routings and fuel-efficient operations. Metering automation will manage the flow of aircraft to meter fixes, thus permitting efficient use of runways and airspace.

Building on increased capacity in terminal separation procedures, time-based metering will facilitate efficient arrival and departure flows. Use of advanced performance based navigation procedures will facilitate more fuel efficient routing for arrivals and departures. This will be accomplished using RNAV and RNP routings, coupled with meter fix crossing times. Arrivals will be issued a RNAV routing to link arrival procedures to designated runways. Aircraft will navigate from en route to approach and landing phases with minimal adjustments (i.e., speed adjustments) or changes to flight trajectories by Air Navigation Service Provider (ANSP).

CO Benefit

- Capacity (P): During off-nominal conditions when airspace is constrained (e.g., RNAV routes closures), capacity is increased through the ability to conduct metering operations with additional RNAV/RNP route options.
- Efficiency (P): Increased routing options decrease the need for inefficient low altitude maneuvers as delays needed to achieve sequencing and spacing requirements are taken in en route airspace. Additional routing options decrease delays associated with waiting for an available arrival or departure route.
- Environment (S): Environmental impacts are reduced by transferring delays needed for sequencing and spacing to higher altitude airspace where the impacts are less.

Increments

Alpha
(2010 - 2015)

2

A [104123-11] Use Area Navigation (RNAV) Route Data to Calculate Trajectories Used to Conduct TBM Operations (2014 - 2014) ✔ (Complete)

A [104123-12] Ground-based Interval Management - Spacing (2014 - 2014) ✔ (Complete)

Time-Based Flow Management

Increments/Enabling Activities

A [104123-11] Use Area Navigation (RNAV) Route Data to Calculate Trajectories Used to Conduct TBM Operations (2014 - 2014)

Increment Overview

In addition to the en route RNAV routes, which are already used to calculate trajectories, the TRACON RNAV routes for both Standard Instrument Departures (SIDs) and Standard Terminal Arrivals (STARs) will be used to calculate the terminal component of aircraft trajectories.

Increment Status

Complete



Success Criteria

- 2011 : Successful completion of RTCA TF5 7b/8/46-AP1 (Institute TBFM program). This AP is complete.
- 2014 : Operationally available at ZLA ARTCC.

Implementation Approach

Operational capability was made available through TBFM WP2. This increment has achieved its success criteria.

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety

Capacity (S): The improved accuracy will also enhance system-wide capacity of airspace and airport capacity

Efficiency (P): Flight efficiency, and thereby environmental benefits, are achieved through the increased opportunity to conduct an optimized descent during TBM operations in the TRACON environment that this increment enables

Environment (P): The increased opportunity to conduct an optimized descent during TBM operations in the TRACON environment that this increment enables. The improved accuracy will also enhance system-wide capacity of airspace and airport capacity. The automation of RNAV in the TRACON environment will also improve the predictability of aircraft

Predictability (S): The automation of RNAV in the TRACON environment will also improve the predictability of aircraft

System Interactions

ERAM (P): In addition to the en route RNAV routes, which are already used to calculate trajectories, the TRACON RNAV routes for both Standard Instrument Departures (SIDs)

Time-Based Flow Management

Primary Systems

- STARS: Standard Terminal Automation Replacement System
- TBFM: Time Based Flow Management
- ERAM: En Route Automation Modernization

Time-Based Flow Management

Increments/Enabling Activities

A [104123-12] Ground-based Interval Management - Spacing (2014 - 2014)

Increment Overview

This increment introduces automation support to sequence and schedule en route arrival flows at one or more meter points upstream from terminal arrival meter fixes such that the schedules are de-conflicted at all meter points and fixes. GIM-S automation also provides en route controllers with speed advisories to help deliver aircraft to those meter points and meter fixes in accordance with the arrival flow schedule. Together, these GIM-S capabilities facilitate increased opportunities for aircraft to fly optimized profile descents.

Increment Status

Complete

Success Criteria

- ✓ 2014 : Operationally available at ZAB ARTCC and PHX (P50) airport.
- ✓ 2014 : Successful completion of RTCA TF5 7b/8/46-AP1 (Institute TBFM program). This AP is complete.

