

Improved Approaches and Low-Visibility Operations

Active Increments

Portfolio Overview

The Improved Approaches and Low-Visibility Operations portfolio outlines ways to increase access and flexibility for approach operations. This will be accomplished through a combination of procedural changes, improved aircraft capabilities, and improved precision approach guidance. The procedural changes allow for more efficient profiles. The improved aircraft capabilities include vertical navigation. Ground-Based Augmentation Systems (GBAS) will provide improved approach guidance to flight crews and will enhance satellite navigation capabilities

In the Bravo and Charlie timeframes, this portfolio focuses on safely providing additional low-visibility approaches (i.e., during Category I and lower weather conditions) in NAS operations through the use of advanced navigation, imaging sensors, and computational technologies.

The anticipated benefits of the LowVis portfolio are in the areas of improved access to and capacity at airports during certain weather conditions.

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.

Improved Approaches and Low-Visibility Operations

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)	5	0	0	0	0	5
Charlie (2021 - 2025)	0	0	0	0	0	0
Delta (2026 - 2030)	0	0	0	0	0	0
Echo (2031 - 2035)	1	0	1	0	0	0
Foxtrot (2036 - 2040)	0	0	0	0	0	0
TOTAL	12	0	1	0	0	11
Segment	% by Segment	% by Segment/Increment Status				
*Alpha (2010 - 2015)	50 %	0 %	0 %	0 %	0 %	100 %
*Bravo (2016 - 2020)	42 %	0 %	0 %	0 %	0 %	100 %
Charlie (2021 - 2025)	0 %	0 %	0 %	0 %	0 %	0 %
Delta (2026 - 2030)	0 %	0 %	0 %	0 %	0 %	0 %
Echo (2031 - 2035)	8 %	0 %	100 %	0 %	0 %	0 %
Foxtrot (2036 - 2040)	0 %	0 %	0 %	0 %	0 %	0 %
TOTAL	100%	0 %	8 %	0 %	0 %	92 %

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

Improved Approaches and Low-Visibility Operations

Operational Improvements/Current Operations & Increments

Benefits

OI: [107107] Ground Based Augmentation System (GBAS) Precision Approaches (2012 - 2037)

E [107107-21] GBAS Category II/III Standards and Non-Federal Approval (2033 - 2037)



External Commitment

Primary Benefit

Secondary Benefit

Operationally Available

Complete

Access & Equity

Capacity

Flexibility

Efficiency

Environment

Predictability

Safety

Charlie

Delta

Echo

Foxtrot



Improved Approaches and Low-Visibility Operations

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
OI: [107107] Ground Based Augmentation System (GBAS) Precision Approaches (2012 - 2037)																			
							E [107107-21] GBAS Category II/III Standards and Non-Federal Approval (2033 - 2037)												

Improved Approaches and Low-Visibility Operations

OI: [107107] Ground Based Augmentation System (GBAS) Precision Approaches (2012 - 2037)

Global Positioning System (GPS)/GBAS support precision approaches to Category I and eventually Category II/III minimums, for properly equipped runways and aircraft. GBAS can support approach minimums at airports with fewer restrictions to surface movement, and offers the potential for curved precision approaches. GBAS may also support high-integrity surface movement requirements.

GBAS would provide Category I and Category II/III precision approach and landing services and position information for surface operations. GBAS Category I systems may be installed at airports requiring a stand-alone augmented GPS navigation and landing capability, or at airports where Satellite-Based Augmentation System (SBAS) coverage is unable to meet existing navigation and landing requirements due to insufficient satellite coverage or availability (e.g., some locations in Alaska). GBAS Category II/III systems may be installed at higher usage airports that require more capable navigation and landing services.

A single GBAS system provides precision-approach capabilities to multiple runways or landing areas. GBAS provides precision-approach service that is robust to atmospheric phenomena that might cause loss of SBAS vertical guidance.

OI Benefit

Access and Equity (P): Provides precision approach capabilities to airports without alternate working precision instrument landing systems which increases airport access in low visibility conditions.

Capacity (P): Increases precision approach capability for equipped aircraft/airports thereby increasing airport capacity in low visibility conditions.

Efficiency (S): Aircraft operators will benefit from reduced fuel expenses due to more direct terminal area routing and improved access to airports during extremely low visibility operations. GBAS in combination with RNAV and RNP procedures will allow for predictable flight paths in the terminal area which could potentially reduce pilot controller communications workload and the variability in the time and distance flown in the terminal area and lead to more flexible routing.

Environment (S): GBAS capability for displaced threshold and variable glide path provides flexibility for airlines for improved noise abatement procedures. GBAS can provide optimized precision approaches (RNP to GLS) which are fuel efficient, with low noise and emissions to support access through high density airspace to the runway.

Safety (S): Provides the aircraft with more accurate vertical and lateral position accuracy on GPS instrument approaches, thus enabling more repeatable descent along the glideslope centerline where an ILS is not available.

Predictability (S): Provides alternate means to conduct precision approaches for all runways at an airport.

Improved Approaches and Low-Visibility Operations

Increments

Echo
(2031 - 2035)

1

E [107107-21] GBAS Category II/III Standards and Non-Federal Approval (2033 - 2037) (Concept Exploration & Maturation)



Improved Approaches and Low-Visibility Operations

Increments/Enabling Activities

E [107107-21] GBAS Category II/III Standards and Non-Federal Approval (2033 - 2037)

Increment Overview

Similar to Ground Based Augmentation System (GBAS) Category I, GBAS Category II/III provides improved low-visibility access and increases operational efficiency and single- and multiple-runway capacity through the use of GBAS ground stations. GBAS is intended to provide precision approach services to Category II/III minima without the need for critical area protection, and offer the potential for increased flexibility in approach design and highly accurate approach guidance to the runway. Published procedures and Category II/III standards for ground and avionics equipment are based on the International Civil Aviation Organization Standards and Recommended Practices and RTCA requirements documentation for GBAS systems.

Increment Status

Concept Exploration & Maturation

Success Criteria

- ✓ 2015 : ICAO GAST-D SARPS validation report complete.
- ✓ 2018 : Publish ICAO GBAS GAST-D (CAT II/III) Standards and Recommended Practices (SARPS)
- 2026 : Complete GBAS GAST-D (CAT II/III) System Design Approval (Dependent on vendor development)

Implementation Approach

GAST-D (Category III) Non-Federal System Design Approval (SDA): No federal GBAS acquisition is currently planned; development of a GAST-D GBAS will be dependent on vendor development and approval as a non-Federal system. Initial GAST-D Standards and Recommended Practices (SARPS) Validation: GBAS standards for GAST-D, a service type equivalent to ILS Category III, were baselined within an ICAO Navigation Systems Panel proposed amendment to Annex 10 SARPS. ICAO acceptance occurred in December 2016. This increment is identified to have an International harmonization dependency.

Benefits

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

Improved Approaches and Low-Visibility Operations

- Access and Equity (S): GBAS equipped aircraft can increase overall airport access by offloading GLS capable aircraft to a runway where the ILS is not functional, thereby allowing ILS aircraft to use any remaining operational ILS runways and thus reducing the number of approaches on remaining operational ILS runways.
- Capacity (P): GBAS does not have the critical areas associated with ILS. This reduces arrival and taxi delays. GBAS can facilitate takeoff operations in low visibility, conditions, which reduces departure delays for properly equipped aircraft. As an alternate/additional GNSS precision landing system GBAS will reduce the number of flight disruptions in a terminal area, leading to fewer inclement weather delays. GBAS can be installed at airports that currently do not have precision approaches due to ILS siting constraints, improving capacity at that specific airport. GBAS capability for displaced threshold and variable glide path procedures provides flexibility for airlines and potential for improved closely parallel operations and wake turbulence avoidance.
- Efficiency (S): Aircraft operators will benefit from reduced fuel expenses due to more direct terminal area routing and improved access to airports during extremely low visibility operations.
- Environment (S): GBAS capability for displaced threshold and variable glide path provides flexibility for improved noise abatement procedures. GBAS can provide optimized precision approaches (RNP to GLS) which are fuel efficient, with low noise and emissions to support access through high density airspace to the runway.
- Predictability (S): GBAS in combination with RNAV and RNP procedures will allow for predictable flight paths in the terminal area which could potentially reduce pilot controller communications workload and the variability in the time and distance flown in the terminal area.
- Safety (S): GBAS can be installed at airports for use on runways that currently do not have precision approaches due to ILS siting constraints, improving safety at those airports. GBAS will reduce the number of flight disruptions in a terminal area as an alternate/additional GNSS precision landing system.

