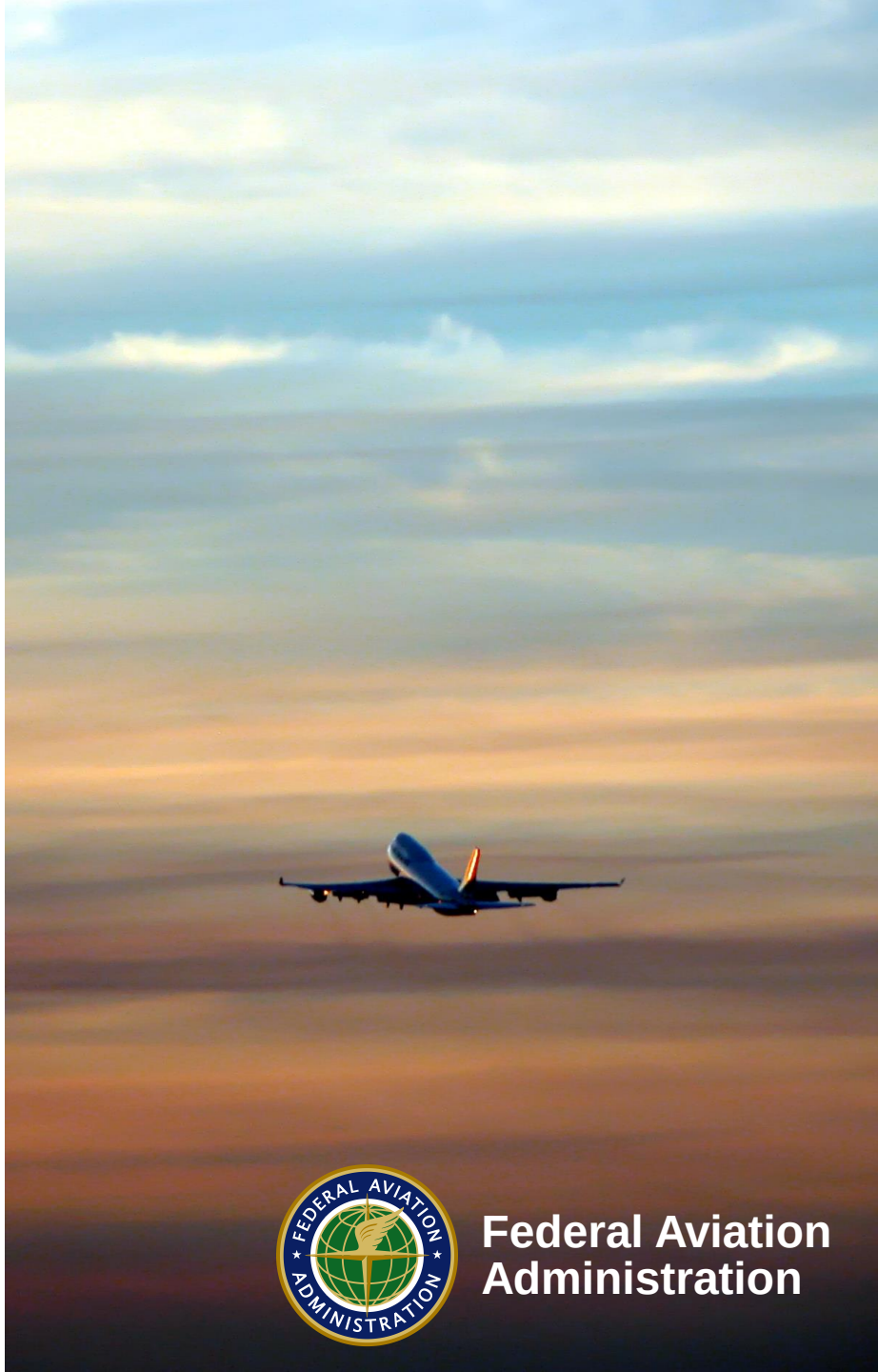
Innovate with the FAA: The Future of Aviation Surveillance Services

2022 Surveillance Services Industry Day

Surveillance Services Strategy and Roadmaps

March 23, 2022

Part 1 of 2

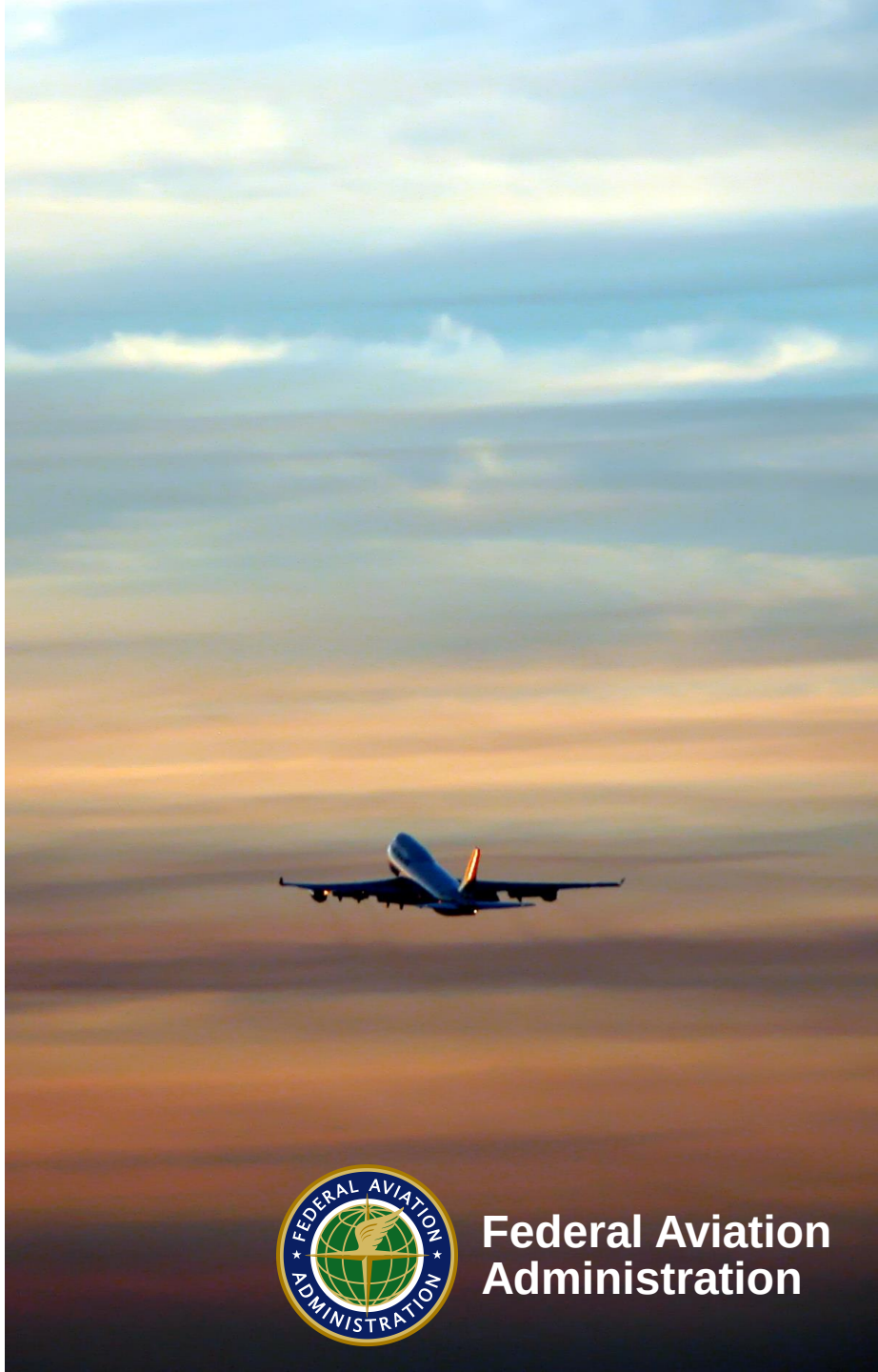


Innovate with the FAA: The Future of Aviation Surveillance Services

Welcome to the 2022 Surveillance Services Industry Day

March 23, 2022

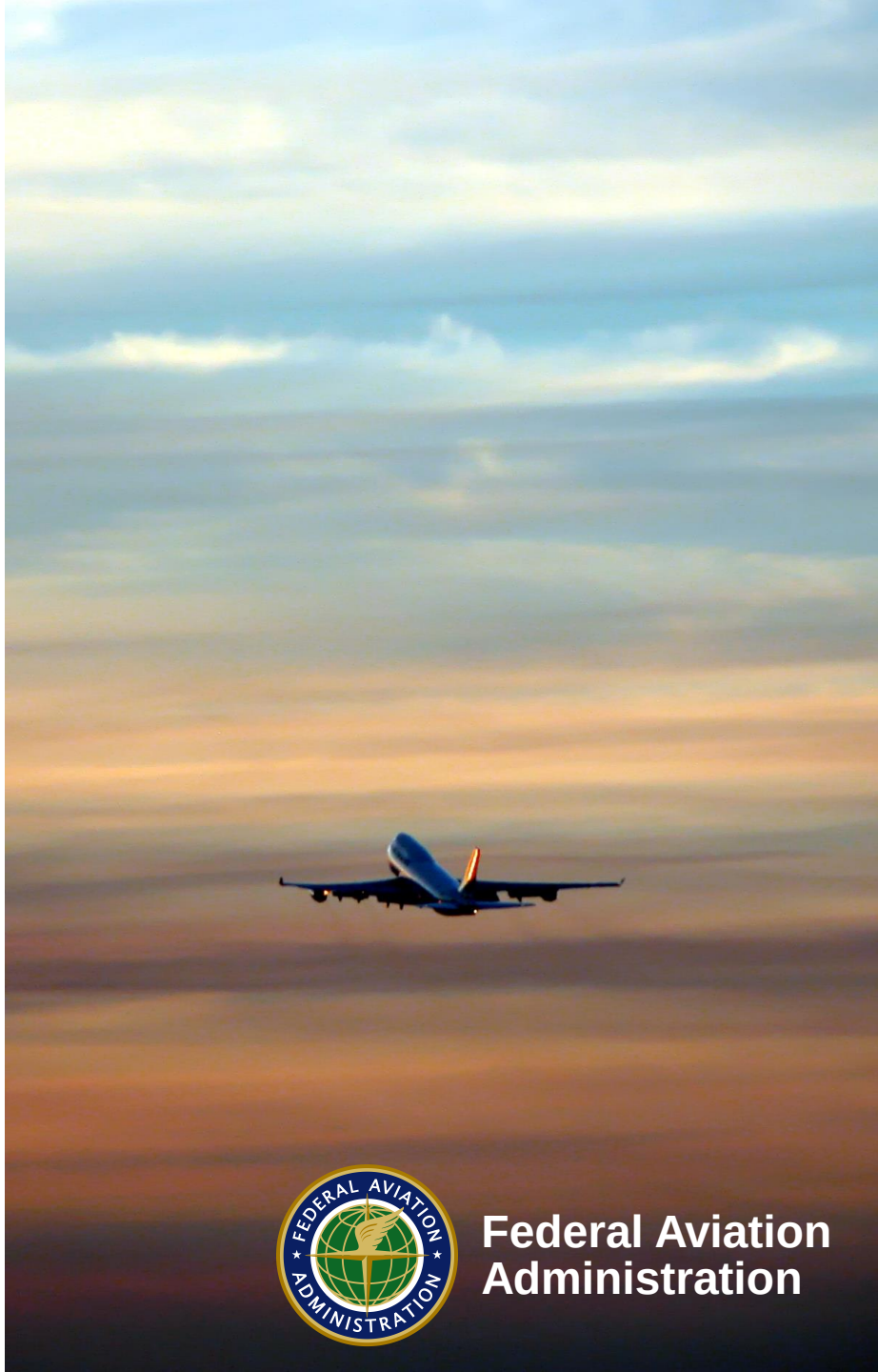
We will begin at 9:00 am ET



Amy Gusky

FAA Surveillance Services Directorate

Deputy Director (A)



Surveillance Services Industry Day

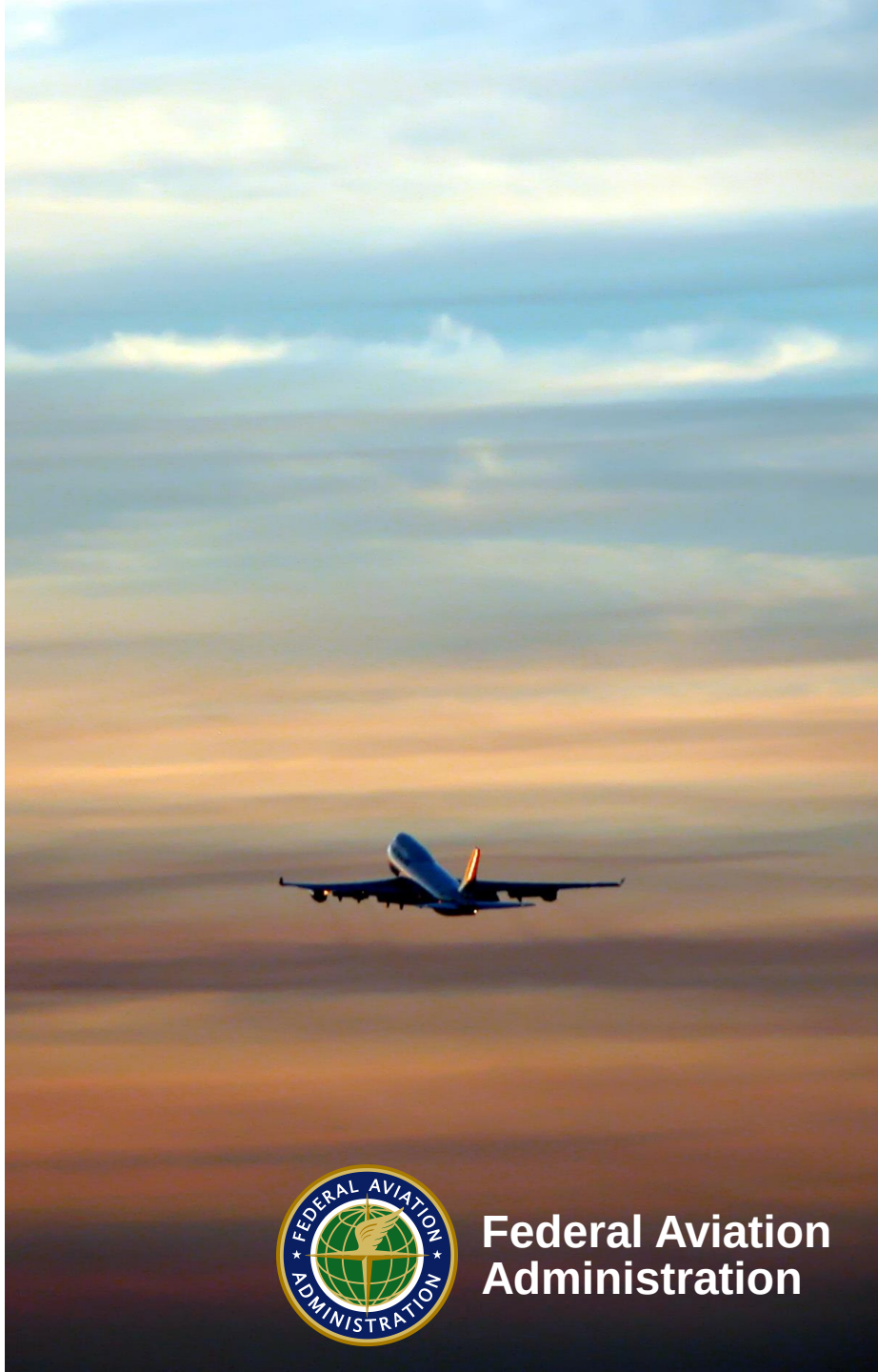
Wednesday, March 23, 2022

Welcome	Amy Gusky
Keynote Address	Dan Hicok
AJM-4 Surveillance Services Strategy	Mike Freie
AJM-41 Surveillance Acquisition and Sustainment	Brad Kenemuth
AJM-42 Surveillance and Broadcast Services	Evan Setzer
AJM-43 Spectrum Efficient National Surveillance Radar (SENSR)	Adrian Caster
Lunch Break	
Surveillance Contracting Opportunities	Patrick Weare
Radar Surveillance Future Focus	Brad Kenemuth
Surface Surveillance	Bill Kaplan
• **Runway Status Lights: Field Lighting System Replacement**	Syed Tahmid
• **ASDE-3 Surface Movement Radar Replacement**	Joe Robinson
Updates to 2021 Industry Day	
• **Surveillance Processing and Networking**	Bob Pomrink
• **Surveillance Broadcast and Information Services (SBIS) Update**	Pamela Maxwell
• **Airspace Non-cooperative Surveillance Radar (ANSR)**	Fred Atwood
• **Wind Turbine Radar Interference Mitigation**	James Osburn
Close	Amy Gusky