Implementation Approach

Operational capability was made available through TBFM WP2. GIM-S Adjacent Center Metering (ACM) became operational between ZAB and ZDV in Q4FY15. This increment has achieved its success criteria.

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety

Capacity (S): The improved accuracy improvement with which aircraft are delivered to the TRACON will also enhance system-wide capacity of airspace and airport capacity















Efficiency (P): Flight efficiency, and thereby environmental benefits, are achieved through the increased opportunity to conduct an optimized descent during TBM operations that this increment enables

Environment (P): Environmental benefits, are achieved through the increased opportunity to conduct an optimized descent during TBM operations that this increment enables

System Interactions

ERAM (P): En Route Automation Modernization (ERAM) controller display information are necessary to enable the implementation of this increment

TBFM (P): Changes to TBFM (trajectory modeling, meet-time problem detection/resolution) and En Route Automation Modernization

-  External Commitment
-  Primary Benefit
-  Secondary Benefit
-  Operationally Available
-  Complete
- 
-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety
-  Alpha



Time-Based Flow Management

Primary Systems

- ERAM: En Route Automation Modernization
- TBFM: Time Based Flow Management

Time-Based Flow Management

COE: [104115] Current Tactical Management of Flow in En Route for Arrivals and Departures (N/A)

For departures, the Air Traffic Control Tower (ATCT) Local Controller instructs the pilot, after he takes off from a towered airport, to contact the Terminal Radar Approach Control (TRACON) Departure Controller for further instructions. The departure controller monitors the aircraft and provides air traffic control services using flight plan information, weather, and radar information from a ground-based network of radar, communications, and automation systems. In the New York City area, controllers and traffic managers have automation support to assist with merging aircraft departing the area airports into a single departure stream that leads to the merge point with the en route overhead stream. The automation provides a departure time to the tower controller to ensure that aircraft can be safely merged with other departing traffic.

For arrivals, Air Route Traffic Control Center (ARTCC) controllers establish inbound flows of aircraft over specified arrival fixes before aircraft reach the TRACON boundaries. During heavy volume, ARTCC controllers are responsible for sequencing aircraft to cross specific fixes at specific times or based on miles in trail separation between aircraft. The objective is to set up adequate spacing as the aircraft approach the En Route sector area or near the airport in order to maximize capacity. En Route, and select TRACON and tower traffic managers have an automation decision support tool that enhances traffic flow to airports by providing arrival scheduling tools to synchronize traffic. For major airports, the Traffic Management Coordinator (TMC) creates a plan to deliver the aircraft to the TRACON at a rate that fully subscribes, but does not exceed, the capacity of the TRACON and destination airport. Using Time Based Metering decision support tools, the TMC establishes a plan for the Scheduled Time of Arrival (STA) at the meter fix, which consists of published points that lie on the ARTCC boundary.

The ARTCC air traffic controller issues clearances to aircraft so that they cross the meter fixes at the STA specified in the TMC's plan. Center controllers use the times presented on their radar scope to ensure that the aircraft meets the scheduled time. To achieve required miles-in-trail spacing, or to move each aircraft over the arrival fix to meet a required time of arrival, the estimated time of arrival, or a scheduled time of arrival, the controller may instruct an aircraft to reduce or increase speed; vector an aircraft through a series of turns; or have an aircraft enter a holding pattern. Aircraft descend through the airspace and are transferred from high to low sectors in the ARTCC to arrival controllers in the TRACON and on to local controllers in the tower.

Pilots follow ATC instructions while stepping down through altitudes, being queued into landing order by a team of controllers who make decisions based on any number of local conditions and parameters. When reporting on the frequency of the arrival controller, the pilot calls out the aircraft identification, current altitude, and the altitude to which the aircraft is cleared. The controller verifies the altitude based on a comparison of the pilot's reported altitude and the alphanumeric readout on the controller's display. The aircraft is then sequenced to join the arrival flow with other aircraft that entered the TRACON airspace. The Next Generation Air Transportation System has implemented improved arrival procedures for aircraft which is detailed in the current operational description for Use Optimized Profile Descent (CO number 104124).