System Interactions

- GBAS (P): GBAS includes both ground and airborne components. GBAS differential corrections, integrity data, and approach path definitions are provided to the aircraft via Omnidirectional VHF data Broadcast (VDB) signal, and are received by the airborne component.
- GPS (T): GBAS augments the existing Global Positioning System (GPS) signals by providing corrections to aircraft in the vicinity of an equipped airport in order to improve the accuracy of, and provide integrity for, these aircraft's GPS navigation positions.
- GBAS CAT II/III Avionics (A): Receives GBAS information broadcast and displays final approach path deviations to the pilot

 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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Improved Approaches and Low-Visibility Operations

Primary Systems

 GBAS: Ground Based Augmentation System

Tertiary Systems

 GPS: Global Positioning System

Avionics Systems

 GBAS CAT II/III Avionics: Ground Based Augmentation System Category II/III Avionics

Improved Approaches and Low-Visibility Operations

Stakeholders

Specific roles and responsibilities for the implementation of all capabilities in this portfolio are outlined in the RASCI (Responsible, Accountable, Supporting, Consulted, Informed) matrix below. All stakeholder organizations involved in the delivery of capabilities are listed across the top. Portfolio capabilities are listed on the left side of the table, organized by OI and increment. For the GBAS increment, AJW-121 is accountable and responsible for system design approval of non-fed acquired GBAS. AJM-32 is responsible by the Non-Fed Order (6700.20B) for maintaining the existing non-federal specification and siting order. ANG-C32 continues to provide support to AJW-121 for GBAS under a program agreement. AFS-400 has responsibility regarding flight procedures and design criteria and AIR-6 for avionics standards and installation policy. For the Low-Visibility increments of EFVS, SVGS, or other vision systems, AFS-400 is accountable and responsible for the implementation of these new operations with AIR-130 being responsible for avionics standards and installation policy. Also notable is the role of AJM-32 regarding consultation on LED lighting. AFS-200, AFS-800, ARP, AGC, APO, and ARM also have a supporting role for rulemaking. For Expanded Low-Visibility Operations Using Lower RVR Minima, AJM-32 is accountable and responsible for RVR implementation, with support from AJT-2 regarding terminal infrastructure integration. AFS-400 has responsibility for standards and operations specifications and AIR-130 is responsible for avionics standards and installation policy. The appropriate lead offices will coordinate with external stakeholders.

- 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.



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RASCI Matrix		AJM			ANG			APO	ARM	AJT		AJI			AJV	AFS				AOV		AIR		AAE	AGC	ARP	AJF	AJW
		32	321	23	C	C7	C32	001	001	2	32	1	2	3	A	001	400	410	420	140	250	620	001	001	001	001	170	121
● E [107107-21] GBAS Category II/III Standards and Non-Federal Approval (2033 - 2037)			C			C	S				S	I	S	S	S			S	S	S	S	S					S	A/R

Improved Approaches and Low-Visibility Operations

Appendix A

Alpha Increments

Portfolio Overview

The Improved Approaches and Low-Visibility Operations portfolio outlines ways to increase access and flexibility for approach operations. This will be accomplished through a combination of procedural changes, improved aircraft capabilities, and improved precision approach guidance. The procedural changes allow for more efficient profiles. The improved aircraft capabilities include vertical navigation. Ground-Based Augmentation Systems (GBAS) will provide improved approach guidance to flight crews and will enhance satellite navigation capabilities.

In the Bravo and Charlie timeframes, this portfolio focuses on safely providing additional low-visibility approaches (i.e., during Category I and lower weather conditions) in NAS operations through the use of advanced navigation, imaging sensors, and computational technologies.

The anticipated benefits of the LowVis portfolio are in the areas of improved access to and capacity at airports during certain weather conditions.

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.

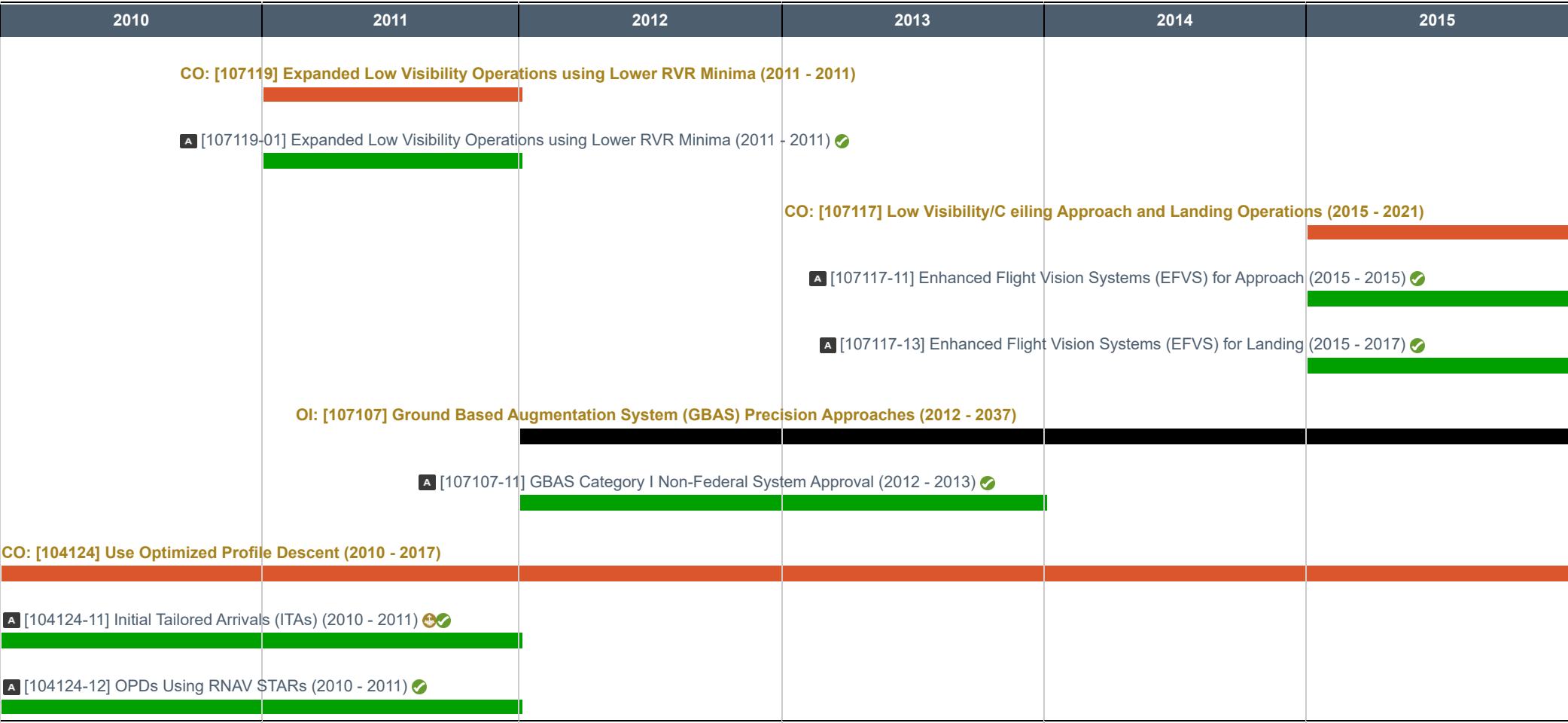
Portfolio Content Summary Statistics

		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 %

Improved Approaches and Low-Visibility Operations

Operational Improvements/Current Operations & Increments	Benefits
CO: [107119] Expanded Low Visibility Operations using Lower RVR Minima (2011 - 2011)	
A [107119-01] Expanded Low Visibility Operations using Lower RVR Minima (2011 - 2011)	
CO: [107117] Low Visibility/Ceiling Approach and Landing Operations (2015 - 2021)	
A [107117-11] Enhanced Flight Vision Systems (EFVS) for Approach (2015 - 2015)	
A [107117-13] Enhanced Flight Vision Systems (EFVS) for Landing (2015 - 2017)	
OI: [107107] Ground Based Augmentation System (GBAS) Precision Approaches (2012 - 2037)	
A [107107-11] GBAS Category I Non-Federal System Approval (2012 - 2013)	
CO: [104124] Use Optimized Profile Descent (2010 - 2017)	
A [104124-11] Initial Tailored Arrivals (ITAs) (2010 - 2011)	
A [104124-12] OPDs Using RNAV STARs (2010 - 2011)	

Improved Approaches and Low-Visibility Operations



Improved Approaches and Low-Visibility Operations

CO: [107119] Expanded Low Visibility Operations using Lower RVR Minima (2011 - 2011)

Lowering runway visual range (RVR) minima from 2400 ft. to 1800 ft. (or lower depending on the airport and requirement) at selected airports using RVR systems, aircraft capabilities and procedural changes provides greater access to OEP, satellite and feeder airports during low visibility conditions. Utilization of these improvements will increase NAS capacity and traffic flow during periods of Instrument Meteorological Conditions (IMC) and allowing a greater number of aircraft completing scheduled flights under marginal weather conditions. Without these improvements, flight are either diverted or delayed, both with rippling impact throughout the NAS and a high cost associated with them.