Patrick Weare

Office of Finance and Management

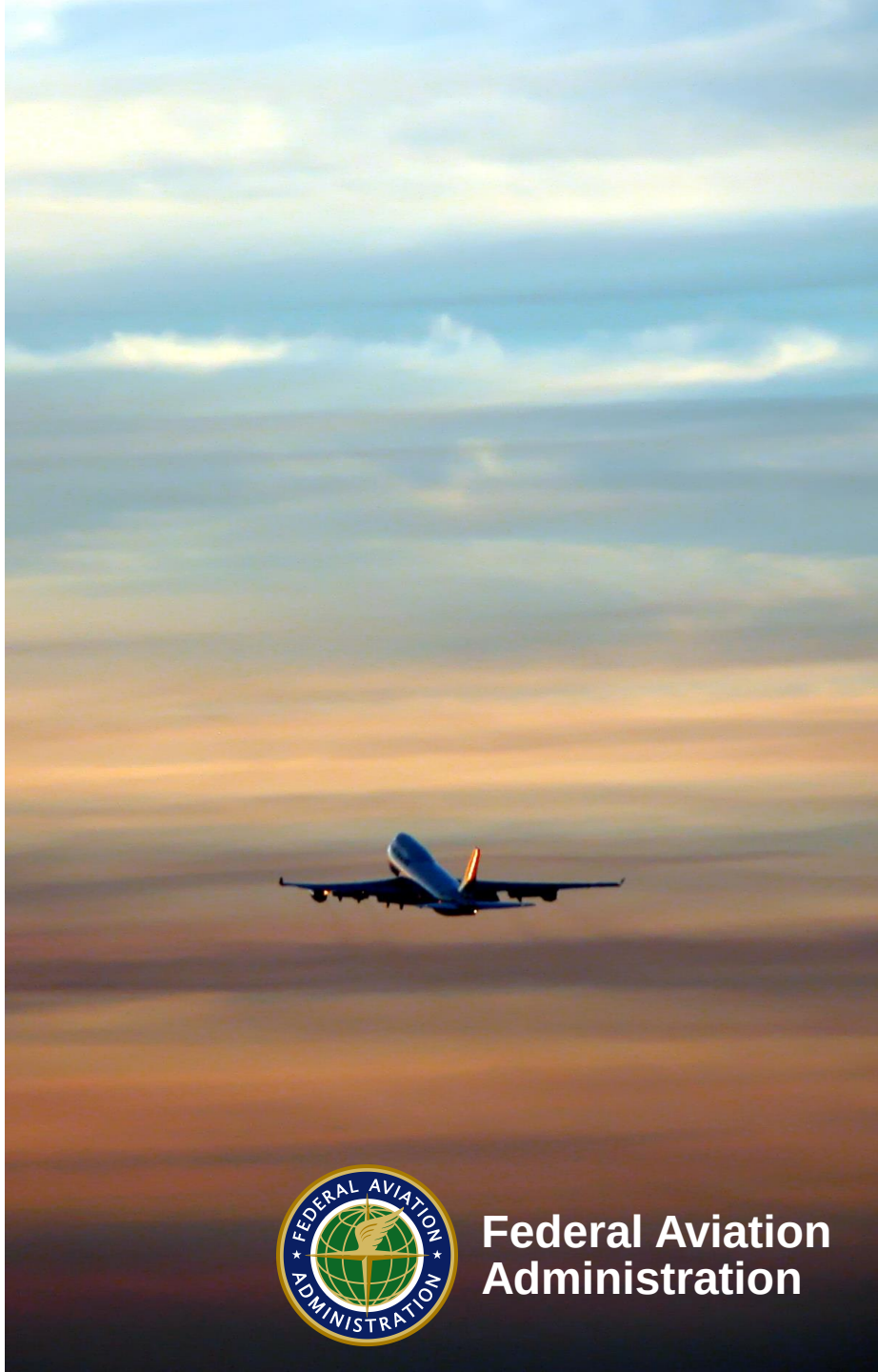
Contracting Officer



Amy Gusky

FAA Surveillance Services Directorate

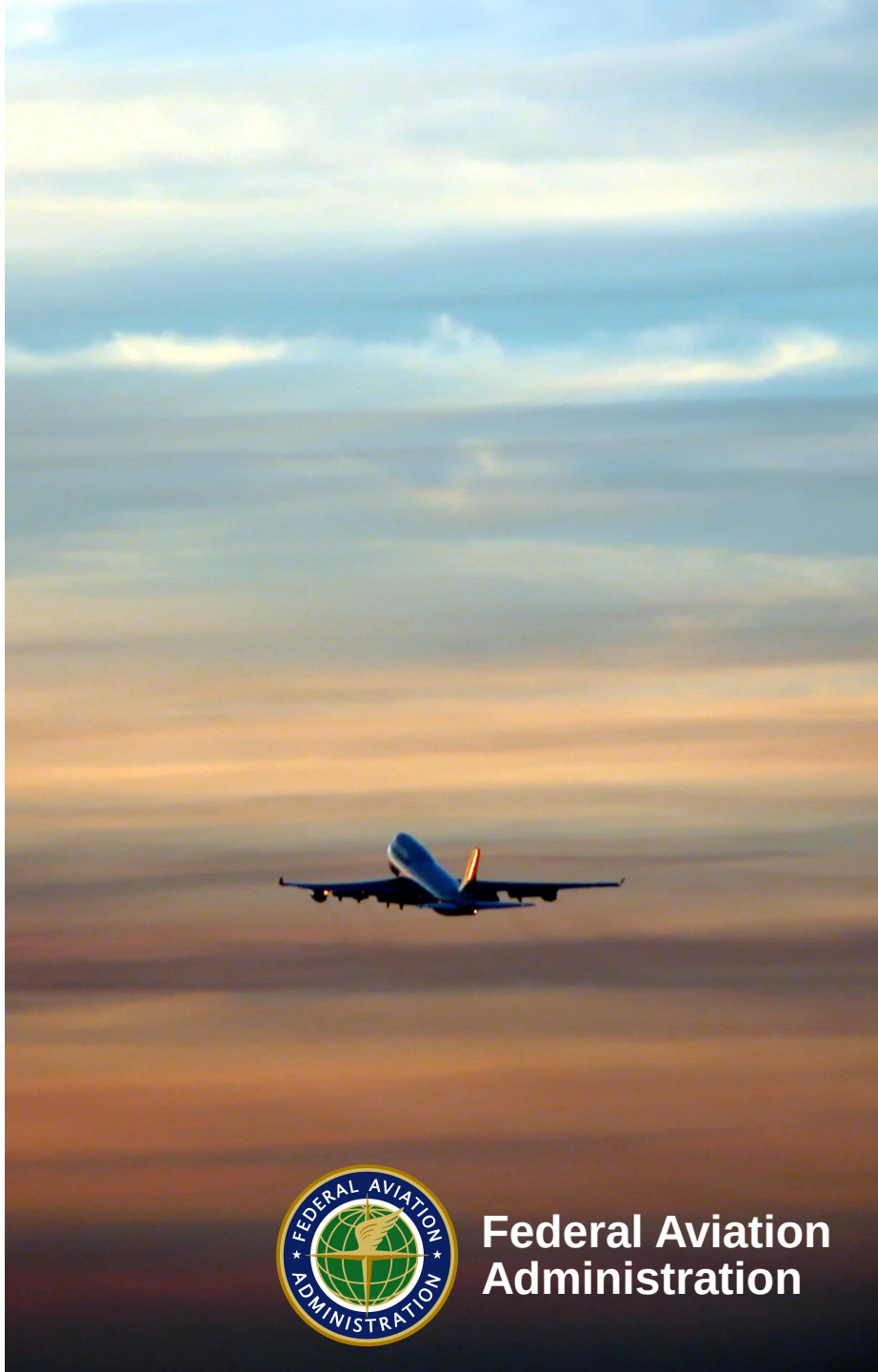
Deputy Director (A)



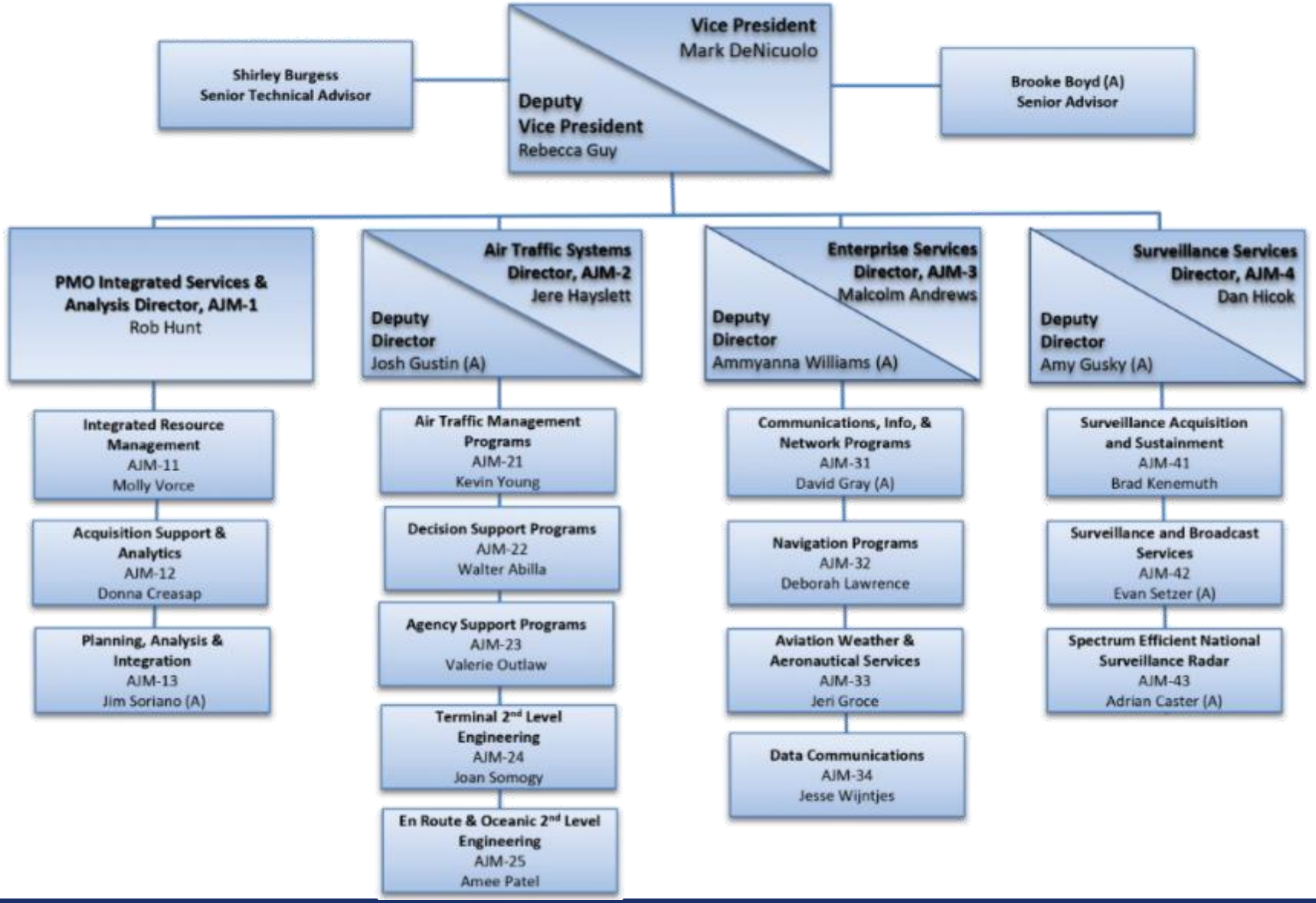
Dan Hicok

FAA Surveillance Services Directorate

Director



Program Management Organization, AJM PMO Directorates and Groups



Surveillance Services

Amy Gusky
Deputy Director (A), AJM-4
Surveillance Services

Dan Hicok
Director, AJM-4
Surveillance Services

Mike Freie
Technical Advisor, AJM-4
Surveillance Services

Brad Kenemuth
Group Manager, AJM-41
Surveillance Acquisition and Sustainment (SAS)

Evan Setzer
Group Manager (A), AJM-42
Surveillance and Broadcast Services (SBS)

Adrian Caster
Group Manager (A), AJM-43
Spectrum Efficient National Surveillance Radar (SENSR)

Surveillance Acquisition and Sustainment (SAS)

- Acquire, optimize and sustain radar services including:
  - Refresh technology
  - Integrate with new technologies
- Divest radars no longer needed
- Invest in new surveillance technologies

Surveillance and Broadcast Services (SBS)

- Provide situational awareness and surveillance of the surface movement area, approach and departure routes
- Monitor and maintain existing ADS-B systems performance and services
- Develop and implement enhanced surveillance capabilities

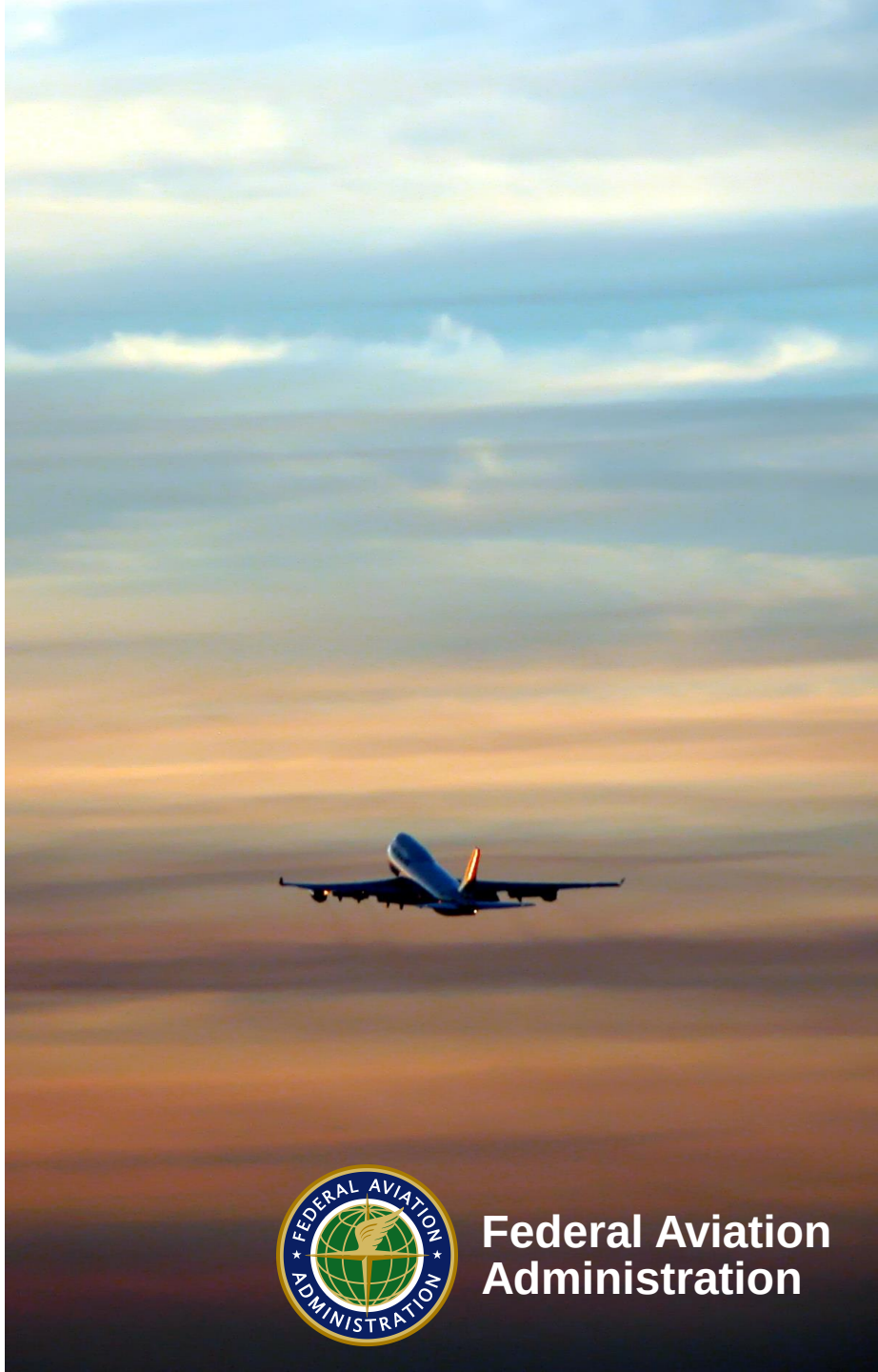
Spectrum Efficient National Surveillance Radar (SENSR)