COE Benefit

Current operations are provided in the NAS.

 External Commitment

 Primary Benefit

 Secondary Benefit

 Operationally Available

 Complete

 Access & Equity

 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

 Alpha



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Time-Based Flow Management

Increments

Alpha
(2010 - 2015)

3

- A [104115-11] Implement TMA's Adjacent Center Metering Capability at Additional Locations (2014 - 2014) (Complete)
- A [104115-12] Implement TMA at Additional Airports (2014 - 2014) (Complete)
- A [104115-13] Extended Metering (2014 - 2014) (Complete)

Time-Based Flow Management

Increments/Enabling Activities

A [104115-11] Implement TMA's Adjacent Center Metering Capability at Additional Locations (2014 - 2014)

Increment Overview

To expand the benefits of time-based metering and TBFM's other advanced flow management capabilities, ACM will be implemented at the following additional locations:

- LAX — ACM from ZAB and ZLA
- SFO — ACM from ZSE, ZOA, ZLA, and ZLC
- SAN — ACM from ZLA and ZOA
- ATL — ACM from ZDC and ZHU
- IAD — ACM from ZNY.

Increment Status

Complete



Success Criteria

- ✔ 2014 : Operationally available for arriving aircraft at LAX, SFO, SAN, ATL, and IAD.
- ✔ 2014 : Successful completion of RTCA TF5 24-AP1 (positive business case). This AP is complete.

Implementation Approach

Adjacent Center Metering (ACM) was implemented at the following locations: BWI, CLE, DCA, SAN, TEB, HPN LAX, SFO, SAN, ATL, and IAH were completed in 2014. This increment has achieved its success criteria.

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety















Capacity (S): Will improve capacity via its system-wide demand/capacity imbalance decision aids

Efficiency (P): Locations in the NAS will enhance flight efficiency through its delay allocation capabilities

Environment (P): This also results in environmental benefits and flight predictability

Predictability (S): The expansion of TBM and its advanced flow management capabilities, to include TBM, to additional locations in the NAS will enhance flight efficiency through its delay allocation capabilities. It also will improve capacity via its system-wide demand/capacity imbalance decision aids. This also results in environmental benefits and flight predictability

System Interactions

-  External Commitment
-  Primary Benefit
-  Secondary Benefit
-  Operational Availability
-  Complete
- 
-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety
-  Alpha



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Time-Based Flow Management

TBFM (P): TBFM will obtain convective weather data from the CDDS in the Segment Alpha timeframe. TBFM will obtain this weather via CSS-Wx in the Segment Bravo timeframe

TMA (P): Traffic Management Advisor (TMA), is an automation system currently available that enables the use of time-based metering to optimize the flow of aircraft as they approach and depart congested airspace and airports

CIWS (S):Prototype CIWS CDDS will provide convective weather to TBFM in the Segment Alpha timeframe. In the Bravo timeframe TBFM will transition to CSS-Wx to obtain this information

Primary Systems

- TMA: Traffic Management Advisor
- TBFM: Time Based Flow Management

Secondary Systems

- CIWS: Corridor Integrated Weather System

Time-Based Flow Management

Increments/Enabling Activities

A [104115-12] Implement TMA at Additional Airports (2014 - 2014)

Increment Overview

To expand the benefits of TBM and TBFM's other advanced flow management capabilities, TBFM will be implemented at the following additional locations:

- Baltimore, Maryland (BWI)
- Cleveland, Ohio (CLE)
- Washington, DC, Reagan National (DCA)
- San Diego, California (SAN)
- Teterboro, New Jersey (TEB)
- White Plains, New York (HPN)

Increment Status

Complete


Success Criteria

✔ 2014 : Operationally available for arriving aircraft at BWI, CLE, DCA, HPN, SAN, and TEB. This will satisfy RTCA TF5 24-AP3.

Implementation Approach

This capability was part of TBFM Work Package 2 and implemented at the following additional locations: BWI, CLE, DCA, SAN, TEB, HPN. This increment has achieved its success criteria.