This improvement allows increased runway capacity during periods of low visibility by providing increased arrivals/departures at high density airports. It also allows the airlines to maintain planned scheduled flights in marginal weather conditions to decrease flight delays, cancellations, and/or very costly diversions. Capacity in NAS is also increased through use of a greater number airports, extending the base capacity beyond the OEP core. Flight Standards is instituting reduced takeoff and landing minima across the NAS based on RVR and in certain cases, installation of additional RVR are required.

This Next Generation Air Transportation System (NextGen) program realizes near-term benefits that enable other mid-term and far-term Operational Improvements. It also addresses improvements to low visibility operations throughout the NAS. This improvement achieves Area Navigation (RNAV) benefits as stipulated in the NextGen Implementation Plan and the Roadmap for Performance-Based Navigation.

CO Benefit

Access and Equity (P): Provides for increased use of airport during lower RVR levels which increases airport access and throughput in lower visibility conditions.

Capacity (P): By lowering the RVR minima, airport will be able to conduct additional operations in low visibility conditions, thereby increasing airport capacity.

Predictability (S): Lower RVR minima will increase the percentage availability of the airport and increase predictability.

Increments

Alpha
(2010 - 2015)
1

A [107119-01] Expanded Low Visibility Operations using Lower RVR Minima (2011 - 2011) (Complete)

Improved Approaches and Low-Visibility Operations

Access (P): Provides for increased use of airport during lower RVR levels which increases airport access and throughput in lower visibility conditions.
Capacity (S): By lowering the RVR minima, airport will be able to conduct additional operations in low visibility conditions, thereby increasing airport capacity.
Predictability (S): Lower RVR minima will increase the percentage availability of the airport and increase predictability.

System Interactions

EFVS to be used in lieu of natural vision to descend below DA/DH or MDA down to 100 feet above the runway touchdown zone on an instrument approach procedure. In order to descend below 100 feet, however, the visual references (e.g., lighting system) must be identified using natural vision. Approach Lighting Systems (ALS) provide the basic means to transition from instrument flight to visual flight for landing.

Primary Systems

- ILS: Instrument Landing System
- RVR: Runway Visual Range
- ALS: Approach Lighting System

Improved Approaches and Low-Visibility Operations

CO: [107117] Low Visibility/Ceiling Approach and Landing Operations (2015 - 2021)

The ability to complete approaches and landings in low visibility/ceiling conditions is improved for aircraft equipped with some combination of navigation derived from augmented GNSS or ILS and other cockpit-based technologies or combinations of cockpit-based technologies and ground infrastructure.

The ability to complete approaches in low visibility/ceiling conditions is improved for aircraft equipped with some combination of navigation derived from augmented GNSS or ILS and Head-up Display (HUD), Enhanced Flight Vision System (EFVS), Synthetic Vision Guidance System (SVGS), advanced vision system and other cockpit-based technologies that combine to improve human performance. Cockpit-based technologies allow instrument approach procedure access with reduced requirements on ground-based navigation and airport infrastructure. Due to onboard avionics airport access is maintained in low visibility/ceiling conditions.

CO Benefit

Access and Equity (P): Enables aircraft systems to assist with the safe continuation of approach and landing operations when visibility is below minimums on certain instrument approach procedures in order to access airports that would otherwise not be able to be accessed due to low visibility.

Capacity (S): Increases airport capacity and access during low visibility conditions through continuation of operations.

Efficiency (S): Increases access, efficiency, and throughput at airports when low visibility is a factor.

Increments

Alpha
(2010 - 2015)

2

A [107117-11] Enhanced Flight Vision Systems (EFVS) for Approach (2015 - 2015) (Complete)

A [107117-13] Enhanced Flight Vision Systems (EFVS) for Landing (2015 - 2017) (Complete)

Improved Approaches and Low-Visibility Operations

Increments/Enabling Activities

A [107117-11] Enhanced Flight Vision Systems (EFVS) for Approach (2015 - 2015)

Increment Overview

The ability to conduct an approach and land in low-visibility conditions depends largely on the type of approach and aircraft capability. Infrared (IR) sensor technology currently is used in EFVS to provide a pilot with an enhanced visual image and allow him/her to see, in certain low-visibility conditions, the visual references necessary to continue descending below Decision Altitude/Decision Height (DA/DH) or Minimum Descent Altitude (MDA) on an instrument approach procedure. Under 14 CFR Part 91.175, the FAA already allows EFVS to be used in lieu of natural vision to descend below DA/DH or MDA down to 100 feet above the runway touchdown zone on an instrument approach procedure, provided the enhanced flight visibility is not less than the visibility prescribed by the instrument approach procedure. In order to descend below 100 feet, however, the visual references must be identified using natural vision.

The FAA is currently engaged in rulemaking actions that would expand EFVS approach operations to the Part 121 and Part 135 operators.

Increment Status

Complete

Success Criteria

✔ 2016 : Suitably equipped and authorized EFVS operators will be able to dispatch, release a flight, or takeoff under IFR, and initiate and continue an approach, when the weather at the destination airport is below authorized visibility minimums for the runway of intended landing.

Implementation Approach

The FAA is currently engaged in rule-making to expand the operational benefits available to operators who conduct EFVS operations to 100 feet above the touchdown zone elevation. This rule-making would permit operators who conduct authorized EFVS operations under Parts 121, 125, or 135 to use EFVS-equipped aircraft to dispatch, release a flight, or takeoff under IFR, and to initiate and continue an approach, when the weather at the destination airport is below authorized visibility minimums for the runway of intended landing. This increment is identified to have an International harmonization dependency.

Benefits

Access & Equity

Capacity

Flexibility

Efficiency

Environment

Predictability

Safety

Access and Equity (P): EFVS provides a pilot with an enhanced visual image which allows him/her to see the visual references necessary to continue descending below minimums on certain instrument approach procedures.

Capacity (S): The use of EFVS maximizes the benefits of rapidly evolving instrument approach procedures and advanced flight deck

External Commitment

Primary Benefit

Secondary Benefit

Operationally Available

Complete

Access & Equity

Capacity

Flexibility

Efficiency

Environment

Predictability

Safety

Alpha

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System Interactions

Tertiary: ILS CAT I

EFVS (A), ILS CAT I (A)

When EFVS is used in lieu of natural vision to descend below DA/DH or MDA down to 100 feet above the touchdown zone elevation on an instrument approach procedure, a pilot must be able to identify certain required visual references using the EFVS.

Tertiary Systems

- ILS: Instrument Landing System

Avionics Systems

- ILS CAT I Avionics: Instrument Landing System Category I Approach Avionics
- EFVS: Enhanced Flight Vision System

Improved Approaches and Low-Visibility Operations

Increments/Enabling Activities

A [107117-13] Enhanced Flight Vision Systems (EFVS) for Landing (2015 - 2017)

Increment Overview

EFVS will allow improved access, with a greater assurance of landing without needing to execute a missed approach. Under specific visibility conditions, authorized users could utilize the enhanced visual image to touchdown, which will further increase access to runways in low-visibility conditions. The FAA worked with RTCA on DO-315A to support the use of EFVS all the way to touchdown.

Increment Status

Complete

Success Criteria

- 2016 : Operationally available for suitably equipped and authorized operators who wish to conduct EFVS operations to touchdown and rollout.
- 2020 : Installation guidance for EFVS systems suitable for approach and landing with visibility as low as 1000 ft (300 m) RVR and several aircraft certified to use EFVS under specified conditions.

Implementation Approach

The FAA recently published a new EFVS rule which expands upon the 2004 EFVS rule to allow the use of EFVS to touchdown and rollout (EFVS for Landing) for suitably equipped and authorized operators. This rulemaking leverages existing EFVS equipment, with some revisions to operating and airworthiness requirements, and provides a performance-based regulatory framework for approving future EFVS equipment and operations. The FAA worked with industry through RTCA Special Committee 213 (RTCA SC-213) to develop Minimum Aviation System Performance Standards for EFVS equipment. This increment is identified to have an International harmonization dependency.

Benefits

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

Access and Equity (P): EFVS provides a pilot with an enhanced visual image which allows him/her to see the visual references necessary to continue descending below minimums on certain instrument approach procedures.

Capacity (S): The use of EFVS maximizes the benefits of rapidly evolving instrument approach procedures and advanced flight deck technology to increase access and capacity during low visibility operations.

Efficiency (S): EFVS increases access, efficiency, and throughput at airports when low visibility is a factor.

System Interactions

 External Commitment

 Primary Benefit

 Secondary Benefit

 Operationally Available

 Complete

 Access & Equity

 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

 Alpha



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Tertiary: ILS CAT I, GNSS/GPS, GBAS CAT I

EFVS (A), ILS CAT I (A), GNSS/GPS (A), GBAS CAT I (A)

When EFVS is used in lieu of natural vision to descend below DA/DH to touchdown and rollout on an instrument approach procedure, a pilot must be able to identify certain required visual references using the EFVS.