- Continue technical feasibility assessment of re-tuning long-range non-cooperative radars
- Evaluate acquisition strategy and policy options, and continue surveillance investment analysis
- Strive to obtain the best value from the auction to realize benefits across the NAS

Dan Hicok

FAA Surveillance Services Directorate

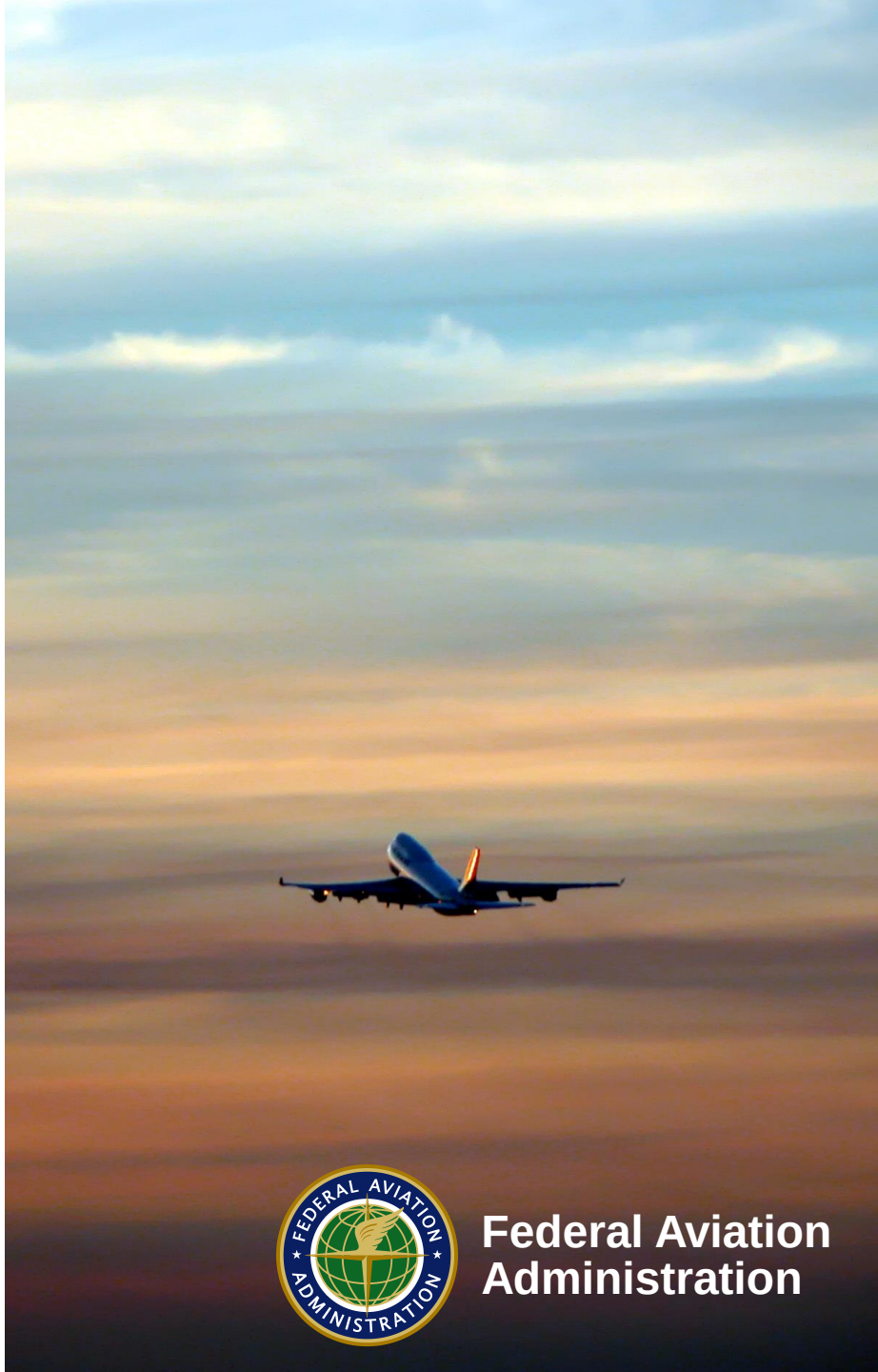
Director



Mike Freie

FAA Surveillance Services Directorate

Technical Advisor



Surveillance Services | Mission

Surveillance Acquisition and Sustainment (SAS)

Surveillance and Broadcast Services (SBS)

Spectrum Efficient National Surveillance Radar (SENSR)

Provide programmatic excellence in the acquisition, deployment and sustainment of air traffic surveillance systems and services…

…to provide air traffic control and aircraft operators the situational awareness needed for safe and efficient use of the National Airspace System (NAS).

Surveillance in The NAS Today

Automatic Dependent Surveillance-Broadcast (ADS-B) service is fully deployed and integrated into all automation platforms.

– As of March 2022, **158,000+** aircraft in the U.S. are equipped with ADS-B out.

Over 750 ground-based radar systems continue to be integral to air traffic surveillance for FAA, DoD, and DHS.

Wide Area Multilateration (WAM) is a proven surveillance service and considered a backup to ADS-B.

Automation systems fuse together data inputs from ADS-B, WAM and multiple radars to form a single visual for air traffic controllers.

Surveillance Services 2035 Vision Alignment

Future of the Ocean 2035

NAS Vision 2035

Automation Evolution

UAS/UTM ConOps

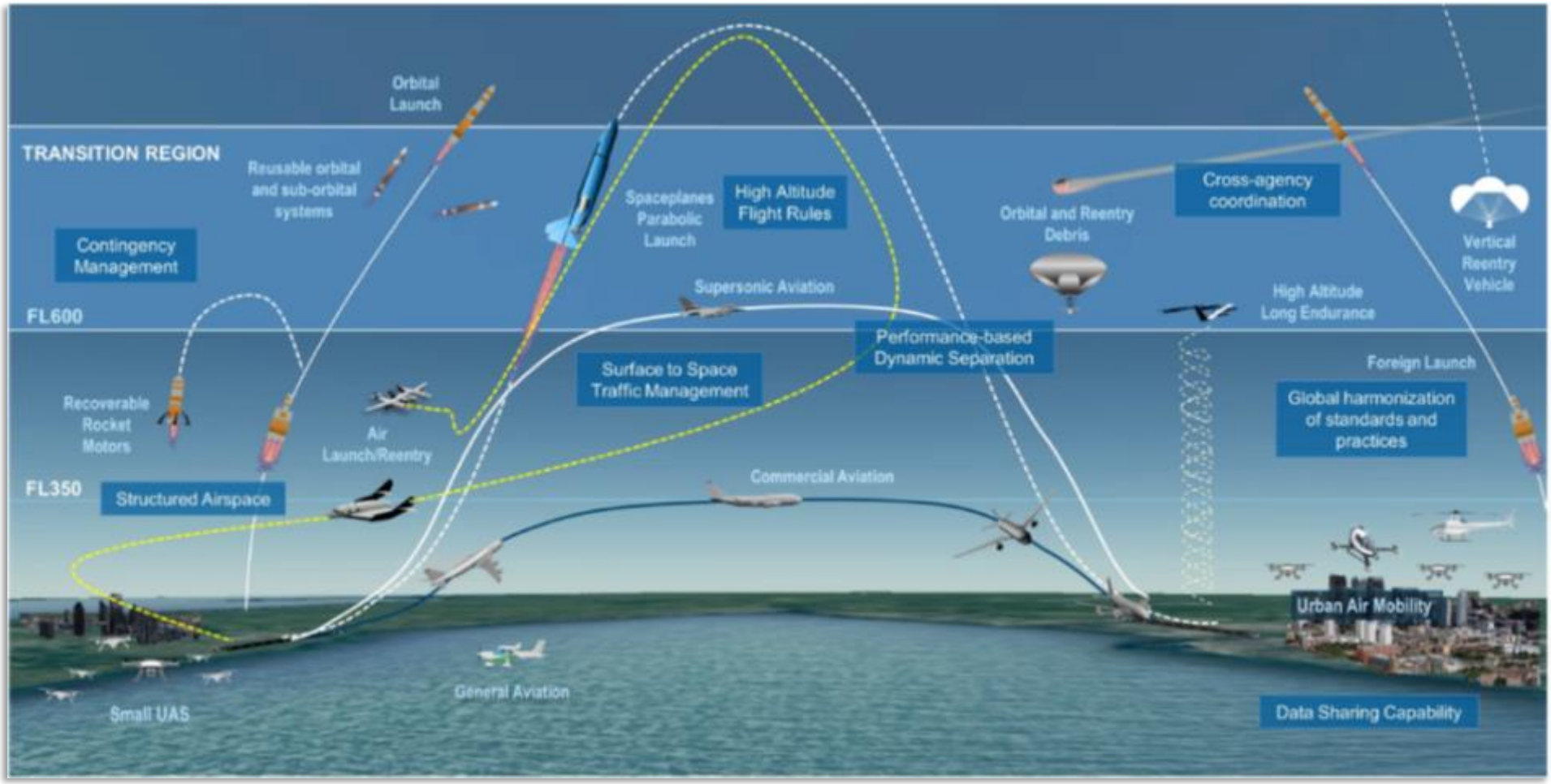
Technical Operations Strategic Plan

Commercial Space NAS Integration ConOps

Surveillance Services ConUse 2025

Federal Aviation Administration

2035 Vision for Surveillance Services



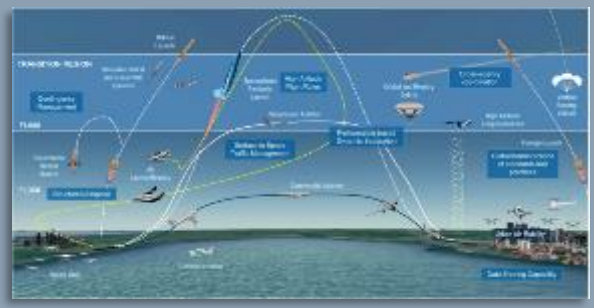
Approach to achieve the 2035 Vision

Define surveillance services in support of FAA vision

Create transition to address surveillance vision shortfalls

Identify Shortfalls/Gaps – Vision versus today

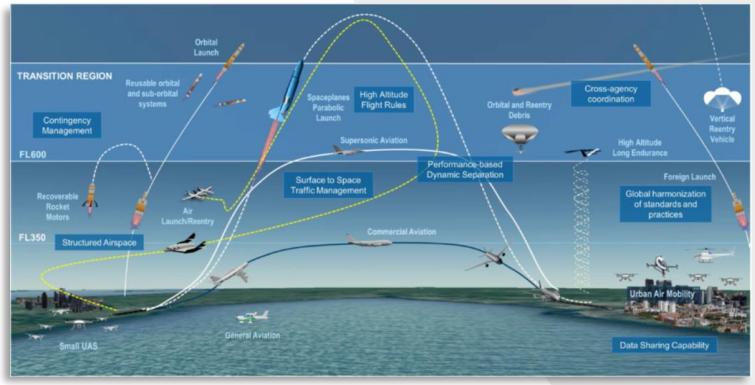
Implement phased Surveillance Services transition approach



2035 Vision for Surveillance Services

Approach

- Define surveillance services in support of FAA vision
- Identify Shortfalls/Gaps – Vision versus today
- Create transition to address surveillance vision shortfalls
- Implement phased Surveillance Services transition approach



Establish Foundational Architecture

- Surveillance Processing and Networking
- Computing Infrastructure or Cloud
- Agile development at reduced cost

Optimization of Surveillance Services

- Cooperative backup to ADS-B
  - Mode S Beacon Replacement System (MSBRS)
  - Wide Area Multilateration (WAM)Service
- Non-cooperative
  - Airspace Non-cooperative Surveillance Radar (ANSR)
  - Future ARSR-4/CARSR
- Streamlined system configurations

Modern Interfaces and Protocols

- ASTERIX and IP
- Enhanced Resiliency

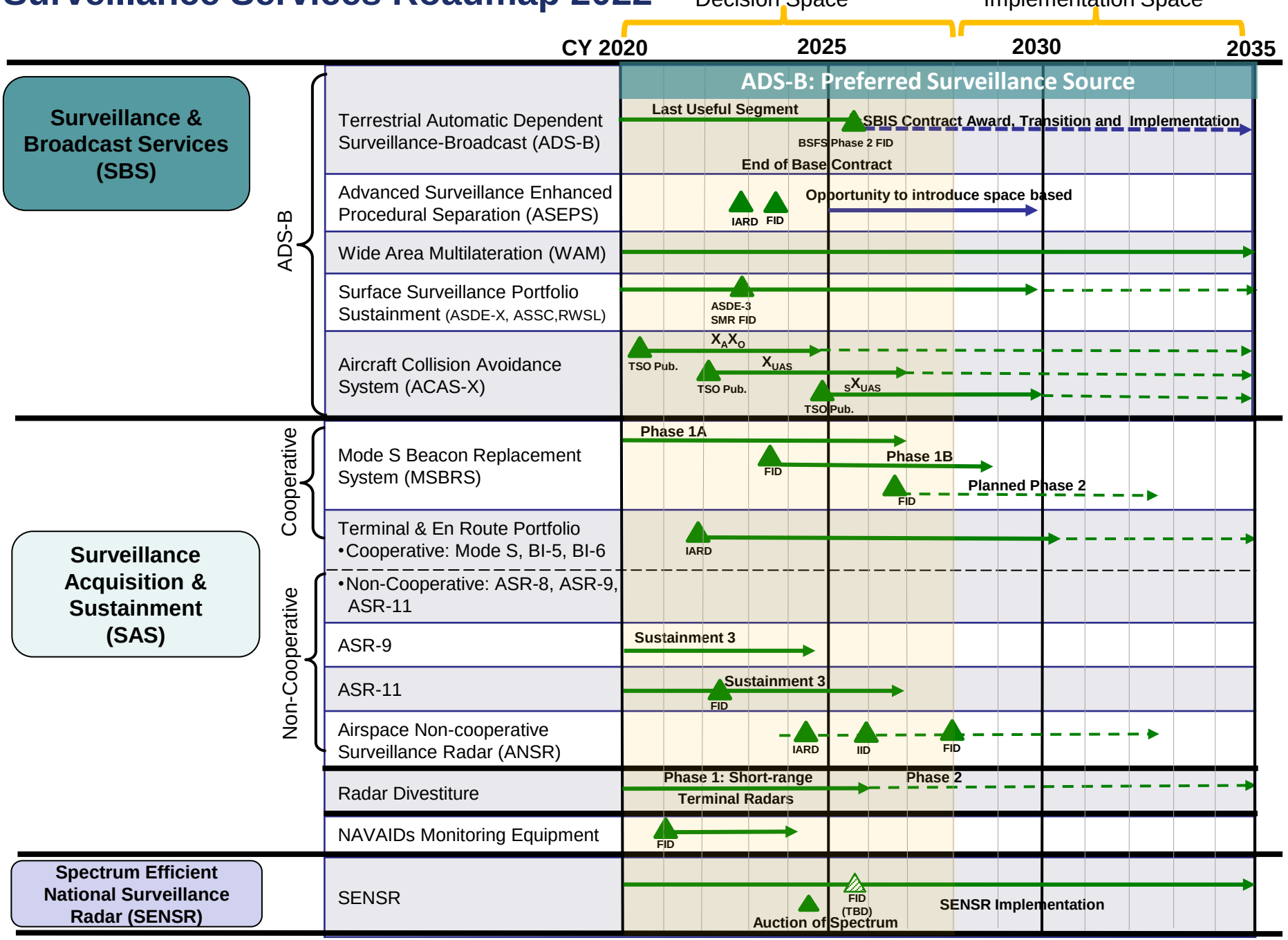
Extensible Traffic Management (xTM) Surveillance

- Requirements will be defined
- Integrate into Enterprise Surveillance Architecture

FAA Surveillance Portfolio Analysis Group Focus Areas

Surveillance Strategy	Surveillance Architecture	Surveillance Requirements	Surveillance Infrastructure Optimization	Future Surveillance Technologies
High-level Objectives				
Define the surveillance vision and guide surveillance programs' acquisitions to align with the Surveillance Strategy and manage cost, technical resources, and impacts to Air Traffic operations	**Define the evolution of the Surveillance Services architecture** from present day through 2035 and beyond to modernize the surveillance services capabilities for the future	**Document and define requirements for future surveillance services** to meet the needs identified in the CONUSE, deliver ATC weather, and accommodate new entrants	Assess the existing surveillance infrastructure landscape to **determine an optimal layout of surveillance assets and services**	**Evaluate surveillance technologies and capabilities** for the future to provide recommendations for inclusion in the Enterprise Surveillance Services Architecture
Near Term Deliverables				
Surveillance Services Vision Document	**Surveillance Architecture Definition Document**	**Surveillance Requirements Document**	**Surveillance Systems and Services Optimum Layout**	**Technology Evaluation Plans**

Surveillance Services Roadmap 2022



Note: Roadmap is notional and subject to change.