Benefits

-  Access & Equity
-  Capacity
-  Flexibility
-  Efficiency
-  Environment
-  Predictability
-  Safety

Capacity (S): It will improve capacity via its system-wide demand/capacity imbalance decision aids

Efficiency (P): Likewise, the expansion of TMA and its advanced flow management capabilities, to include TBM, to additional airports in the NAS will enhance flight efficiency through its delay allocation capabilities

Environment (P): This also results in environmental benefits and flight predictability as described above

Predictability (S): This also results in environmental benefits and flight predictability as described above

System Interactions

 External Commitment

 Primary Benefit

 Secondary Benefit

 Operationally Available

 Complete



 Access & Equity

 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

 Alpha



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Time-Based Flow Management

TBFM (P): In the Bravo timeframe TBFM will transition to CSS-Wx to obtain this information.

TMA (P): Traffic Management Advisor (TMA), is an automation system currently available that enables the use of time-based metering to optimize the flow of aircraft as they approach and depart congested airspace and airports

CIWS (S):Prototype CIWS CDDS will provide convective weather to TBFM in the Segment Alpha timeframe. In the Bravo timeframe TBFM will transition to CSS-Wx to obtain this information.

ERAM (S): Interacts and will provide track data & flight plan data to TBFM

Primary Systems

TMA: Traffic Management Advisor

TBFM: Time Based Flow Management

Secondary Systems

CIWS: Corridor Integrated Weather System

ERAM: En Route Automation Modernization

Time-Based Flow Management

Increments/Enabling Activities

A [104115-13] Extended Metering (2014 - 2014)

Increment Overview

This increment will increase the distance from the airport where metering will be conducted without significant degradation in the accuracy of aircraft-specific slot times to the meter reference points. This will provide flow decongestion for metered aircraft at the meter reference points (in addition to meter fixes). The specific distances and locations where extended metering operations will be implemented will be based on operational need and expected benefits. Extended metering enables the metering to begin meeting further from the airport so that aircraft can be managed with minor speed adjustments for maintaining efficient flows to sustain capacity.

Increment Status

Complete








Success Criteria

- ✓ 2014 : Successful development of an improved Traffic Management Coordinator (TMC) training program. This will satisfy RTCA TF5 24-AP2 and AP4.
- ✓ 2014 : Operationally available at ZAB ARTCC and PHX airport.

Implementation Approach

This capability was part of TBFM Work Package 2. The Extended Metering capability operationally available, and the Traffic Management Coordinator (TMC) Training Program completed at ZAB ARTCC in 2014. This increment has achieved its success criteria.

Benefits

 Access & Equity  Capacity  Flexibility  Efficiency  Environment  Predictability  Safety

Capacity (S): Optimizes system demand and capacity by expanding the proven benefits of TBM to additional geographical areas

Efficiency (P): Is enhanced by applying the necessary arrival delay for each aircraft at a higher altitude than applied today

Environment (P): Accrues environmental benefits but optimizes system demand and capacity by expanding the proven benefits of TBM to additional geographical areas, while enhancing the predictability of aircraft movement both for the Air Navigation Service Provider (ANSP) and the user community

Predictability (S): Contains movement both for the Air Navigation Service Provider (ANSP) and the user community

System Interactions

 External Commitment  Primary Benefit  Secondary Benefit  Operationally Available  Complete 

 Access & Equity  Capacity  Flexibility  Efficiency  Environment  Predictability  Safety  Alpha

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Time-Based Flow Management

TBFM (P): TBFM will require functional, interface and adaptation changes. In addition, although not required for the implementation of Extended Metering, improvements to the display and management of metering data for en route controllers will be implemented via ERAM to optimize the use of TBM.