Tertiary Systems

●

 ILS: Instrument Landing System

●

 GBAS: Ground Based Augmentation System

●

 GPS: Global Positioning System

Avionics Systems

●

 EFVS: Enhanced Flight Vision System

●

 GBAS CAT I Avionics: Ground Based Augmentation System Category I Approach Avionics

●

 ILS CAT I Avionics: Instrument Landing System Category I Approach Avionics

●

 GNSS/GPS Avionics: Global Navigation Satellite System/Global Positioning System Avionics

Improved Approaches and Low-Visibility Operations

OI: [107107] Ground Based Augmentation System (GBAS) Precision Approaches (2012 - 2037)

Global Positioning System (GPS)/GBAS support precision approaches to Category I and eventually Category II/III minimums, for properly equipped runways and aircraft. GBAS can support approach minimums at airports with fewer restrictions to surface movement, and offers the potential for curved precision approaches. GBAS may also support high-integrity surface movement requirements.

GBAS would provide Category I and Category II/III precision approach and landing services and position information for surface operations. GBAS Category I systems may be installed at airports requiring a stand-alone augmented GPS navigation and landing capability, or at airports where Satellite-Based Augmentation System (SBAS) coverage is unable to meet existing navigation and landing requirements due to insufficient satellite coverage or availability (e.g., some locations in Alaska). GBAS Category II/III systems may be installed at higher usage airports that require more capable navigation and landing services.

A single GBAS system provides precision-approach capabilities to multiple runways or landing areas. GBAS provides precision-approach service that is robust to atmospheric phenomena that might cause loss of SBAS vertical guidance.

OI Benefit

Access and Equity (P): Provides precision approach capabilities to airports without alternate working precision instrument landing systems which increases airport access in low visibility conditions.

Capacity (P): Increases precision approach capability for equipped aircraft/airports thereby increasing airport capacity in low visibility conditions.

Efficiency (S): Aircraft operators will benefit from reduced fuel expenses due to more direct terminal area routing and improved access to airports during extremely low visibility operations. GBAS in combination with RNAV and RNP procedures will allow for predictable flight paths in the terminal area which could potentially reduce pilot controller communications workload and the variability in the time and distance flown in the terminal area and lead to more flexible routing.

Environment (S): GBAS capability for displaced threshold and variable glide path provides flexibility for airlines for improved noise abatement procedures. GBAS can provide optimized precision approaches (RNP to GLS) which are fuel efficient, with low noise and emissions to support access through high density airspace to the runway.

Safety (S): Provides the aircraft with more accurate vertical and lateral position accuracy on GPS instrument approaches, thus enabling more repeatable descent along the glideslope centerline where an ILS is not available.

Predictability (S): Provides alternate means to conduct precision approaches for all runways at an airport.

 External Commitment

 Primary Benefit

 Secondary Benefit

 Operationally Available

 Complete



 Access & Equity

 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

 Alpha



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Improved Approaches and Low-Visibility Operations

Increments

Alpha
(2010 - 2015)

1

A [107107-11] GBAS Category I Non-Federal System Approval (2012 - 2013)  (Complete)

Improved Approaches and Low-Visibility Operations

Increments/Enabling Activities

A [107107-11] GBAS Category I Non-Federal System Approval (2012 - 2013)

Increment Overview

This increment improves accuracy, integrity, and availability of the navigation service. GBAS is designed and is being implemented to enable GBAS precision instrument approaches to Category I. This includes airports/runways not served by Instrument Landing Systems (ILS). GBAS Category I is being implemented as a non-federal system on a per-airport request basis. GBAS benefits allow for increased airspace efficiency, safer, more precise approaches and reduced fuel-burn and emissions due to curved approach paths.

Increment Status

Complete


Success Criteria


✔ 2013 : Complete installation and achieve operational approval of GBAS Category I service at IAH.


Implementation Approach


The FAA has identified GBAS as an enabler for NextGen. A single GBAS installation can provide precision approach to multiple runway ends at a single airport at less expected expense than additional ILS installations. GBAS is a component of the FAA plan to transition to a primarily satellite-based navigation system. The FAA decided not to acquire federal Category I GBAS; however, the FAA has continued to cooperate with industry and airport authorities in the non-federal deployment of Category I GBAS systems. The FAA strategy is to leverage single-frequency Category I GBAS operational experience and invest in research and development activities to develop a non-federal Category III GBAS capability. Honeywell International proceeded with a non-federal GBAS development following the FAA strategy decision. Honeywell submitted the Category I SLS-4000 GBAS to the FAA for system design approval and FAA approval was obtained in September 2009. The SLS-4000 is available for implementation by airport authorities based on their customer requests. The FAA has continued to support non-federal Category I GBAS implementation into the NAS. The Port Authority of New York and New Jersey purchased the first SLS-4000 unit for use in the United States. A second SLS-4000 is installed at Houston (IAH) to support Continental/United Airlines efforts for Newark-Houston city pair operations starting in early 2013. The FAA, in cooperation with Houston Airport Systems, provided the GBAS previously installed at Memphis (MEM) for installation and operational approval at IAH as a non-federal system. Operational approval was granted in 2013. The FAA's William J. Hughes Technical Center has installed GBAS performance monitors at EWR, MWH, and IAH to monitor and evaluate the system performance and airports' RFI environments.


Benefits


 Access & Equity


 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

Access and Equity (P): GBAS Category I systems will provide greater access to equipped users, especially in low-visibility conditions and adverse weather conditions like snow storms when ILS are not available.

 External Commitment

 Primary Benefit

 Secondary Benefit

 Operationally Available

 Complete

 Access & Equity

 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

 Alpha



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Improved Approaches and Low-Visibility Operations

System Interactions

GBAS (P): GBAS includes both ground and airborne components. GBAS differential corrections, integrity data, and approach path definitions are provided to the aircraft via Omnidirectional VHF data Broadcast (VDB) signal, and are received by the airborne component. This enables the aircraft to fly CAT-I GLS approaches with the accuracy, integrity, and continuity required for this level of service. Several approved airborne GBAS-capable multimode receivers (MMRs) are available commercially and are installed either standard or via option on many Boeing and Airbus aircraft

GNSS/GPS (T): GBAS augments the existing Global Positioning System (GPS) signals by providing corrections to aircraft in the vicinity of an equipped airport in order to improve the accuracy of, and provide integrity for, these aircraft's GPS navigation positions

GBAS CAT I (A), GNSS/GPS (A)

Primary Systems

- GBAS: Ground Based Augmentation System

Tertiary Systems

- GPS: Global Positioning System

Avionics Systems

- GBAS CAT I Avionics: Ground Based Augmentation System Category I Approach Avionics
- GNSS/GPS Avionics: Global Navigation Satellite System/Global Positioning System Avionics

Improved Approaches and Low-Visibility Operations

CO: [104124] Use Optimized Profile Descent (2010 - 2017)

Optimized Profile Descents (OPDs) permit aircraft to remain at higher altitudes on arrival to the airport and use lower power settings during descent. OPD arrival procedures will decrease noise and be more fuel-efficient. The air navigation service provider procedures and automation accommodate OPDs when operationally advantageous.

An OPD, in its optimal form, is an arrival where aircraft are cleared to descend from cruise altitude to final approach using the most economical power setting at all times. Based on published arrival procedures at final approach, aircraft begin a continuous rate of descent using a window of predetermined height and distance. Thrust may be added to permit a safe, stabilized approach-speed and flap-configuration down a glide slope to the runway.

Conventional or RNAV STARs can be defined with vertical constraints incorporated as crossing restrictions. Careful selection of constraints allows most aircraft FMS VNAV systems to calculate a continuously descending flight path, although the flight path may require a slightly non-optimal power setting. In addition, static spacing guidance, based on weight class and winds, as well as speed commands for descending traffic, allows STAR to be used with minimal impact to airport throughput, although with a slight additional environmental penalty compared to the ideal STAR OPD.

At busy airports, achieving full fuel/emissions/noise benefits will be difficult without impacting capacity, unless advanced avionics and/or ground capabilities, and perhaps larger-scale airspace redesign are added.

CO Benefit

Efficiency (P): Efficiency is achieved through more fuel efficient descent profiles.

Environment (P): The use of lower thrust settings during descent from cruise operations results in environmental benefits such as reduced noise, emissions, and fuel burn.

Increments

Alpha
(2010 - 2015)

2

A [104124-11] Initial Tailored Arrivals (ITAs) (2010 - 2011) (Complete)

A [104124-12] OPDs Using RNAV STARs (2010 - 2011) (Complete)

Improved Approaches and Low-Visibility Operations

Increments/Enabling Activities

A [104124-11] Initial Tailored Arrivals (ITAs) (2010 - 2011)

Increment Overview

ITAs are used in the Segment Alpha timeframe to address an initial version of the tailored arrivals concept. ITAs are pre-planned, fixed routings assigned by oceanic Air Traffic Control (ATC) facilities and sent from the Oceanic Automation System (Ocean21) via Data Communications to suitably equipped (i.e., FANS 1/A) aircraft as an arrival clearance into coastal airports. The ITA limits vectoring and minimizes the time the aircraft spends maintaining level flight during its descent. The concept has matured during four years of demonstrations, and the FAA started transitioning to normal operations in 2011.