Surveillance Services | Takeaways

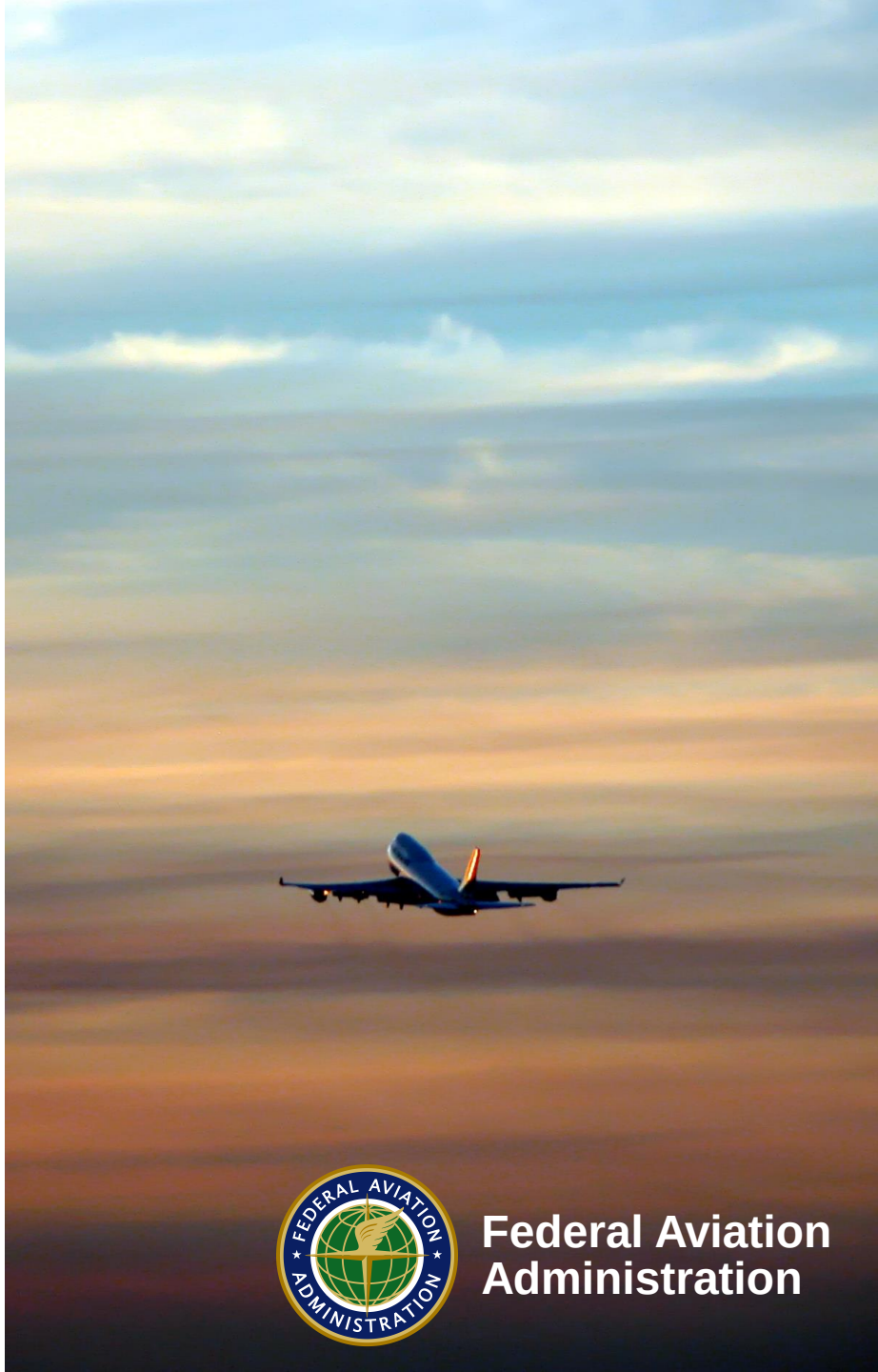
- Surveillance Services vision will define the surveillance innovation to meet the needs of the future NAS.
- Decisions made over the next 5 years will determine the architecture of Surveillance Services of the future.
- Industry engagement and collaboration will continue to be a key part of Surveillance Services success.

Surveillance Services Strategy

Brad Kenemuth

FAA Surveillance Acquisition and Sustainment (SAS)

Group Manager



Surveillance Acquisition and Sustainment (SAS)

Surveillance Acquisition and Sustainment (SAS)

Surveillance and Broadcast Services (SBS)

Spectrum Efficient National Surveillance Radar (SENSR)

Surveillance Acquisition and Sustainment (SAS)

Mission

Provide programmatic excellence in the acquisition, deployment and sustainment of radar surveillance systems to support safe and efficient air traffic management by the FAA and DoD.

Programs

Surveillance Strategy Programs

1. Radar Divestiture, Phase 1
2. Wind Turbine Radar Interference Mitigation
3. Airspace Non-cooperative Surveillance Radar (ANSR)

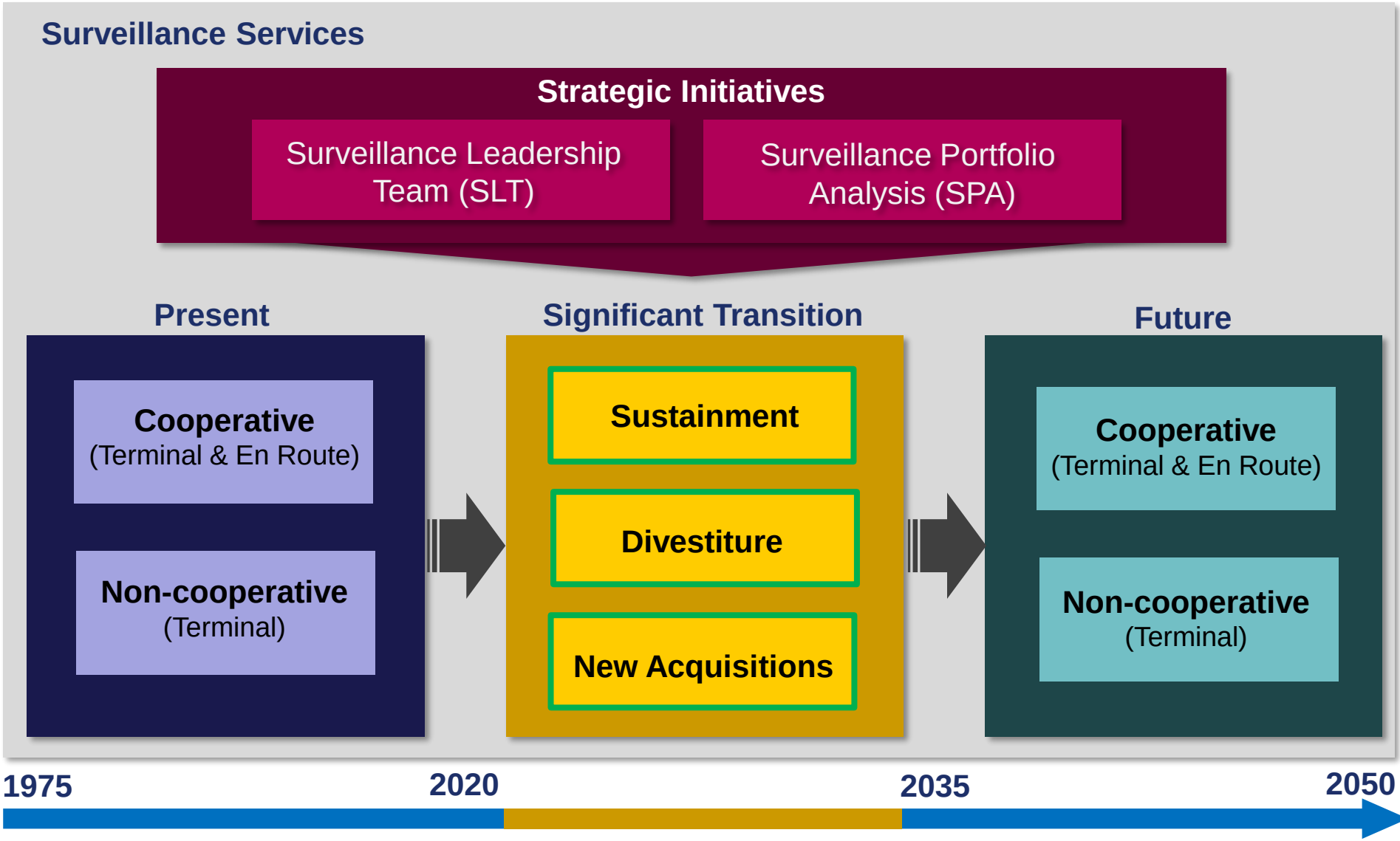
Acquisition Programs

1. Mode S Beacon Replacement System (MSBRS)
2. Mode 5 *(DoD Program)*
3. NAVID Monitoring Equipment (NME)

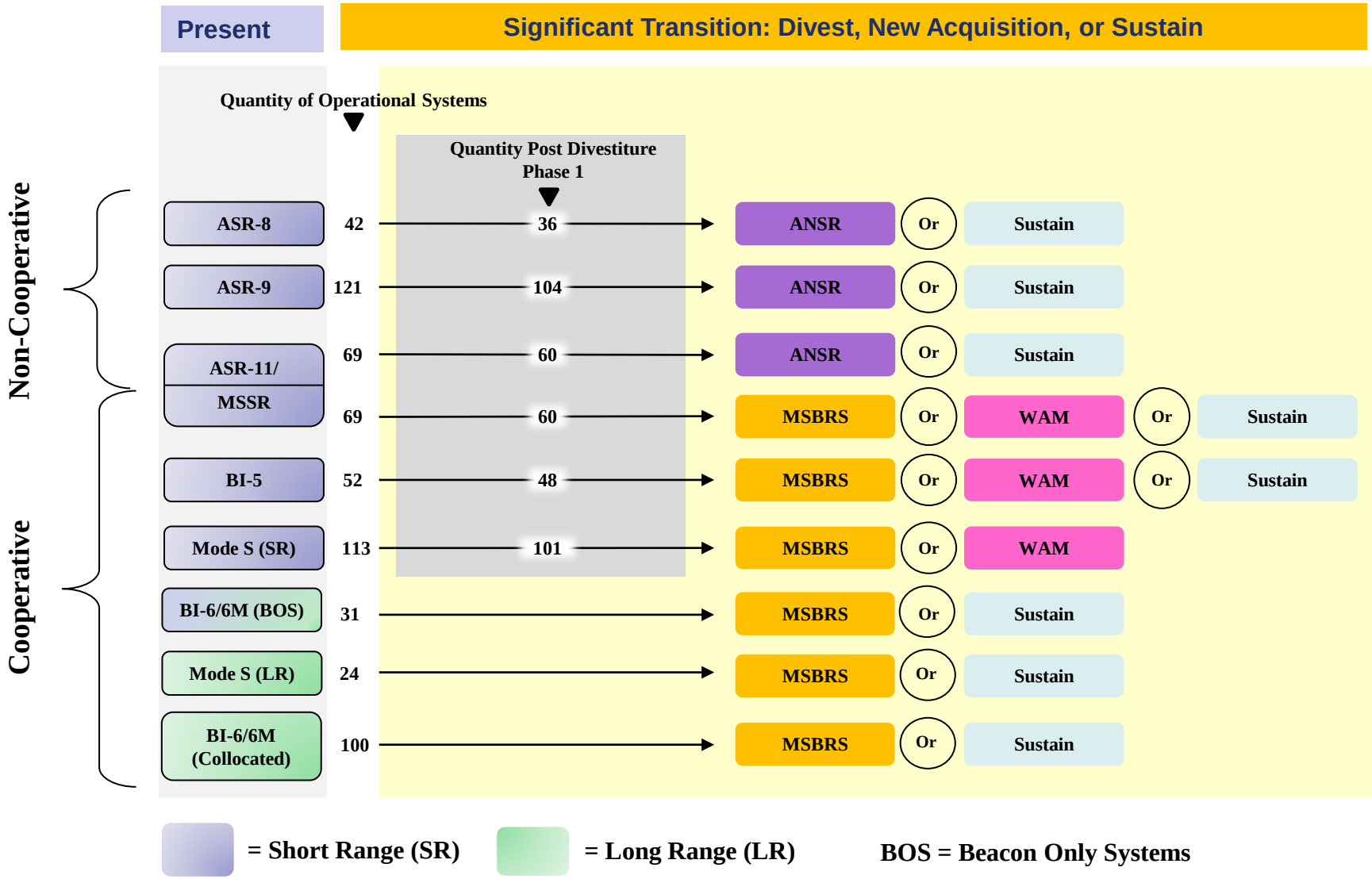
Sustainment Programs

1. Common Terminal Digitizer (CTD)
2. Airport Surveillance Radar Model 9 (ASR-9) S3
3. Airport Surveillance Radar Model 11 (ASR-11) S3
4. Terminal and En Route Surveillance Portfolio
   - Air Traffic Control Beacon Interrogator Model 5 (ATCBI-5)
   - Air Traffic Control Beacon Interrogator Model 6 (ATCBI-6)
   - Mode Select (Mode S)
   - Airport Surveillance Radar Model 8 (ASR-8)
   - Airport Surveillance Radar Model 9 (ASR-9)
   - Airport Surveillance Radar Model 11 (ASR-11)