CIWS (S): Prototype CIWS CDDS will provide convective weather to TBFM in the Segment Alpha timeframe

ERAM (S): Interacts and will provide track data & flight plan data to TBFM

TFMS (S): Will require functional changes to TBFM and interface changes to TFMS, enabling both systems to share data, ensuring consistent and seamless traffic flow management between the different phases of flight

Primary Systems

TBFM: Time Based Flow Management

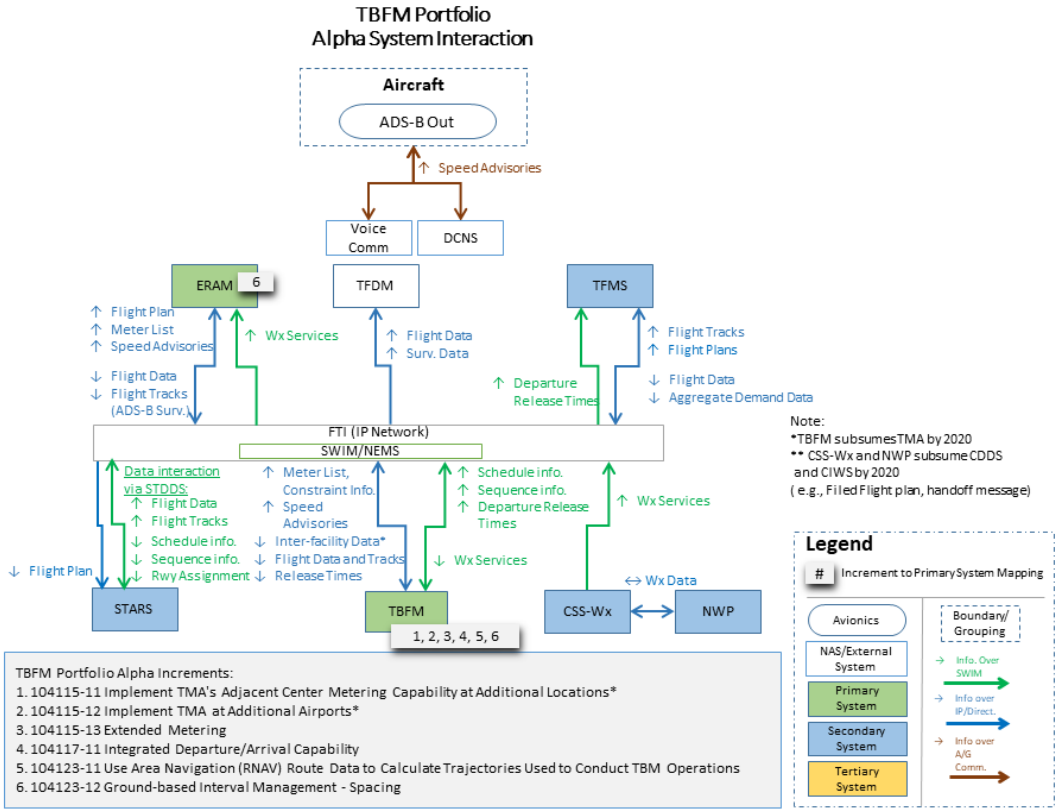
Secondary Systems

- TFMS: Traffic Flow Management System
- ERAM: En Route Automation Modernization
- CIWS: Corridor Integrated Weather System

Time-Based Flow Management

Systems Interactions

Though TBFM is the principal system that will host and deliver the increments within this portfolio, a number of other system changes are necessary for their implementation. Additionally, external system improvements will require the migration of certain TMA interfaces from existing services to new NAS Infrastructure services such as Weather and Surveillance.



Time-Based Flow Management

Increment	CIWS	ERAM	STARS	TBFM	TFMS	TMA
<div><div>A</div><div>[104115-11] Implement TMA's Adjacent Center Metering Capability at Additional Locations </div></div>	S			P		
<div><div>A</div><div>[104115-12] Implement TMA at Additional Airports </div></div>	S	S		P		
<div><div>A</div><div>[104115-13] Extended Metering </div></div>	S	S		P	S	
<div><div>A</div><div>[104117-11] Integrated Departure/Arrival Capability </div></div>	S	S	S	P	S	
<div><div>A</div><div>[104123-11] Use Area Navigation (RNAV) Route Data to Calculate Trajectories Used to Conduct TBM Operations </div></div>		P	P	P		
<div><div>A</div><div>[104123-12] Ground-based Interval Management - Spacing </div></div>		P		P		