Operational capability initially available; this increment has achieved its success criteria.

Increment Status

Complete

Success Criteria

- ✓ 2011 : Identify potential required changes to automation platforms necessary to optimize the use of Oceanic Tailored Arrivals. This will satisfy RTCA TF5 42a-AP6.
- ✓ 2011 : Operationally available at SFO, LAX, and MIA. This will satisfy RTCA TF5 42a-AP5 and AP7.

Implementation Approach

Made operationally available at demonstration sites.

Benefits

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

- Efficiency (P): Efficiency is improved through reduced workload and the potential for pilot and controller error, allowing aircraft more fuel-efficient descent profiles.
- Environment (P): Environment is improved through reductions in emissions and fuel burn.
- Flexibility (S): Flexibility is improved allowing descent procedures that meet the airspace design objective of separating different flows while allowing aircraft more fuel- efficient descent profiles

System Interactions

ATOP (S): ATOP fully integrates flight and radar data processing, detects conflicts between aircraft, provides data link and surveillance capabilities, and automates the manual processes used previously

 External Commitment

 Primary Benefit

 Secondary Benefit

 Operational Availability

 Complete

 Access & Equity

 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

 Alpha



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Improved Approaches and Low-Visibility Operations

Secondary Systems

- ERAM: En Route Automation Modernization
- ATOP: Advanced Technologies and Oceanic Procedures

Avionics Systems

- FANS 1/A: Future Air Navigation System 1/A

Improved Approaches and Low-Visibility Operations

Increments/Enabling Activities

A [104124-12] OPDs Using RNAV STARs (2010 - 2011)

Increment Overview

RNAV STAR procedures are being implemented with vertical profiles that are designed to allow aircraft to descend using reduced or even idle thrust settings from the top of descent to points along the downwind or final approach. They are optimized to the extent possible that will accommodate use by a large population of aircraft and within constraints of the air traffic system. Design is based on the application of altitude windows that can be met by a range of aircraft and performance capabilities.

Operational capability initially available; this increment has achieved its success criteria.

Increment Status

Complete


Success Criteria

✔ 2011 : Operationally available at PHX, HNL, and CHS.

Implementation Approach

Made operationally available at demonstration sites.

Benefits

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

Efficiency (P): OPDs provide benefits through descent procedures that meet the airspace design objective of separating different flows while allowing aircraft more fuel-efficient descent profiles.

Environment (P): OPDs also enable environmental benefits such as reduced noise, emissions, and fuel burn due to the use of lower thrust settings during descent from cruise operations.

Flexibility (S): Flexibility is improved allowing descent procedures that meet the airspace design objective of separating different flows while allowing aircraft more fuel- efficient descent profiles

System Interactions

Improved Approaches and Low-Visibility Operations

ERAM (P): ERAM provides the controllers with air traffic control displays that are essential to maintaining aircraft separation

STARS (S): STARS provides the controllers with air traffic control displays that are essential to maintaining aircraft separation.

TBFM (S): TBFM is designed to improve the flow of aircraft within congested airspace

GNSS/GPS (T): GPS provides precise Positioning, Navigation, and Timing (PNT) information to suitably equipped aircraft and is the principal enabler of two-dimensional PBN

SBAS/WAAS (T): WAAS provides aircraft guidance during approach procedure. WAAS is used to improve the accuracy, integrity, and availability of basic GPS services to enable vertically guided LPV approach or horizontally guided LP approach operations. WAAS users also experience higher availability of service and therefore do not typically need IRUs, which provide a lower-cost avionics solution

Avionics: GNSS/GPS, SBAS/WAAS

Primary Systems

- ERAM: En Route Automation Modernization

Secondary Systems

- TBFM: Time Based Flow Management
- STARS: Standard Terminal Automation Replacement System

Tertiary Systems

- GPS: Global Positioning System
- SBAS (WAAS): Satellite Based Augmentation System (Wide-Area Augmentation System)

Avionics Systems

- GNSS/GPS Avionics: Global Navigation Satellite System/Global Positioning System Avionics
- SBAS (WAAS) Avionics: Satellite Based Augmentation System/Wide Area Augmentation System Avionics

Systems Interactions

Improved Approaches and Low Visibility Operations Portfolio Alpha System Interaction

↓ Vertical & Horizontal Nav. During Approach ↓ Position, Navigation, and Timing (PNT)

SBAS/WAAS GNSS/GPS

Aircraft

EFVS SVGS/SVS 1, 2, 4, 5, 6

FANS 1/A GBAS I, II/III

SBAS/WAAS GNSS/GPS

↑ Arrival Approach Clearances

↑ Surveillance Data

ERAM ATOP

FTI (IP Network) SWIM/NEMS

↓ Surveillance Data

STARS

↑ Meter List ↑ Speed Advisories ↑ Adaptation Data

TBFM

Voice Comm. DCNS

↑ Surveillance Data

Radar

↓ Surveillance Data

Navigation Systems

GBAS I ALS I 3

GBAS II/III ILS CAT I

DME TLS

LPV

↑ Nav.

Legend

Increment to Primary System Mapping

Avionics

NAS/External System

Primary System

Secondary System

Tertiary System

Boundary/Grouping

→ Info over SWIM

→ Info over P/Direct

→ Info over A/G Comm

Improved Approaches and Low-Visibility Operations

Increment	ALS	ATOP	EFVS	ERAM	FANS 1/A	GBAS	GBAS CAT I Avionics	GNSS/GPS Avionics	GPS	IIS	IIS CAT I Avionics	RVR	SBAS (WAAS)	SBAS (WAAS) Avionics	STARS	TBFM
A [104124-11] Initial Tailored Arrivals (ITAs) ✓		S		S	A											
A [104124-12] OPDs Using RNAV STARs ✓				P				A	T				T	A	S	S
A [107107-11] GBAS Category I Non-Federal System Approval ✓						P	A	A	T							
A [107117-11] Enhanced Flight Vision Systems (EFVS) for Approach ✓			A							T	A					
A [107117-13] Enhanced Flight Vision Systems (EFVS) for Landing ✓			A			T	A	A	T	T	A					
A [107119-01] Expanded Low Visibility Operations using Lower RVR Minima ✓	P									P		P				

✓ Operationally Available

P Primary Systems

✓ Complete

S Secondary Systems

● In Service System

T Tertiary Systems

● Planned System

A Avionics Systems

A Alpha

Improved Approaches and Low-Visibility Operations

Stakeholders

Specific roles and responsibilities for the implementation of all capabilities in this portfolio are outlined in the RASCI (Responsible, Accountable, Supporting, Consulted, Informed) matrix below. All stakeholder organizations involved in the delivery of capabilities are listed across the top. Portfolio capabilities are listed on the left side of the table, organized by OI and increment. For the GBAS increment, AJW-121 is accountable and responsible for system design approval of non-fed acquired GBAS. AJM-32 is responsible by the Non-Fed Order (6700.20B) for maintaining the existing non-federal specification and siting order. ANG-C32 continues to provide support to AJW-121 for GBAS under a program agreement. AFS-400 has responsibility regarding flight procedures and design criteria and AIR-6 for avionics standards and installation policy. For the Low-Visibility increments of EFVS, SVGS, or other vision systems, AFS-400 is accountable and responsible for the implementation of these new operations with AIR-130 being responsible for avionics standards and installation policy. Also notable is the role of AJM-32 regarding consultation on LED lighting. AFS-200, AFS-800, ARP, AGC, APO, and ARM also have a supporting role for rulemaking. For Expanded Low-Visibility Operations Using Lower RVR Minima, AJM-32 is accountable and responsible for RVR implementation, with support from AJT-2 regarding terminal infrastructure integration. AFS-400 has responsibility for standards and operations specifications and AIR-130 is responsible for avionics standards and installation policy. The appropriate lead offices will coordinate with external stakeholders.

- 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 AcquisitionProgram Baseline. To foster a clear line of accountability, two different offices can never be Accountable for the same increment, andAccountability 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 theAccountable 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



Improved Approaches and Low-Visibility Operations

RASCI Matrix	AJM			ANG			APO	ARM	AJT		AJI			AJV	AFS				AOV		AIR		AAE	AGC	ARP	AJF	AJW
	32	321	23	C	C7	C32	001	001	2	32	1	2	3	A	001	400	410	420	140	250	620	001	001	001	001	170	121
•  [104124-11] Initial Tailored Arrivals (ITAs) (2010 - 2011) 					C		S		A/R		S	S	S		R							R	S				
•  [104124-12] OPDs Using RNAV STARs (2010 - 2011)					C		S				S	S	S		R							R	S				
•  [107107-11] GBAS Category I Non-Federal System Approval (2012 - 2013)				A/R	C											R									S		
•  [107117-11] Enhanced Flight Vision Systems (EFVS) for Approach (2015 - 2015)	C				C		S	S							S	A/R								S	S		
•  [107117-13] Enhanced Flight Vision Systems (EFVS) for Landing (2015 - 2017)	C				C		S	S							S	A/R								S	S		
•  [107119-01] Expanded Low Visibility Operations using Lower RVR Minima (2011 - 2011)	A/R				C				S		S	S	S		R							R					

 Operationally Available

 Complete

 External Commitment

 Alpha



Improved Approaches and Low-Visibility Operations

Appendix B

Bravo Increments

Portfolio Overview

The Improved Approaches and Low-Visibility Operations portfolio outlines ways to increase access and flexibility for approach operations. This will be accomplished through a combination of procedural changes, improved aircraft capabilities, and improved precision approach guidance. The procedural changes allow for more efficient profiles. The improved aircraft capabilities include vertical navigation. Ground-Based Augmentation Systems (GBAS) will provide improved approach guidance to flight crews and will enhance satellite navigation capabilities.