SAS | Significant Transition

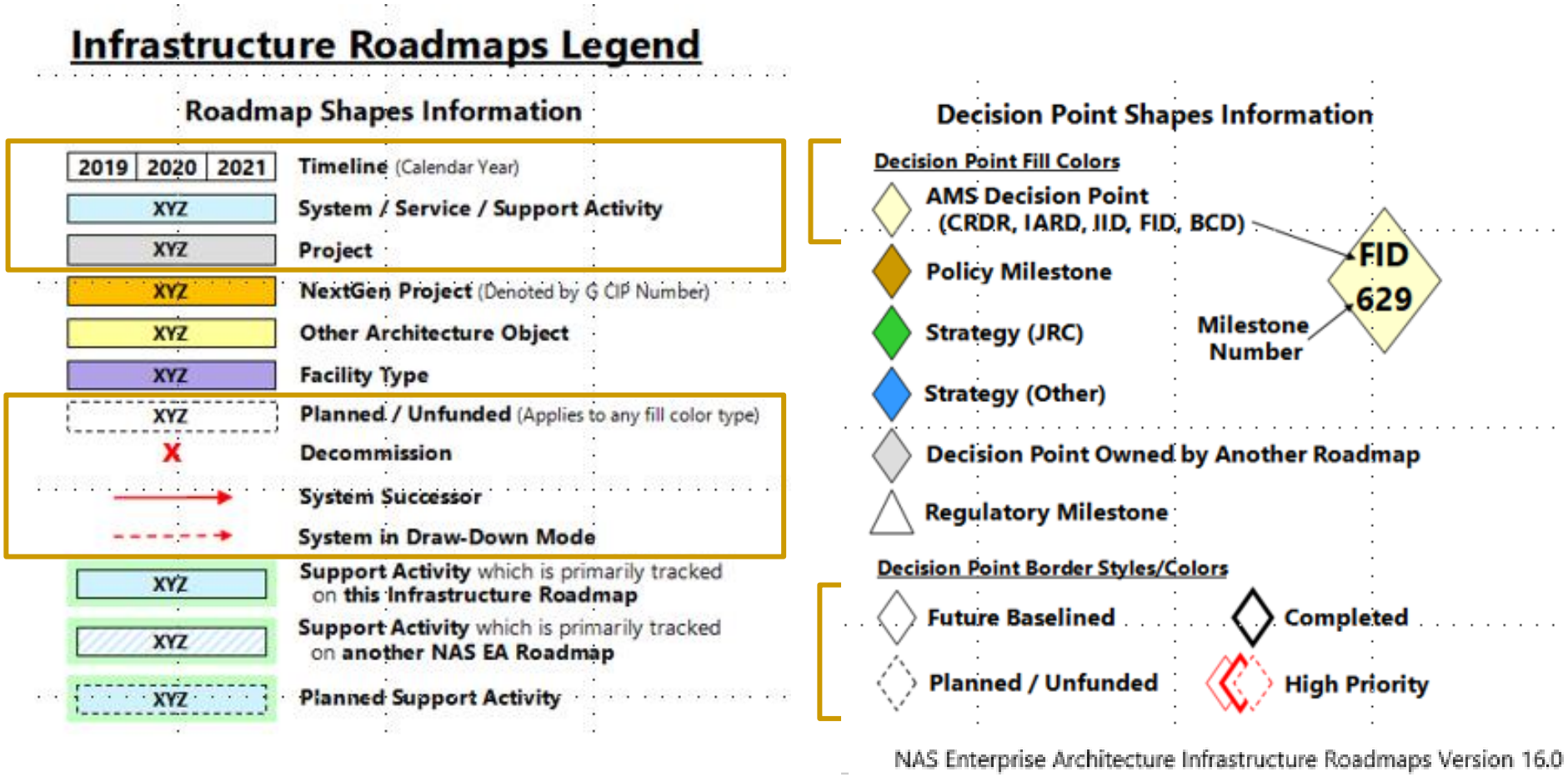


Surveillance Evolution

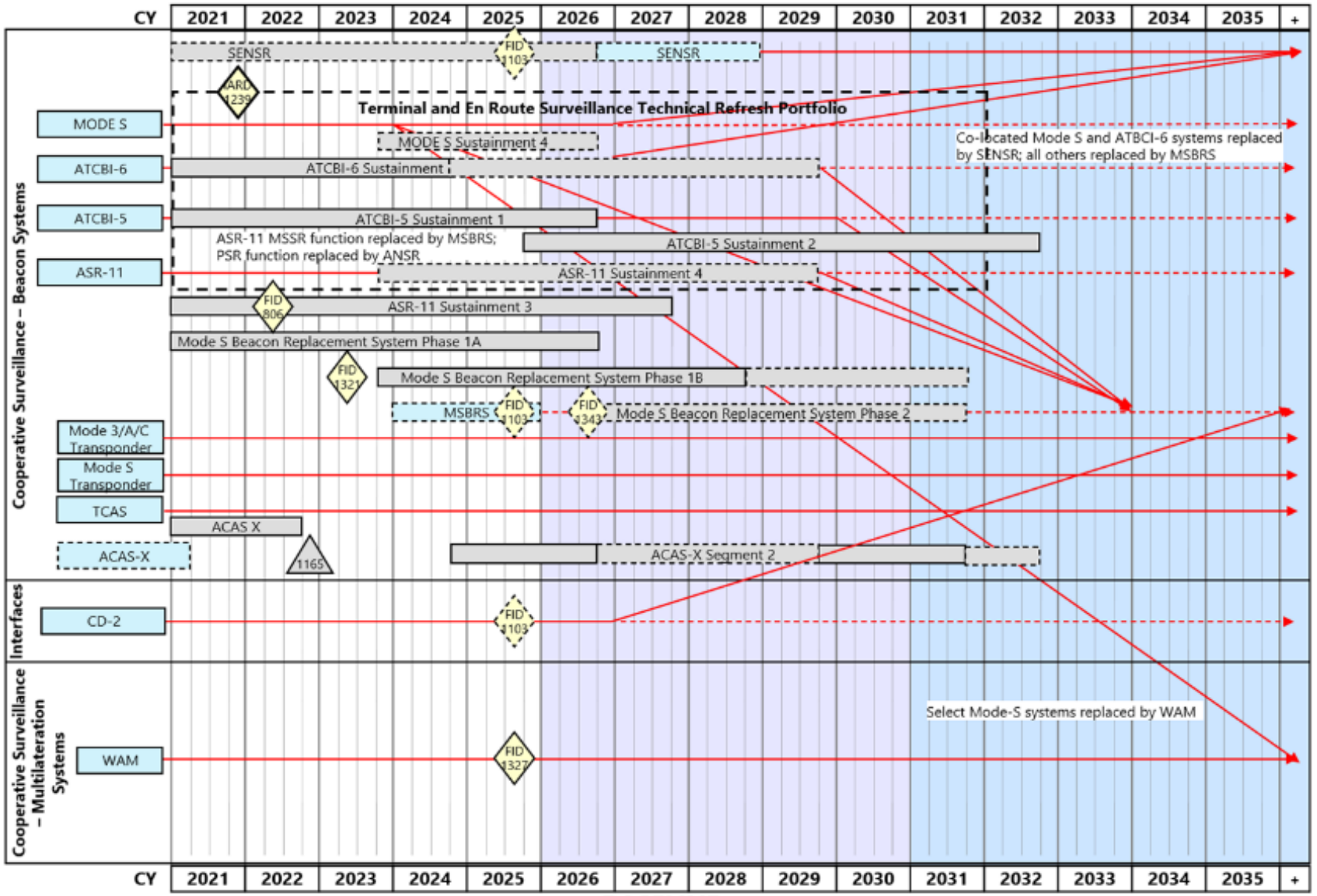


2022 EA Infrastructure Roadmaps Legend

Find Surveillance Infrastructure Roadmaps at: https://www.FAA.gov/nextgen/

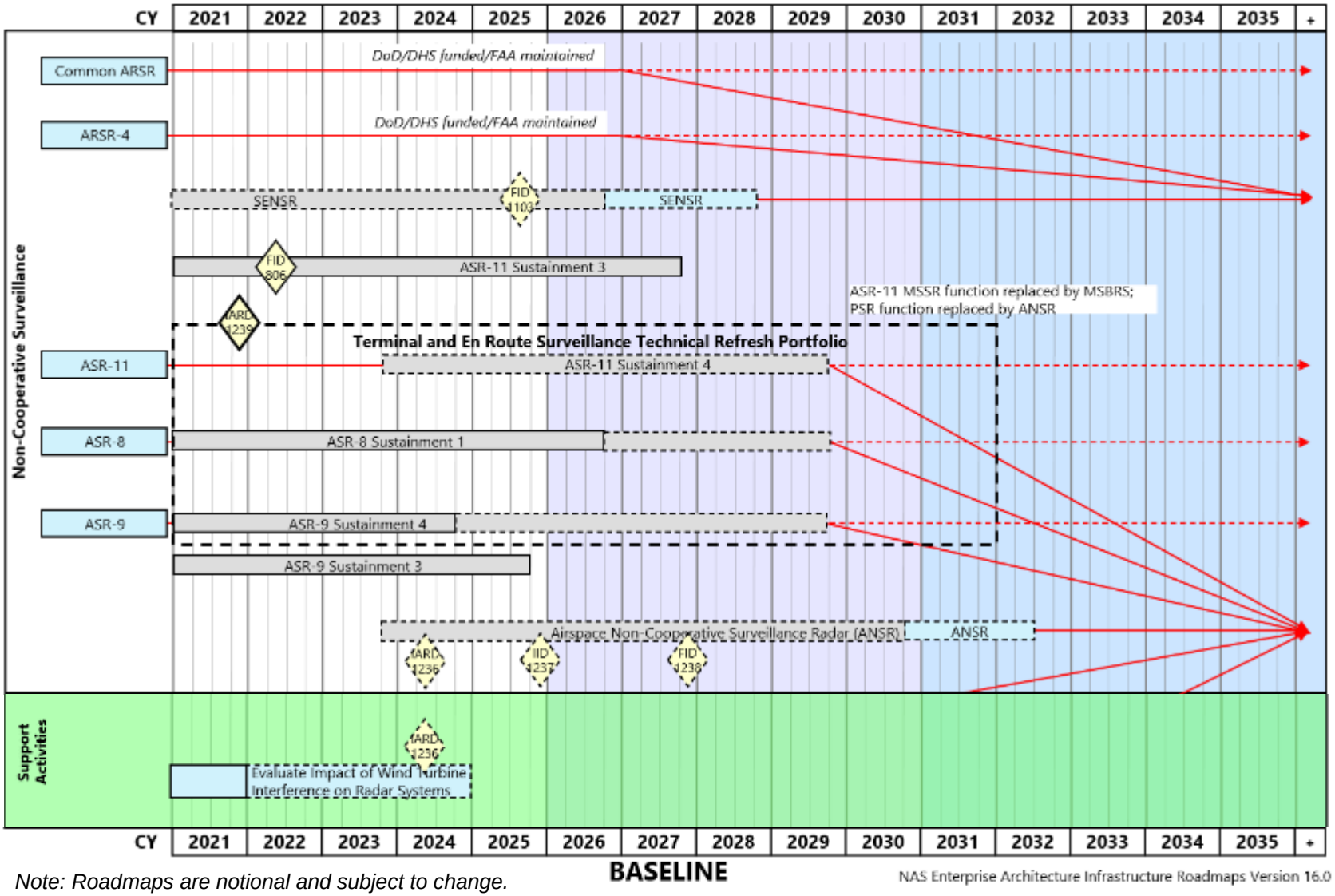


Surveillance Roadmap (2 of 4)



Note: Roadmaps are notional and subject to change.

Surveillance Roadmap (3 of 4)



BASELINE

NAS Enterprise Architecture Infrastructure Roadmaps Version 16.0

Note: Roadmaps are notional and subject to change.

SAS | Critical Activities

Sustainment

- **ASR-11 Sustainment 3 and Terminal & Enroute Surveillance Tech Refresh Portfolio (TES TRP)**

  Determination of optimal sustainment approach while considering the strategic direction of Surveillance Services.

- **Wind Turbine Radar Interference Mitigation**

  Near/Mid-term mitigation approach.

Replacement

- **Mode S Beacon Replacement System (MSBRS) Phase 1A and Phase 1B**
  - Complete Phase 1A In Plant Development Test (IPDT) by March 2023.
  - Determination of Phase 1B quantity
  - FY24 First Year Phase 1B Funding, procurement of production systems.

- **Airspace Non-cooperative Surveillance Radar (ANSR)**

  FY24 First Year Funding, supporting an IARD in 2024.

Surveillance Acquisition and Sustainment (SAS)

Key Takeaways

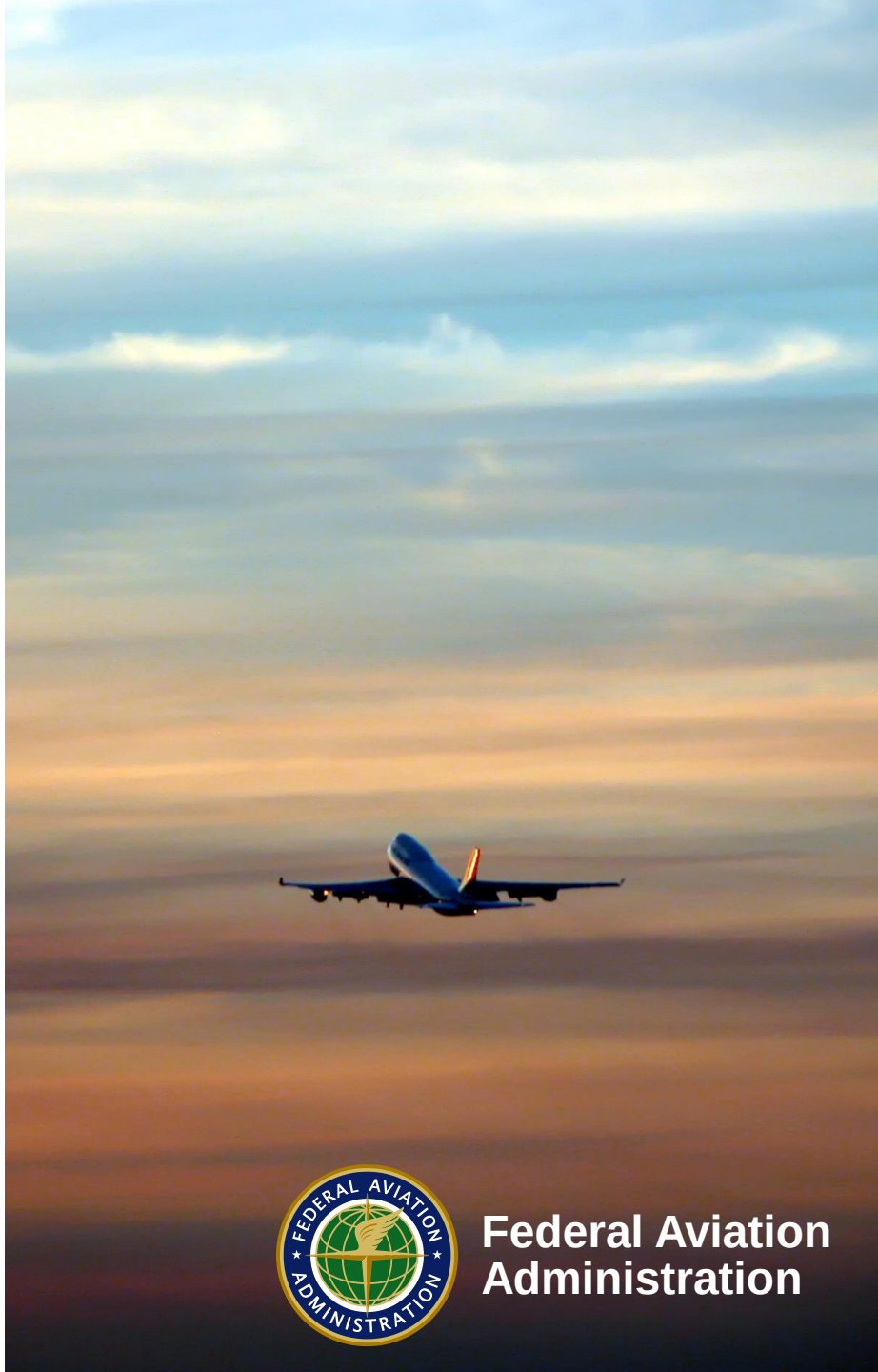
- We need to continue investing in the sustainment of radars as we simultaneously research and develop replacement solutions and consider divestiture.
- We are in a transition period between current and future surveillance architecture.
- Industry is critical to ensure a seamless and cost-effective transition.

The FAA seeks industry input on:

- Innovative cost-effective solutions for sustainment.
- Application of new technologies for future non-cooperative surveillance services in the NAS.

AJM-41 Surveillance Acquisition and Sustainment

Break



Surveillance Services Industry Day

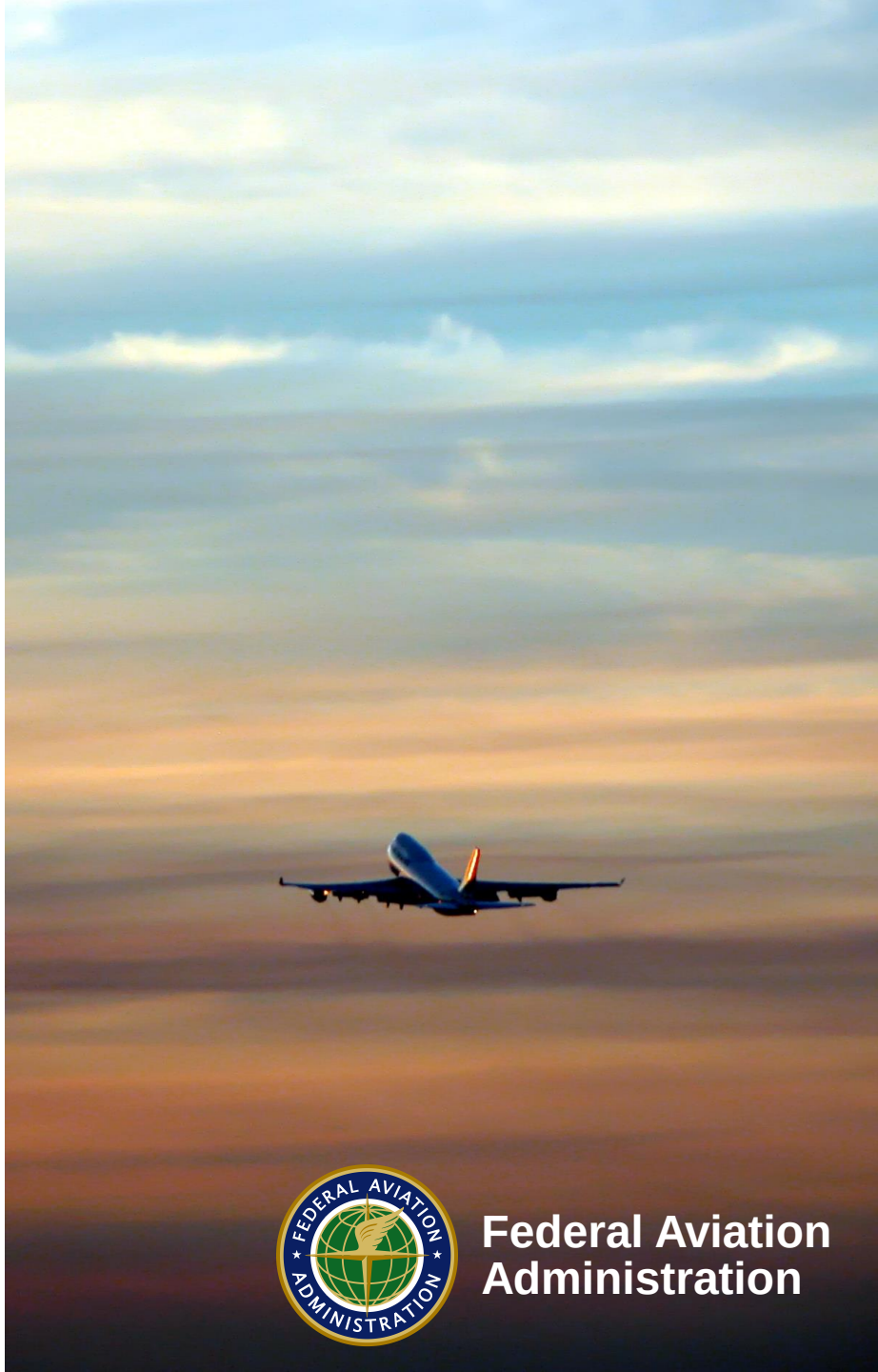
Wednesday, March 23, 2022

Welcome	Amy Gusky
Keynote Address	Dan Hicok
AJM-4 Surveillance Services Strategy	Mike Freie
AJM-41 Surveillance Acquisition and Sustainment	Brad Kenemuth
AJM-42 Surveillance and Broadcast Services	Evan Setzer
AJM-43 Spectrum Efficient National Surveillance Radar (SENSR)	Adrian Caster
Lunch Break	
Surveillance Contracting Opportunities	Patrick Weare
Radar Surveillance Future Focus	Brad Kenemuth
Surface Surveillance	Bill Kaplan
• **Runway Status Lights: Field Lighting System Replacement**	Syed Tahmid
• **ASDE-3 Surface Movement Radar Replacement**	Joe Robinson
Updates to 2021 Industry Day	
• **Surveillance Processing and Networking**	Bob Pomrink
• **Surveillance Broadcast and Information Services (SBIS) Update**	Pamela Maxwell
• **Airspace Non-cooperative Surveillance Radar (ANSR)**	Fred Atwood
• **Wind Turbine Radar Interference Mitigation**	James Osburn
Close	Amy Gusky