Operationally Available

Complete

In Service System

Planned System

P Primary Systems

S Secondary Systems

T Tertiary Systems

A Avionics Systems

A Alpha



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Time-Based Flow Management

Stakeholders

All stakeholder organizations involved in the delivery of Segment Alpha capabilities are listed across the top. Portfolio capabilities are listed on the left side of the table, organized by OI and increment. AJM-23 is the accountable office for the increments Extended Metering and Arrival Interval Management Using Ground Automation. AJM-22 is responsible for implementing the necessary changes in TBFM. AJM-21 is responsible for making the necessary changes in ERAM for Arrival Interval Management Using Ground Automation. AJM-21 is responsible for the changes to ERAM to facilitate multiple metering operations. AJE and AJT will provide operational support in the form of procedural guidance, training support, and safety analysis/documentation. AEE will provide support for Extended Metering in the form of subject matter expertise, guidance, and tools. AJM-22 is the accountable and responsible office for modifying TBFM to enable the use of RNAV data to calculate trajectories. AIR and AFS have responsible roles for this increment. AEE will provide support in the form of subject matter expertise, guidance, and tools. AJM-22 is the accountable office for IDAC, and is responsible for making changes to TBFM to host this capability. AJM-22 is also responsible for making the changes to TFMS necessary to interface with TBFM to support IDAC. Finally, AJT will provide the operations support needed to implement IDAC. AEE will provide support in the form of subject matter expertise, guidance, and tools. AJM-22 is the accountable and responsible office for modifying TBFM to implement ACM at additional locations and implement TMA at additional airports, while AJT will provide the operations support needed to implement these two increments. AEE will provide support in the form of subject matter expertise, guidance, and tools. AOV also provides support and AFS is informed on these increments.

- A** Accountable for the completion of NextGen capability. The highest level within the RASCI matrix, this office is charged by the FAA to deliver a particular capability. Typically, this designation is provided via an Acquisition Program Baseline. To foster a clear line of accountability, two different offices can never be Accountable for the same increment, and Accountability can never be delegated to another office.
- R** Responsible for the successful completion of NextGen capability or a critical component of the capability. This office is responsible to the Accountable office. The Responsible office is responsible for initiating an actual change to the NAS such as automation changes, and is often also designated as the Accountable office for that increment. However, there are examples in the NSIP where one office is Accountable for an increment while another office (or offices) is actually making a change in the NAS on behalf of the Accountable office.
- A/R** Accountable for the completion of NextGen capability as well as Responsible for its implementation.
- S** Supports the Responsible office in the implementation of NextGen capability. Typically, this support is in the form of subject matter expertise, procedural guidance, or training activities.
- C** Consulted for input during the implementation of NextGen capability. Provides input on a specific aspect in the development and implementation of a capability, such as safety analysis or approval. Input may or may not be used as determined by the Responsible and Accountable offices.
- I** Informed about the progress of implementation.

 Operationally Available

 Complete

 External Commitment

A Alpha



Time-Based Flow Management

RASCI Matrix	ANG		AOV	AJR	AJT		AFS	AJM					AJI			AAE	AIR	AJV
	B	C7	001	1	2	0	001	2100	22	23	25	0	1	2	3	001	001	0
• A [104115-11] Implement TMA's Adjacent Center Metering Capability at Additional Locations (2014 - 2014)		C	S	S	S		I		A/R				S	S	S	S		
• A [104115-12] Implement TMA at Additional Airports (2014 - 2014)		C	S	S	S		I		A/R				S	S	S	S		
• A [104115-13] Extended Metering (2014 - 2014)		C		S	S				R	A			S	S	S	S		
• A [104117-11] Integrated Departure/Arrival Capability (2014 - 2019)		C		S	S				A/R				S	S	S	S		
• A [104123-11] Use Area Navigation (RNAV) Route Data to Calculate Trajectories Used to Conduct TBM Operations (2014 - 2014)		C					R		A/R				S	S	S	S	R	
• A [104123-12] Ground-based Interval Management - Spacing (2014 - 2014)		C		S	S				R	A			S	S	S			