In the Bravo and Charlie timeframes, this portfolio focuses on safely providing additional low-visibility approaches (i.e., during Category I and lower weather conditions) in NAS operations through the use of advanced navigation, imaging sensors, and computational technologies.

The anticipated benefits of the LowVis portfolio are in the areas of improved access to and capacity at airports during certain weather conditions.

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
*Bravo (2016 - 2020)	5	0	0	0	0	5
TOTAL	5	0	0	0	0	5
Segment	% by Segment	% by Segment/Increment Status				
*Bravo (2016 - 2020)	100%	0 %	0 %	0 %	0 %	100 %
TOTAL	100%	0 %	0 %	0 %	0 %	100 %

Improved Approaches and Low-Visibility Operations

Operational Improvements/Current Operations & Increments	Benefits
OI: [107202] Low Visibility Surface Operations (2016 - 2022)	
B [107202-21] Low-Visibility Taxi Operations (2016 - 2020)	
B [107202-22] Enhanced Flight Vision System (EFVS)/Accurate Position Information for Taxi (2016 - 2020)	
B [107202-23] Protected Low Visibility Taxi Route (2016 - 2020)	
CO: [107117] Low Visibility/Ceiling Approach and Landing Operations (2015 - 2021)	
B [107117-12] Synthetic Vision Guidance Systems (SVGS) for Approach (2016 - 2021)	
CO: [107115] Low Visibility/Ceiling Takeoff and Departure Operations (2014 - 2025)	
B [107115-11] Enhanced Flight Vision Systems (EFVS) for Takeoff (2014 - 2014)	

Improved Approaches and Low-Visibility Operations

2016	2017	2018	2019	2020
OI: [107202] Low Visibility Surface Operations (2016 - 2022)				
B [107202-21] Low-Visibility Taxi Operations (2016 - 2020) ✓				
B [107202-22] Enhanced Flight Vision System (EFVS)/Accurate Position Information for Taxi (2016 - 2020) ✓				
B [107202-23] Protected Low Visibility Taxi Route (2016 - 2020) ✓				
CO: [107117] Low Visibility/Ceiling Approach and Landing Operations (2015 - 2021)				
B [107117-12] Synthetic Vision Guidance Systems (SVGS) for Approach (2016 - 2021) ✓				
CO: [107115] Low Visibility/Ceiling Takeoff and Departure Operations (2014 - 2025)				
B [107115-11] Enhanced Flight Vision Systems (EFVS) for Takeoff (2014 - 2014) ✓				

Improved Approaches and Low-Visibility Operations

OI: [107202] Low Visibility Surface Operations (2016 - 2022)

Airport taxi operations will be permitted in lower visibility allowing continued airport operations in low visibility conditions not previously possible. Via a simplified procedures approval process permitted under FAA Order 8000.94 for a low visibility taxi route, airports without a fully approved Low Visibility Operations / Surface Movement Guidance Control System program will be able to permit aircraft with enhanced flight vision systems to meet visual requirements with the use of emerging technologies. Procedures will also be developed and approved that permit continued taxi operations under lower visibility conditions than allowed today through a combination of enhanced flight vision systems and highly accurate aircraft location information display system in the cockpit.

Aircraft and ground vehicle movement on airports in low visibility conditions is guided by accurate location information [e.g. moving map displays and/or other emerging technologies.] Other examples include aircraft and ground vehicles determining their position on an airport from GPS, WAAS, LAAS, and/or ADS-B and Ground-Based Transceivers (GBT) systems with or without surface based surveillance. Location information of aircraft and vehicles on the airport surface is determined through other types of emerging technologies. Some of these include displays on moving maps, Cockpit Display of Traffic Information (CDTI), and/or use of Enhanced Flight Vision Systems (EFVS), Enhanced Vision Systems (EVS), Synthetic Visions Systems (SVS) or other types of cockpit based technologies. The result will be improved airport access through technological innovations.

OI Benefit

Access and Equity (P): Enables aircraft systems to assist with the safe continuation of surface operations in low visibility conditions in order to access airports that would otherwise not be able to continue operations due to insufficient ground infrastructure to meet safety requirements.

Capacity (S): Increases airport capacity and access during low visibility conditions through continuation of operations.

Efficiency (S): Increases access, efficiency, and throughput at airports when low visibility is a factor.

Increments

Bravo
(2016 - 2020)

3

- [B] [107202-21] Low-Visibility Taxi Operations (2016 - 2020) (Complete)
- [B] [107202-22] Enhanced Flight Vision System (EFVS)/Accurate Position Information for Taxi (2016 - 2020) (Complete)
- [B] [107202-23] Protected Low Visibility Taxi Route (2016 - 2020) (Complete)

Improved Approaches and Low-Visibility Operations

Increments/Enabling Activities

B [107202-21] Low-Visibility Taxi Operations (2016 - 2020)

Increment Overview

Aircraft with current certified Enhanced Flight Vision systems will be able to continue to conduct taxi operations at lower visibilities enabling operations to continue at airports with low surface visibility. This increment will allow Enhanced Flight Vision Systems (EFVS) equipped aircraft to taxi in lower visibility conditions than is normally allowed because pilots are using the enhanced vision to "see" better than natural vision. The specific requirements for use of CVS or SVS (with SBAS or GBAS, for example) for beneficial taxi applications are under development by the FAA and industry, and will be evaluated under scientific data collection criteria on how they function in actual weather obscurations. This effort will improve airport access through technological innovations and grant operators operational credit for equipping with enhanced vision systems.

Increment Status

Complete


Success Criteria

✔ 2020 : Operationally available for suitably equipped operators

Implementation Approach

Users interested in obtaining the benefits of EFVS for low-visibility taxi operations must be equipped with the necessary flight deck capabilities and must train and operate according to federal regulations and operations specifications, or other such approval mechanisms. FAA is conducting research to determine the required visual advantage that EFVS must provide to maintain an equivalent level of safety (i. e. 300 ft, 500 ft, or 1,000 ft) if select NAS infrastructure components are eliminated (i. e. centerline lights or additional signage/markings). This research will support future FAA inputs to airport specific SMS analyses. Applicable FAA orders and Advisory Circulars (AC) that provide guidance for leveraging emerging technologies during taxi operations include FAA Order 8900. 94, AC 150/5340/1J Version L, and AC 150/5340-18D Version F. The expanded use of EFVS during taxi is contingent upon airport operator and user/flightcrew readiness.

Benefits

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

Access and Equity (P): Permit taxi operations to occur that support low visibility operations for takeoff, improving access during those times.

Capacity (S): The use of EFVS maximizes the benefits of rapidly evolving instrument approach procedures and advanced flight deck technologies to increase access and capacity during low visibility operations.

 External Commitment

 Primary Benefit

 Secondary Benefit

 Operational Availability

 Complete

 Access & Equity

 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

 Bravo



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Improved Approaches and Low-Visibility Operations

EFVS (A): EFVS to be used to supplement natural vision in situational awareness and aircraft positioning accuracy during surface operations.

Avionics Systems

EFVS: Enhanced Flight Vision System

Improved Approaches and Low-Visibility Operations

Increments/Enabling Activities

B [107202-22] Enhanced Flight Vision System (EFVS)/Accurate Position Information for Taxi (2016 - 2020)

Increment Overview

EFVS in combination with accurate aircraft location information can be used to meet natural vision surface visibility requirements for taxi operations below any value previously authorized. This capability provides expanded use of the airport under lower visibility conditions for properly equipped aircraft. Aircraft with these EFVS/accurate aircraft location information will be able to continue to conduct surface taxi operations if the EFVS/accurate location capability meets the specifications for natural vision under the airport specific Low Visibility Operations/Surface Movement and Guidance Control System (LVO/SMGCS) approved program. This effort will result in improved airport access through technological innovations.

Increment Status

Complete

Success Criteria

✔ 2020 : Suitably equipped operators and eligible flight crews may leverage the combined use of EFVS and Moving Map displays to meet natural vision requirements under airport specific LVO/SMGCS programs.

Implementation Approach

Users interested in obtaining the benefits of EFVS for low-visibility taxi must be equipped with the necessary flight deck capabilities.