Evan Setzer

FAA Surveillance and Broadcast Services (SBS)

Group Manager (A)



Objectives

- **What does Surveillance and Broadcast Services cover?**
- **Where do we work and intersect with industry?**
- **What should you take away from today?**

Surveillance and Broadcast Services

What We Do

Surveillance Acquisition and Sustainment (SAS)

Surveillance and Broadcast Services (SBS)

Spectrum Efficient National Surveillance Radar (SENSR)

Vision

The SBS Group provides the best air traffic surveillance capabilities in the world.

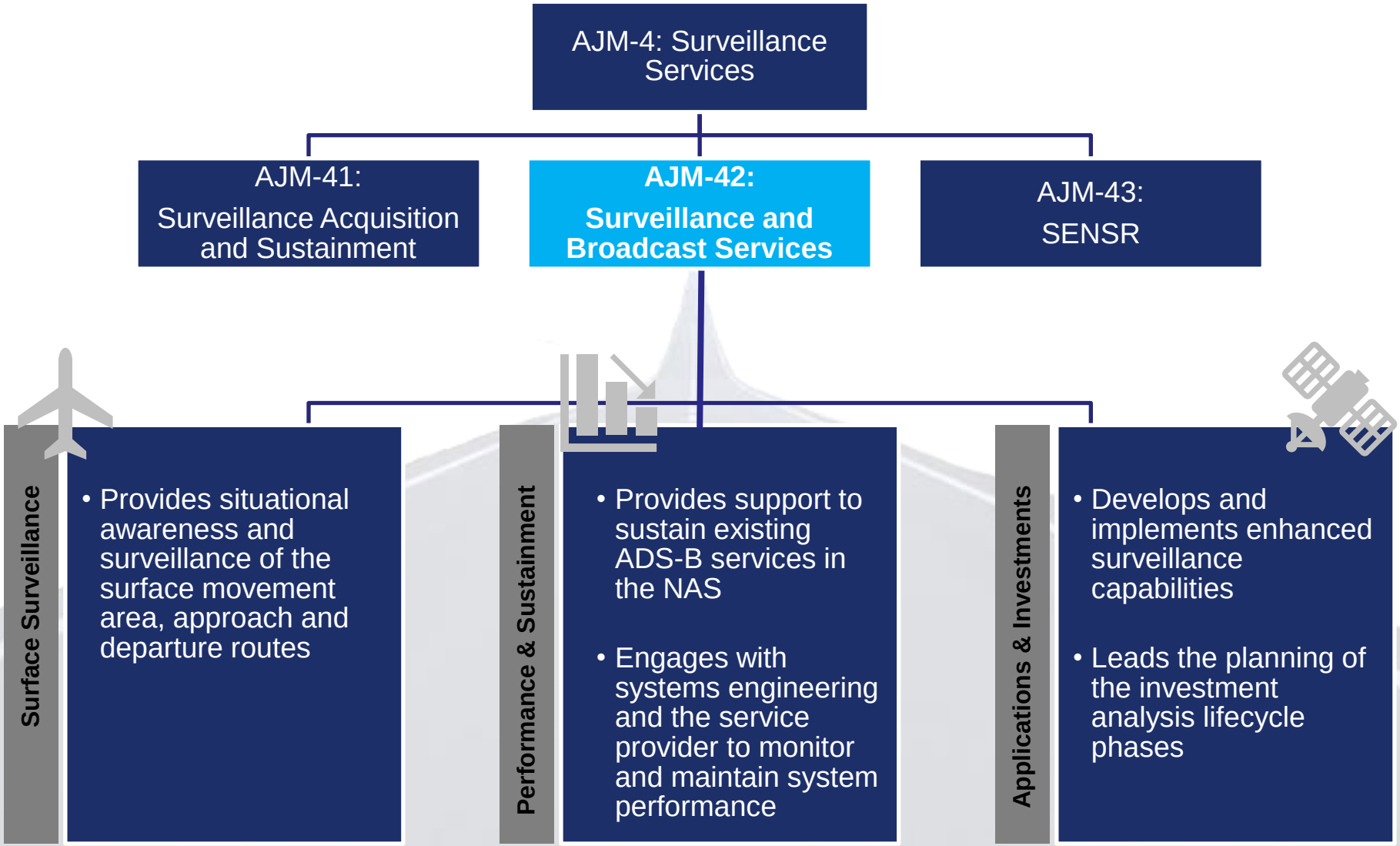
Mission

The SBS Group delivers secure, integrated surveillance and broadcast services to NAS operations by leveraging diverse platforms and domains.

We do this through an innovative mindset, effective leadership at all levels, empowering employees, and collaborating across the aviation community.

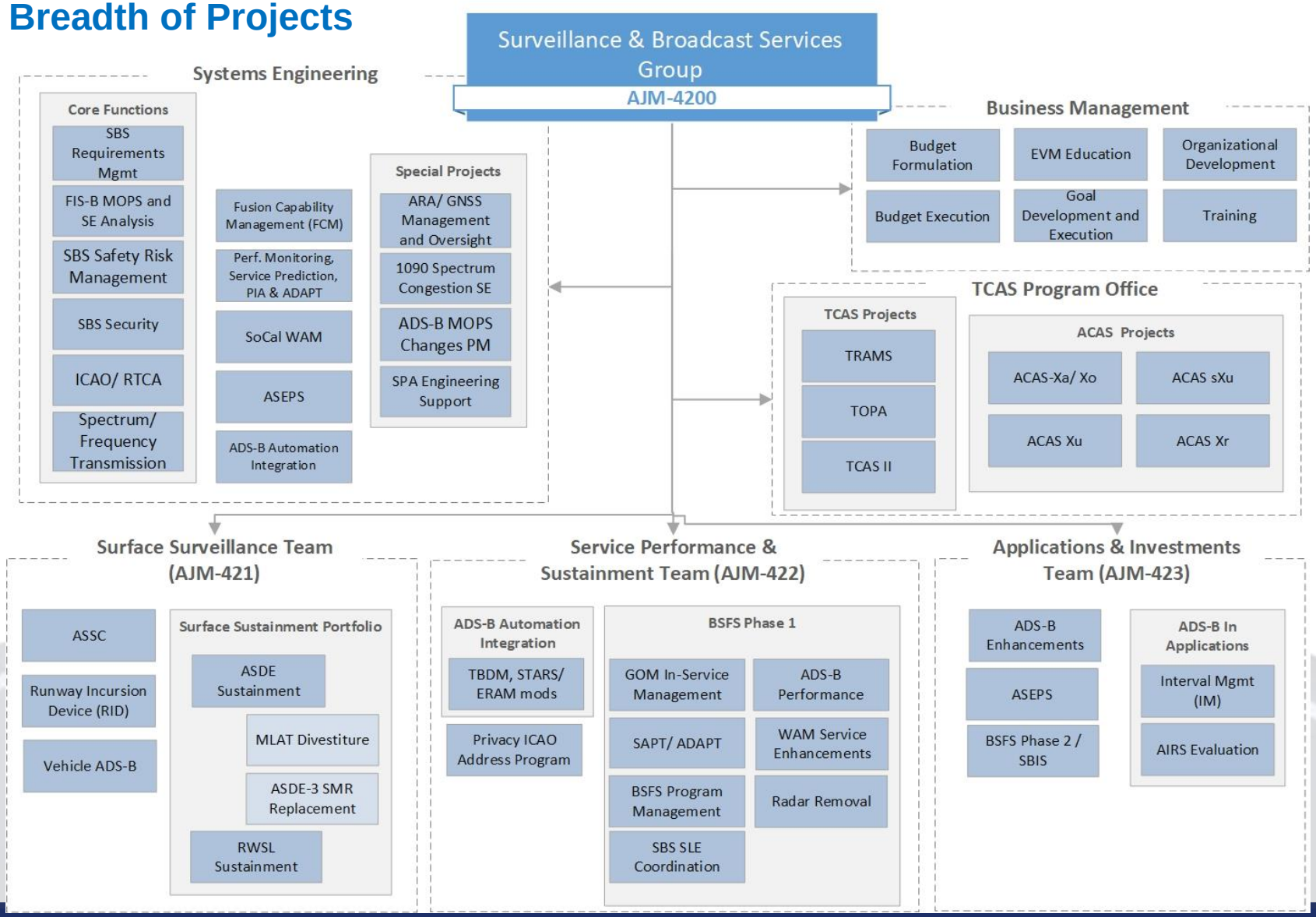
Surveillance and Broadcast Services

Program Overviews



Surveillance and Broadcast Services

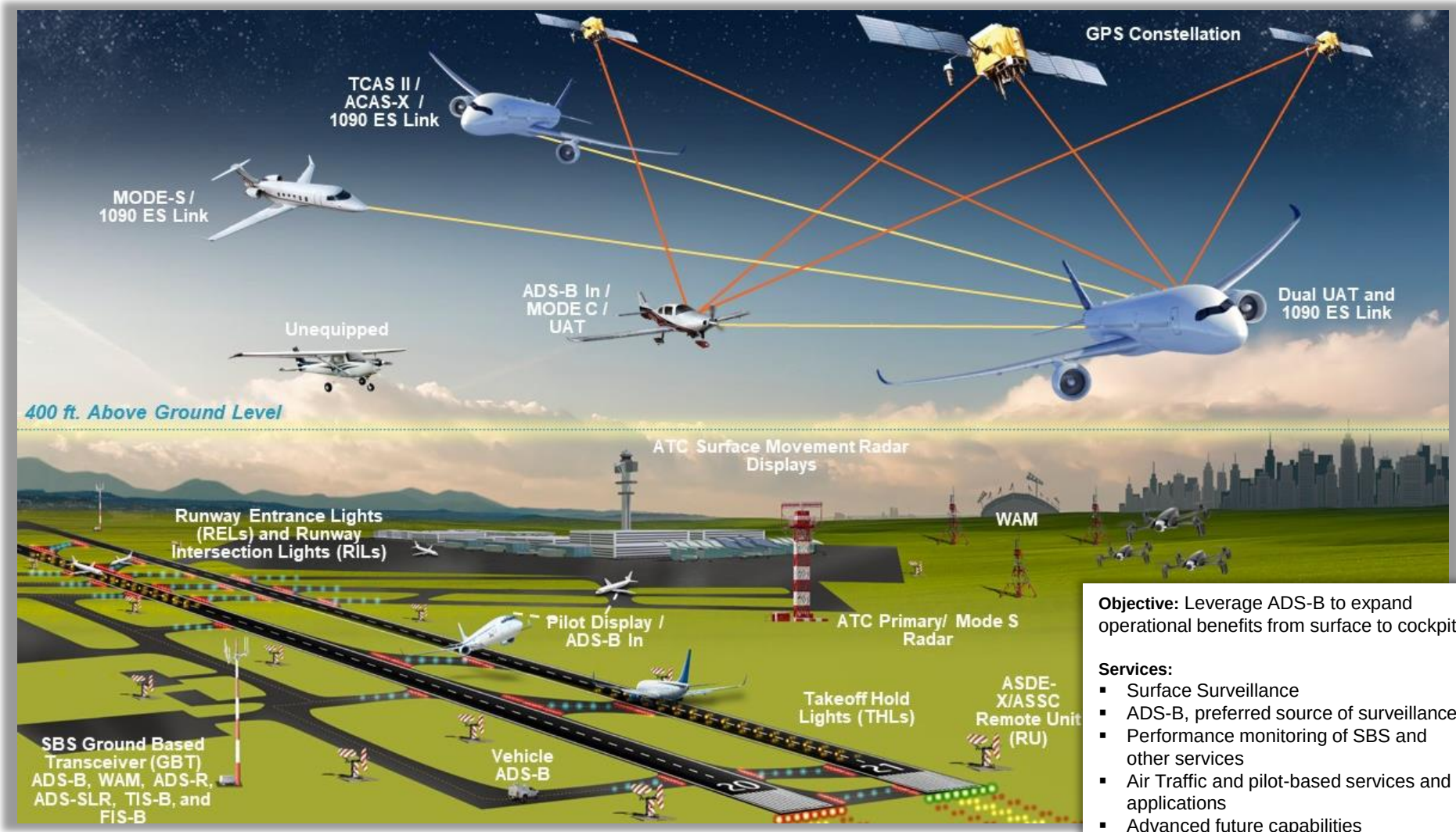
Breadth of Projects



For a complete list of acronyms please see the acronym at end of presentation.

Surveillance and Broadcast Services

National Airspace System Footprint



Objective: Leverage ADS-B to expand operational benefits from surface to cockpit

Services:

- Surface Surveillance
- ADS-B, preferred source of surveillance
- Performance monitoring of SBS and other services
- Air Traffic and pilot-based services and applications
- Advanced future capabilities

Acronyms:

- ACAS-X – Airborne Collision Avoidance System
- ADS-B – Automatic Dependent Surveillance-Broadcast
- ASDE – Airport Surface Detection System
- ASSC – Airport Surface Surveillance Capability
- Mode-S – Mode Select Beacon System
- TCAS II – Traffic, Alert and Collision Avoidance System
- UAT – Universal Access Transceiver
- WAM – Wide Area Multilateration

Surveillance and Broadcast Services

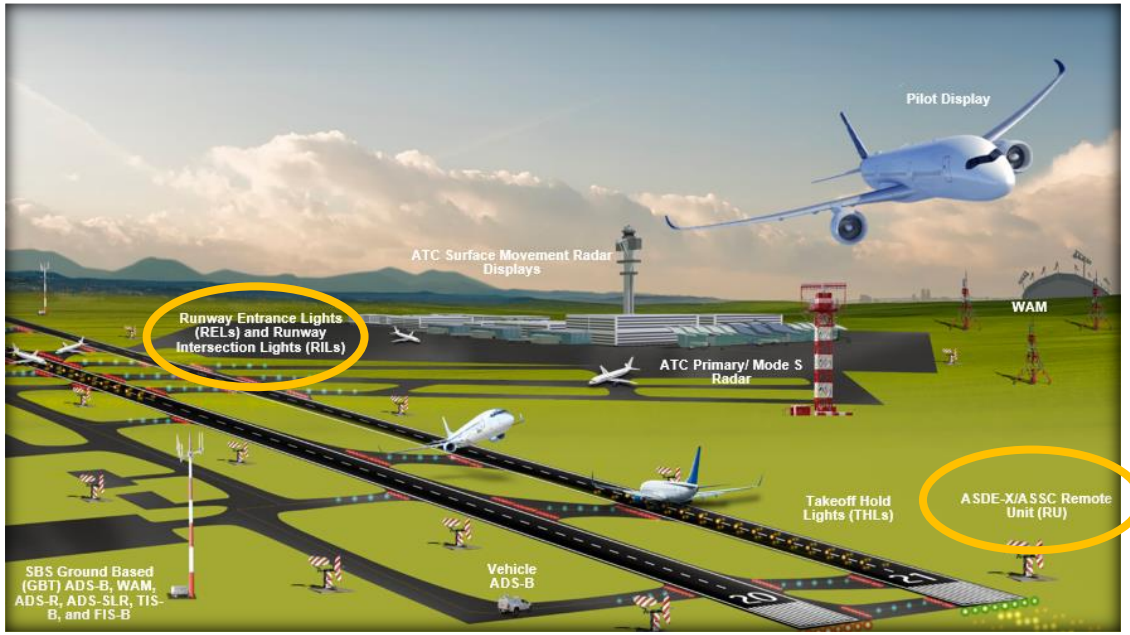
Surface Surveillance Environment

Airport Surface Detection Equipment Model-X (ASDE-X) and Airport Surface Surveillance Capability System (ASSC):

Air traffic surface surveillance systems that are used operationally for situational awareness and surveillance of the surface movement area as well as approach and departure routes at 44 airports.

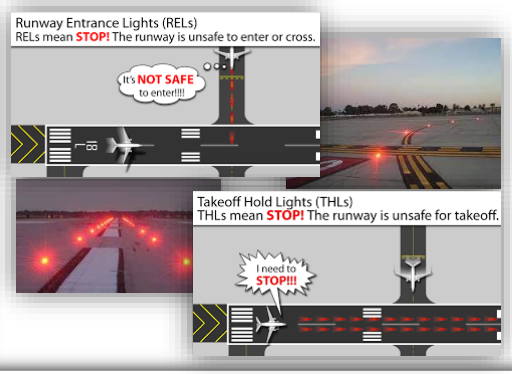
Runway Status Lights (RWSL):

Integrates airport lighting equipment with approach and surface surveillance systems at 20 ASDE-X and ASSC airports to provide a visual signal to pilots and vehicle operators indicating that it is unsafe to enter, cross, or begin takeoff on a runway.



ASDE Equipment

RWSL Equipment



Surveillance and Broadcast Services

ADS-B by the Numbers

Provides coverage to

21%

more airspace than radar at 1500 feet above ground level in the Contiguous U.S. and Hawaii.

Alaskan air taxis with ADS-B In capability are

55%

less likely to have an accident than unequipped aircraft.

The FAA has seen a

33%

reduction in accidents for ADS-B In equipped aircraft in the Contiguous U.S.

ADS-B

ADS-B coverage in the Gulf of Mexico has resulted in a

220%

increase in average annual IFR helicopter flights since 2009.

The SBS team saves an average of

$660,000

per year by using available space on energy company transportation to/from ADS-B stations in the Gulf of Mexico.

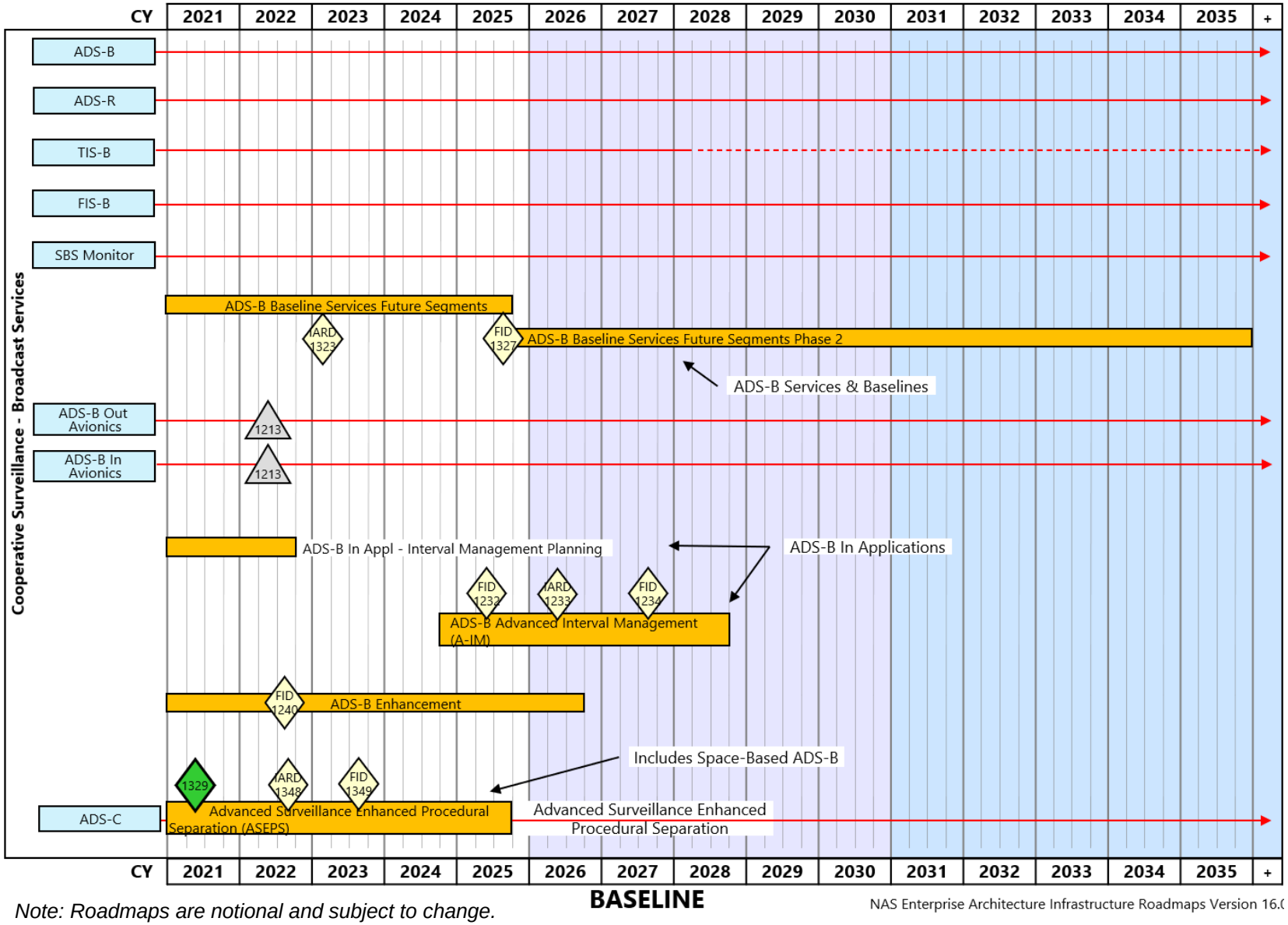
ADS-B equipped IFR helicopter flights in the Gulf of Mexico save approximately

10–30 lbs

of fuel per 100-200 NM trip.

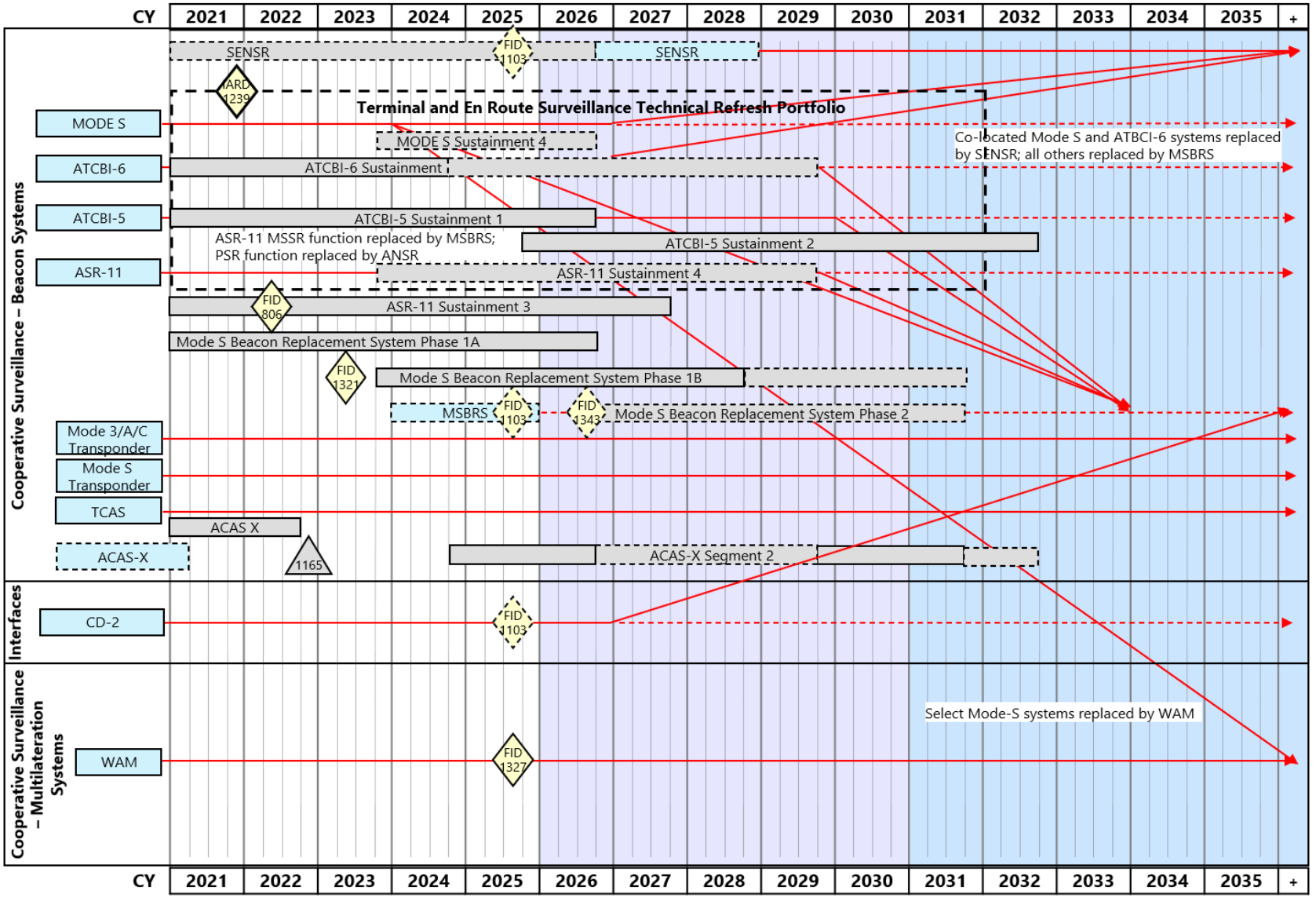
As of March 1, 2022, a total of 158,562 aircraft are equipped with ADS-B Out systems.
As of March 15, 2022, a total of 122,825 aircraft are identified as ADS-B In capable.

Surveillance Roadmap (1 of 4)



Note: Roadmaps are notional and subject to change.

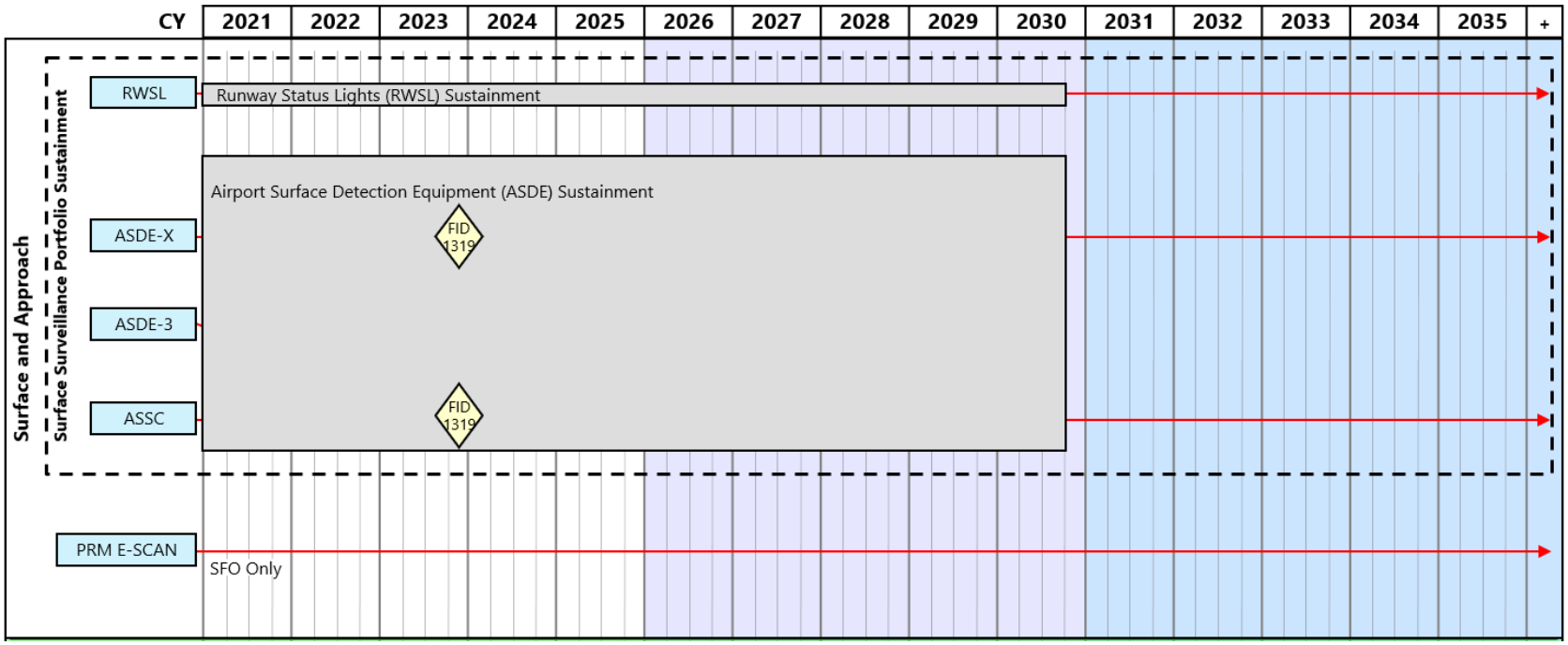
Surveillance Roadmap (2 of 4)



Note: Roadmaps are notional and subject to change.

NAS Enterprise Architecture Infrastructure Roadmaps Version 16.0

Surveillance Roadmap (4 of 4)



Note: Roadmaps are notional and subject to change.

Find Surveillance Infrastructure Roadmaps at: https://www.FAA.gov/nextgen/

Surveillance and Broadcast Services

Industry Impact

Maintaining a **close relationship between Surveillance and Broadcast Services and Industry stakeholders** has had a **significant impact across the breadth of the portfolio of projects**. A few examples are below:

ASDE and RWSL Sustain Projects	**Future of the Ocean 2035 (FOTO35)**	**SBIS Project**	**Gulf of Mexico (GOM)**
Informed the FAA of the nature of the competitive marketplace available to pursue these projects	Helping **confirm user needs and expectations** for development of oceanic standards and procedures	Helped **solidify the acquisition approach** to the follow-on contract and foster competition	Helped **enhance asset relocation and sustainment strategies**
	Led to determination of **efficiency-gaining concepts** desired by operators in the oceanic environment	**Refine the strategy for incorporation of FENS** into the SBIS architecture	Collaboration resulted in **re-evaluation and improvement of GOM's sustainment strategy**
ADS-B In	Supporting development of **harmonized oceanic standards, procedures, and interoperability**	Gaining understanding of opportunities to continue to **refine requirements, transition, and innovation**	Valuable industry **questions illuminated the need to articulate the offshore environment** more clearly
Collaborating with industry on **ADS-B In Retrofit Spacing (AIRS)** Evaluation			

Surveillance and Broadcast Services

Deep Dives this Afternoon

This afternoon SBS project leads will be providing key updates on multiple projects. Below are the **high-level details you need to know** heading into those sessions:

Surveillance Broadcast and Information Services (SBIS)

- Targeting unrestricted, competitive ADS-B service-based **award in 2025.**
- Solution will **keep ADS-B operational in the NAS beyond 2025**.

Surface Surveillance: RWSL Field Lighting Replacement Component Procurement (FLSRCP) and ASDE-3 Surface Movement Radar Replacement

- FLSRCP will **support the testing, installation, integration, and configuration** of the FLS into the legacy RWSL system.
- Investigating **Commercial Off-The-Shelf solutions that can provide an innovative SMR solution** to replace the ASDE-3 radar sub-systems.

Surveillance Processing and Networking (SPaN)

- SPaN **provides the foundation of the Future Enterprise Surveillance Services Architecture** via supporting key NAS Services, xTM Services, and more!
- While SPaN is not just an SBS project, **the future SBIS structure is an integral part of the future surveillance services architecture**.

Surveillance and Broadcast Services

Key Takeaways

Continuous Evolution

ADS-B continues to **impact the NAS** and will have **a significant role into the future with the follow-on** SBIS **contract**.