Benefits

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

Access and Equity (P): Permit taxi operations to occur that support low visibility operations for takeoff, improving access during those times.

Capacity (S): The use of EFVS maximizes the benefits of rapidly evolving instrument approach procedures and advanced flight deck technology to increase access and capacity during low visibility operations.

Efficiency (S): Reduced taxi delay during periods of poor visibility conditions.

System Interactions

EFVS (A): EFVS to be used to supplement natural vision in situational awareness and aircraft positioning accuracy during surface operations.

Avionics Systems

 External Commitment

 Primary Benefit

 Secondary Benefit

 Operational Availability

 Complete



 Access & Equity

 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

 Bravo



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Improved Approaches and Low-Visibility Operations

Increments/Enabling Activities

B [107202-23] Protected Low Visibility Taxi Route (2016 - 2020)

Increment Overview

This increment will increase the number of airports with approval for taxi operations below 1200' RVR and result in increased capacity at these airports during low visibility conditions. Airport taxi operations will be permitted in lower visibility allowing continued airport operations in visibility conditions not previously possible. Via a simplified procedures approval process permitted under FAA Order 8000.94 for a low visibility taxi route, airports without a fully approved Low Visibility Operations Surface Movement Guidance Control System (LVO/SMGCS) program will be able to permit aircraft with enhanced flight vision systems to meet visual requirements with the use of emerging technologies. This improvement implements changes that allow an airport without a full LVO/SMGCS program to be granted approval for a low visibility taxi route for aircraft with an approved enhanced flight vision system via a simplified approval process. This effort will improve airports access through technological innovations.

Increment Status

Complete

Success Criteria

✔ 2020 : Operationally available for suitably equipped operators

Implementation Approach

EFVS aircraft would be able to operate in lower than standard visibility. Protected Low Visibility Taxi Routes would support safe operations at airports with less than standard LVO/SMGCS signage, markings, and equipment by unique low visibility taxi routes set up for EFVS equipped aircraft under the LVO/SMGCS program.

Benefits

 Access & Equity  Capacity  Flexibility  Efficiency  Environment  Predictability  Safety

Access and Equity (P): Permit taxi operations to occur that support low visibility operations for takeoff, improving access during those times.

Capacity (S): The use of EFVS maximizes the benefits of rapidly evolving instrument approach procedures and advanced flight deck technology to increase access and capacity during low visibility operations.

Efficiency (S): Reduced taxi delay during periods of poor visibility conditions.

System Interactions

EFVS (A): EFVS to be used to supplement natural vision in situational awareness and aircraft positioning accuracy during surface

 External Commitment

 Primary Benefit

 Secondary Benefit

 Operationally Available

 Complete 

 Access & Equity

 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

 Bravo



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Improved Approaches and Low-Visibility Operations

Avionics Systems

 EFVS: Enhanced Flight Vision System

Improved Approaches and Low-Visibility Operations

CO: [107117] Low Visibility/Ceiling Approach and Landing Operations (2015 - 2021)

The ability to complete approaches and landings in low visibility/ceiling conditions is improved for aircraft equipped with some combination of navigation derived from augmented GNSS or ILS and other cockpit-based technologies or combinations of cockpit-based technologies and ground infrastructure.

The ability to complete approaches in low visibility/ceiling conditions is improved for aircraft equipped with some combination of navigation derived from augmented GNSS or ILS and Head-up Display (HUD), Enhanced Flight Vision System (EFVS), Synthetic Vision Guidance System (SVGS), advanced vision system and other cockpit-based technologies that combine to improve human performance. Cockpit-based technologies allow instrument approach procedure access with reduced requirements on ground-based navigation and airport infrastructure. Due to onboard avionics airport access is maintained in low visibility/ceiling conditions.

CO Benefit

Access and Equity (P): Enables aircraft systems to assist with the safe continuation of approach and landing operations when visibility is below minimums on certain instrument approach procedures in order to access airports that would otherwise not be able to be accessed due to low visibility.

Capacity (S): Increases airport capacity and access during low visibility conditions through continuation of operations.

Efficiency (S): Increases access, efficiency, and throughput at airports when low visibility is a factor.

Increments

Bravo
(2016 - 2020)

1

B [107117-12] Synthetic Vision Guidance Systems (SVGS) for Approach (2016 - 2021) ✔ (Complete)

Improved Approaches and Low-Visibility Operations

Increments/Enabling Activities

B [107117-12] Synthetic Vision Guidance Systems (SVGS) for Approach (2016 - 2021)

Increment Overview

The ability to complete approaches in low visibility/ceiling conditions is improved for aircraft utilizing SVGS technology that allows for instrument approach procedures lower than standard minima.

Increment Status

Complete



Success Criteria

✔ 2020 : SVGS available for/used by suitably equipped aircraft

Implementation Approach

SVGS is currently enabled via AC 120-118, Criteria for Approval/Authorization of all Weather Operations for Takeoff, Landing, and Rollout, on SA CAT I ILS instrument approach procedures. AC 20-185, Airworthiness Approval of Synthetic Vision Guidance System, provides applicants with guidance for obtaining airworthiness approval for equipment installation of a SVGS in aircraft. There is a potential for follow on implementation on LPV or GLS approaches. Once certified, the SVGS must be authorized by the FAA for operational use for SA CAT I ILS instrument approach procedures. This increment is identified to have an International harmonization dependency.

Benefits

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

Access and Equity (P): Enables aircraft systems to assist with the safe continuation of approach and landing operations when visibility is below minimums on certain instrument approach procedures.

Capacity (S): Increases airport capacity and access during low visibility conditions through continuation of operations.

Efficiency (S): Increases access, efficiency, and throughput at airports when low visibility is a factor.

System Interactions

Improved Approaches and Low-Visibility Operations

GPS (T): GPS is a positioning and timing service provided by way of ranging signals broadcast at the GPS L1 frequency. L1 frequency, transmitted by all satellites, contains a coarse / acquisition (C/A) code ranging signal, with a navigation data message, that is available for peaceful civil, commercial, and scientific use.

SBAS (WAAS) (T): SBAS (WAAS) provides a means of guidance and position assurance for SVGS. The WAAS is a Satellite Based Augmentation System (SBAS) for North America that augments GPS SPS by broadcasting differential GPS (DGPS) correction messages from GEO satellites. The WAAS Service provides augmentation of GPS integrity via integrity data included on the WAAS message broadcasts. The WAAS Service is specifically designed to meet high accuracy, integrity, continuity, availability standards of aviation users, but is an open service that has the capability to support other applications as well. WAAS provides a ranging function throughout the entire satellite footprint that improves the availability of GPS positioning for SBAS users. WAAS also provides differential corrections as well as satellite status for GPS satellites.

SVGS (A), SVS (A), GNSS/GPS Avionics (A), SBAS (WAAS) Avionics (A)

SVGS would not need any ground lighting or infrastructure to support its use; however, once the pilot establishes visual reference such as ALS, then the flight can continue to touchdown. SVS is a database driven depiction of the topography used for situation awareness.

Tertiary Systems

- GPS: Global Positioning System
- SBAS (WAAS): Satellite Based Augmentation System (Wide-Area Augmentation System)

Avionics Systems

- SVS: Synthetic Vision System
- SVGS: Synthetic Vision Guidance System
- GNSS/GPS Avionics: Global Navigation Satellite System/Global Positioning System Avionics
- SBAS (WAAS) Avionics: Satellite Based Augmentation System/Wide Area Augmentation System Avionics

Improved Approaches and Low-Visibility Operations

CO: [107115] Low Visibility/Ceiling Takeoff and Departure Operations (2014 - 2025)

This improvement leverages some combination of Heads-Up Display (HUD), and aircraft vision system capabilities to allow appropriately equipped aircraft to depart, including takeoff, in low visibility conditions. Due to onboard avionics the aircraft will be less dependent on ground based infrastructure at the airport while conducting take-off operations.

Currently, visibility minimums for takeoff and departure are dependent on aircraft equipment, ground infrastructure, and runway marking and lighting. This ensures that pilots are able to visually maintain the runway centerline during both nominal and aborted takeoffs. By using cockpit-based technologies such as HUD, Enhanced Flight Vision Systems (EFVS), Synthetic Vision Systems (SVS) or other advanced vision system technologies, the pilot will be able to maintain an equivalent awareness of runway centerline with reduced dependence on airport infrastructure when visual conditions are below those normally required for takeoff.

CO Benefit

Access and Equity (P) Enables aircraft equipped with EFVS increased access at many airports when low visibility is a factor. Lower departure minimums will be granted through cockpit based technologies. These authorizations will reduce delays, ensure connections and enable the airlines to meet timelines by getting the first flight of the day off on time. Lowering takeoff minimums through technology credits will reduce congestion at airfields during periods of lower visibility by ensuring that aircraft who can land are capable of taking off.

Capacity (S): Increases airport capacity and access during low visibility condition through continuation of operations.