We **continue to focus on** not only new capabilities, but also **ensuring long-term affordability and sustainability**.

Consistent Progress

SBS continues making **progress on initiatives across the NAS** including:

- Focusing on rightsizing the NAS through **divestiture.**
- Working towards global acceptance of **ACAS-X.**
- Continuing to progress toward an Investment Analysis Readiness Decision (IARD) for **Space-Based ADS-B** in late FY2022.

Learning Opportunities

Surface Surveillance, SBIS, and the Surveillance Processing and Networking teams will **dive deeper this afternoon**.

Industry Engagement

And finally, much of the work we do **cannot be done without the cooperation and insight of our industry partners**!

Surveillance and Broadcast Services Acronyms

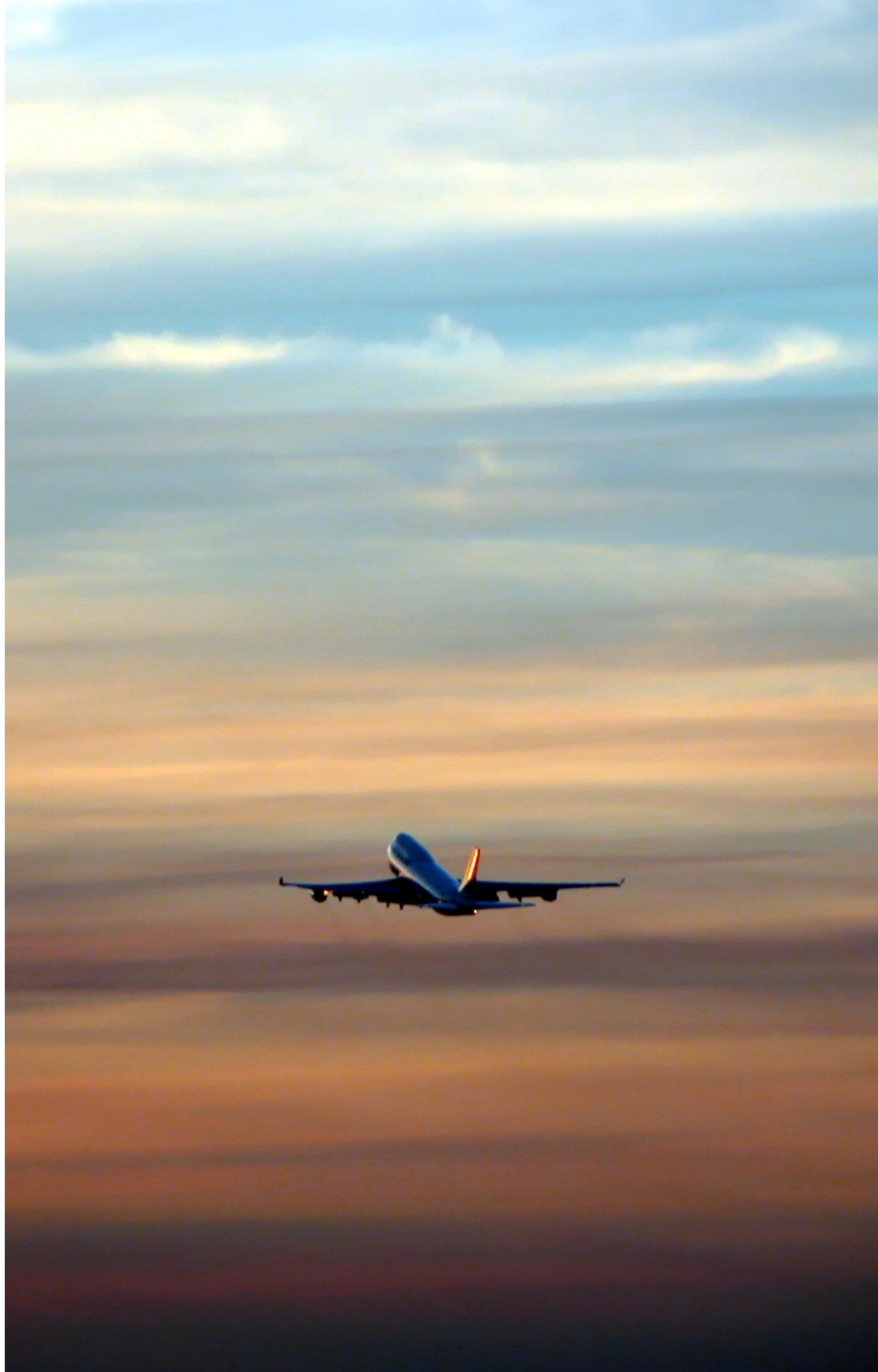
1090ES	Mode S Transponder with Extended Squitter	Mode-S	Mode Select Beason System
ACAS-X	Airborne Collision Avoidance System	MOPS	Minimum Operational Performance Standards
ADS-B	Automatic Dependent Surveillance-Broadcast	MSBRS	Mode S Beacon Replacement System
ADS-C	Automatic Dependent Surveillance-Contract	MSSR	Monopulse Secondary Surveillance Radar
ADS-R	Automatic Dependent Surveillance-Rebroadcast	NAS	National Airspace System
ADS-SLR	Automatic Dependent Surveillance Same Link Rebroadcast	NM	Nautical Miles
A-IM	Advanced Interval Management	PIA	Privacy ICAO Aircraft Address
AIRS	ADS-B In Retrofit Spacing	PMO	Program Management Organization
ASDE	Airport Surface Detection System	PRM	Precision Runway Monitors
ASDE-X	Airport Surface Detection System Model X	REL	Runway Entrance Lights
ASEPS	Advanced Surveillance Enhanced Procedural Separation	RID	Runway Incursion Device
ASR-11	Airport Surveillance Radar	RIL	Runway Intersection Lights
ASSC	Airport Surface Surveillance Capability	RU	Remote Unit
ATC	Air Traffic Control	RWSL	Runway Status Lights
ATCBI	Air Traffic Control Beacon Interrogator	SAS	Surveillance Acquisition Sustainment (Legacy Surveillance)
CD-2	Common Digitizer 2	SBIS	Surveillance Broadcast and Information Services
ESS	Essential Services (Bus)	SBS	Surveillance and Broadcast Services
FAA	Federal Aviation Administration	SE	Systems Engineering
FENS	FAA Enterprise Network Services	SENSR	Spectrum Efficient National Surveillance Radar
FCM	Fusion Capability Management	SMR	Surface Movement Radar
FID	Final Investment Decision	SoCal WAM	Southern California WAM
FIS-B	Flight Information Services - Broadcast	SPaN	Surveillance Processing and Networking
FLSRCP	Field Lighting Replacement Component Procurement	sUAS	Small Unmanned Aircraft Systems
GBT	Ground Based Transceiver	TCAS	Traffic, Alert and Collision Avoidance System
GOM	Gulf of Mexico	THL	Takeoff Hold Lights
GPS	Global Positioning System	TIS-B	Traffic Information Services - Broadcast
IARD	Investment Analysis Readiness Decision	UAT	Universal Access Transceiver
ICAO	International Civil Aviation Organization	WAM	Wide Area Mutlilateration
IFR	Instrument Flight Rule	xTM	Extensible Traffic Management
MLAT	Multilateration		

AJM-42 Surveillance and Broadcast Services

Adrian Caster

FAA Spectrum Efficient National Surveillance Radar (SENSR)

Group Manager (A)



Spectrum Efficient National Surveillance Radar (SENSR)

Surveillance Acquisition and Sustainment (SAS)

Surveillance and Broadcast Services (SBS)

Spectrum Efficient National Surveillance Radar (SENSR)

SENSR Background

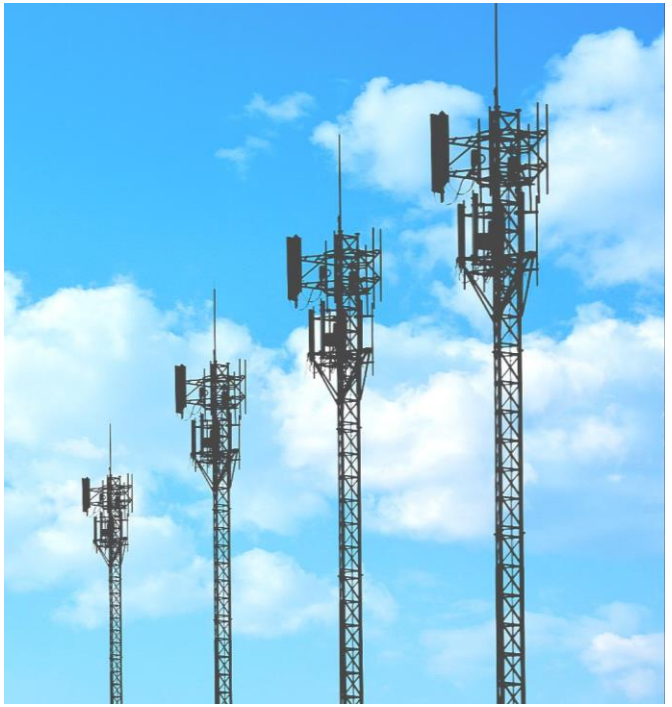
Mission: To make wireless spectrum available for shared federal and non-federal use.
Goal: To free up portions of the spectrum for auction to wireless broadband by 2024 and replace aging radar infrastructure.

The SENSR Joint Program Office (JPO), comprised of the FAA, DoD, and DHS, is collaborating with the Technical Panel, which is composed of representatives from:

- Office of Management and Budget (OMB)
- Federal Communications Commission (FCC)
- Department of Commerce's National Telecommunications and Information Administration (NTIA).

A **spectrum auction** would:

– Re-allocate 30 MHz of federal spectrum to non-federal and/or shared spectrum;
– Make funds available to replace aging radar infrastructure, avoiding agency appropriations.



Changes to the SENSR Program Mission Scope

Replace LRRs

March 2020

- SENSR team achieved **Initial Investment Decision (IID),** which was contingent upon preferred strategy.
- Program scope was to use auction proceeds to fund:
  - Full replacement of all Long Range Radars (LRRs)
  - Short range gap fillers

Retune LRRs in Near Term, Replace in Long Term

August 2020

- The preferred IID strategy lacked policy-level support.
- White House National Security Council (NSC) Policy Coordinating Committee (PCC) revised scope:
  - Retune ARSR-4 and CARSRs out of 36 MHz (30 MHz and two 3-MHz guard bands), while staying in the L-Band.
  - Replace all ARSR-4 radars with modern LRRs and those CARSRs that cannot be retuned.

Retune LRRs in Near Term, Potential Replacement in Long Term

December 2021

- NTIA proposed strategy:
  - Interim solution: Retune ARSR-4 and CARSRs out of 50 MHz (including two 10-MHz guard bands), while staying in L-Band.
  - End-state solution: ARSR-4s replaced with modern LRRs if projected auction funds are sufficient

SENSR Status

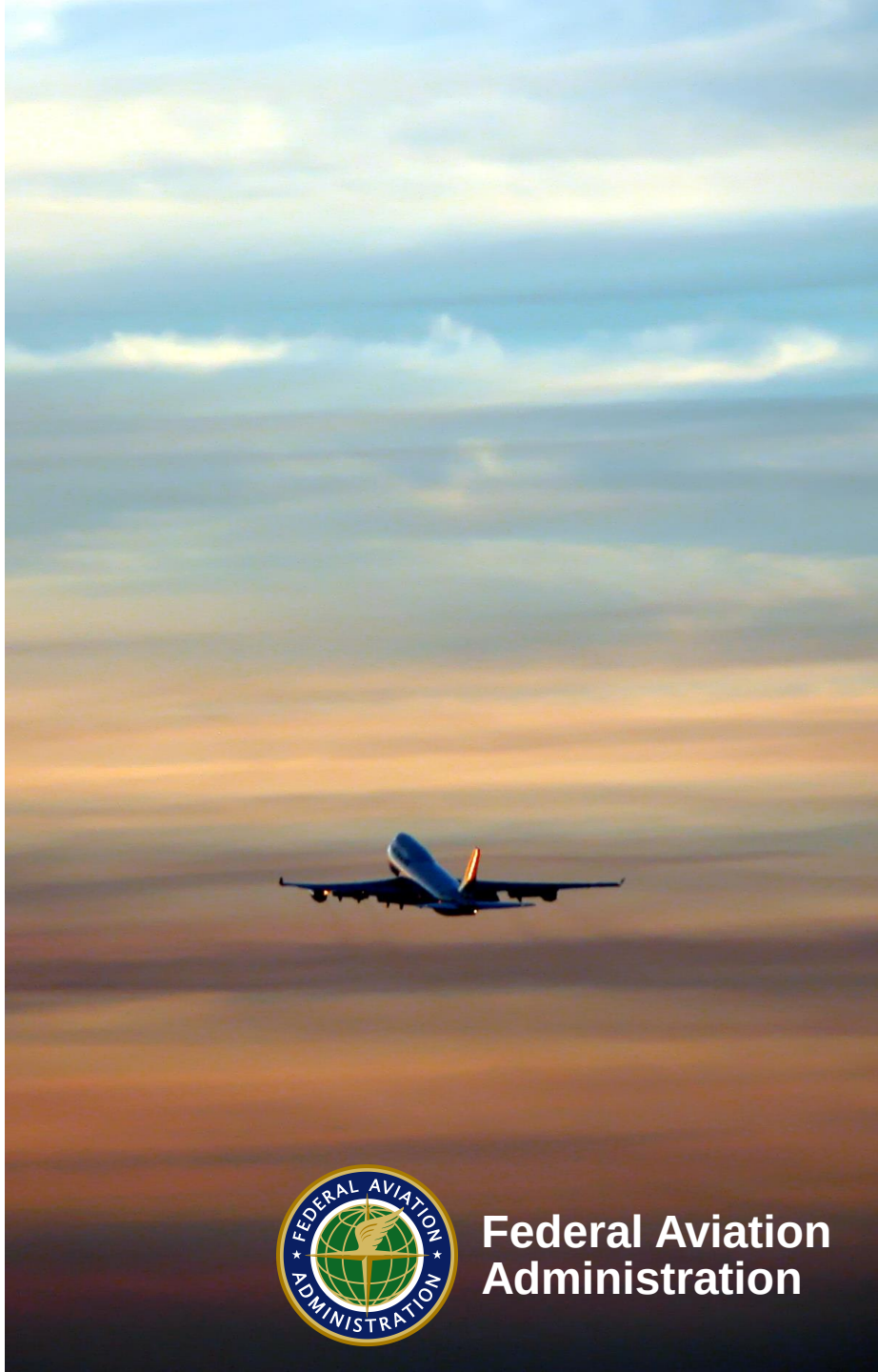
- **In response to Policy Coordination Committee (PCC) Directive, SENSR JPO completed feasibility study and documented results in December 2021 report.**
- **In parallel, NTIA completed their own feasibility assessment; draft report completed in December 2021.**
- **Secretary of Commerce has not yet identified spectrum for auction.**
  - Spectrum Pipeline Act 2015 requires identification by 1 Jan 2022.
  - Secretary's draft letter identifying spectrum for auction was submitted to OMB in December 2021.
  - Currently under review within Executive Office of the President.

What's Next for SENSR?

- Continue communicating the direction of the program with internal and external stakeholders.
- Determine post-feasibility assessment activities based on outcome of the Executive Office review.
- Evaluate policy options and course of action(s) based on outcome of the Executive Office review.
- Continue surveillance investment analysis and program activities in the event SENSR opportunity cannot be realized.

AJM-43 SENSR

Lunch Break



Surveillance Services Industry Day

Wednesday, March 23, 2022

Welcome	Amy Gusky
Keynote Address	Dan Hicok
AJM-4 Surveillance Services Strategy	Mike Freie
AJM-41 Surveillance Acquisition and Sustainment	Brad Kenemuth
AJM-42 Surveillance and Broadcast Services	Evan Setzer
AJM-43 Spectrum Efficient National Surveillance Radar (SENSR)	Adrian Caster
Lunch Break	
Surveillance Contracting Opportunities	Patrick Weare
Radar Surveillance Future Focus	Brad Kenemuth
Surface Surveillance	Bill Kaplan
• **Runway Status Lights: Field Lighting System Replacement**	Syed Tahmid
• **ASDE-3 Surface Movement Radar Replacement**	Joe Robinson
Updates to 2021 Industry Day	
• **Surveillance Processing and Networking**	Bob Pomrink
• **Surveillance Broadcast and Information Services (SBIS) Update**	Pamela Maxwell
• **Airspace Non-cooperative Surveillance Radar (ANSR)**	Fred Atwood
• **Wind Turbine Radar Interference Mitigation**	James Osburn
Close	Amy Gusky