Efficiency (S): Increases access, efficiency, and throughput at airports when low visibility is a factor.

Increments

Bravo
(2016 - 2020)

1

B [107115-11] Enhanced Flight Vision Systems (EFVS) for Takeoff (2014 - 2014) (Complete)

Improved Approaches and Low-Visibility Operations

Increments/Enabling Activities

B [107115-11] Enhanced Flight Vision Systems (EFVS) for Takeoff (2014 - 2014)

Increment Overview

This increment extends previously approved use of EFVS for approach to allow increased access for EFVS low-visibility takeoff operations. EFVS-equipped operators use enhanced vision systems to meet takeoff visibility requirements, as well as depart from some runways with reduced infrastructure (e.g., no centerline lighting).

Increment Status

Complete

Success Criteria

✔ 2014 : Operationally available to suitably equipped operators through issuance of OpSpec C078

Implementation Approach

Low visibility takeoff using EFVS may be authorized through OpSpec C078 or C079.

Benefits

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

Access and Equity (P): EFVS provides a pilot with an enhanced visual image which allows him/her to see the visual references necessary to continue descending below minimums on certain instrument approach procedures.

Capacity (S): The use of EFVS maximizes the benefits of rapidly evolving advanced flight deck technology to increase access and capacity during low visibility operations.

Flexibility (P): The flexibility from using EFVS enables maximum use of available runways and results in increased throughput and reduced delay.

Efficiency (S): EFVS increases access, efficiency, and throughput at airports when low visibility is a factor.

Safety (P): The use of EFVS enables takeoff operations in reduced visibility while maintaining an equivalent level of safety

System Interactions

Runway markings and runway lighting (S): Runway markings and/or runway centerline lights will be sensed by the EFVS imaging sensor which will enable the pilot to maintain runway centerline during the takeoff roll in reduced visibility conditions

EFVS (A): EFVS is used to enhance the view outside the aircraft in reduced visibility conditions and maintain runway alignment during

 External Commitment

 Primary Benefit

 Secondary Benefit

 Operationally Available

 Complete

 Access & Equity

 Capacity

 Flexibility

 Efficiency

 Environment

 Predictability

 Safety

 Bravo



2024 Approved Baseline
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Improved Approaches and Low-Visibility Operations

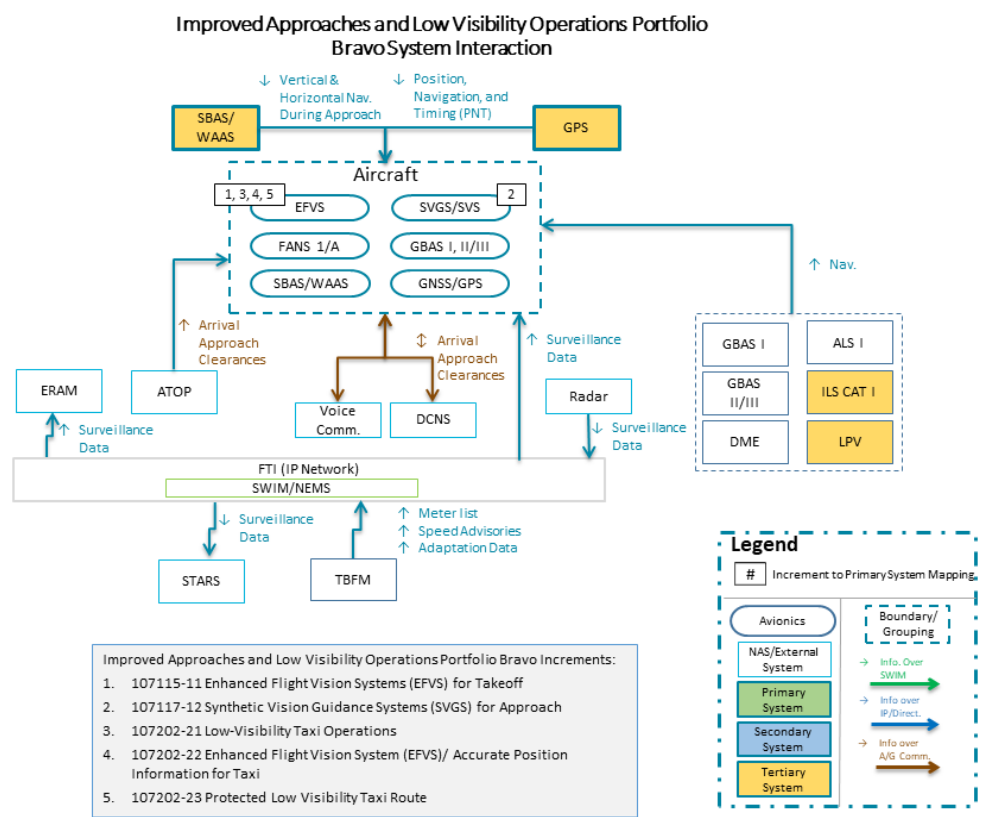
Avionics Systems

 EFVS: Enhanced Flight Vision System

Improved Approaches and Low-Visibility Operations

Systems Interactions

The system interactions associated with this portfolio are depicted in this figure. The majority of the improved capabilities described in this portfolio involve procedural/operational changes that more fully leverage the performance of existing flight deck avionics, in combination with existing or, in the case of GBAS, emerging satellite-based navigation systems. Additionally, some airports will require relatively minor infrastructure improvements (e.g., RVR, lighting, and/or NAVAID antenna upgrades) before these procedural/operational improvements will be authorized at those airports. Controller systems and NAS Infrastructure systems will remain unchanged by the improvements in this portfolio.



Improved Approaches and Low-Visibility Operations

Increment	EFVS	GNSS/GPS Avionics	GPS	SBAS (WAAS)	SBAS (WAAS) Avionics	SVGS	SVS
B [107115-11] Enhanced Flight Vision Systems (EFVS) for Takeoff	A						
B [107117-12] Synthetic Vision Guidance Systems (SVGS) for Approach		A	T	T	A	A	A
B [107202-21] Low-Visibility Taxi Operations	A						
B [107202-22] Enhanced Flight Vision System (EFVS)/Accurate Position Information for Taxi	A						
B [107202-23] Protected Low Visibility Taxi Route	A						

Operationally Available

P Primary Systems

Complete

S Secondary Systems

In Service System

T Tertiary Systems

Planned System

A Avionics Systems

B Bravo

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Improved Approaches and Low-Visibility Operations

Stakeholders

Specific roles and responsibilities for the implementation of all capabilities in this portfolio are outlined in the RASCI (Responsible, Accountable, Supporting, Consulted, Informed) matrix below. All stakeholder organizations involved in the delivery of capabilities are listed across the top. Portfolio capabilities are listed on the left side of the table, organized by OI and increment. For the GBAS increment, AJW-121 is accountable and responsible for system design approval of non-fed acquired GBAS. AJM-32 is responsible by the Non-Fed Order (6700.20B) for maintaining the existing non-federal specification and siting order. ANG-C32 continues to provide support to AJW-121 for GBAS under a program agreement. AFS-400 has responsibility regarding flight procedures and design criteria and AIR-6 for avionics standards and installation policy. For the Low-Visibility increments of EFVS, SVGS, or other vision systems, AFS-400 is accountable and responsible for the implementation of these new operations with AIR-130 being responsible for avionics standards and installation policy. Also notable is the role of AJM-32 regarding consultation on LED lighting. AFS-200, AFS-800, ARP, AGC, APO, and ARM also have a supporting role for rulemaking. For Expanded Low-Visibility Operations Using Lower RVR Minima, AJM-32 is accountable and responsible for RVR implementation, with support from AJT-2 regarding terminal infrastructure integration. AFS-400 has responsibility for standards and operations specifications and AIR-130 is responsible for avionics standards and installation policy. The appropriate lead offices will coordinate with external stakeholders.

- 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

B Bravo



Improved Approaches and Low-Visibility Operations

RASCI Matrix	AJM			ANG			APO	ARM	AJT		AJI			AJV	AFS				AOV		AIR		AAE	AGC	ARP	AJF	AJW
	32	321	23	C	C7	C32	001	001	2	32	1	2	3	A	001	400	410	420	140	250	620	001	001	001	001	170	121
• B [107115-11] Enhanced Flight Vision Systems (EFVS) for Takeoff (2014 - 2014)	C				C		S	S							S	A/R								S	S		
• B [107117-12] Synthetic Vision Guidance Systems (SVGS) for Approach (2016 - 2021)	C				C		S	S							S	A/R								S	S		
• B [107202-21] Low-Visibility Taxi Operations (2016 - 2020)			C		C		S								S	A/R								S	S		
• B [107202-22] Enhanced Flight Vision System (EFVS)/Accurate Position Information for Taxi (2016 - 2020)	C				C		S	S							S	A/R								S	S		
• B [107202-23] Protected Low Visibility Taxi Route (2016 - 2020)	C				C		S	S							S	A/R								S	S		