Federal Aviation Administration

National Airspace System Capital Investment Plan
FY 2015 - 2019

Federal Aviation Administration National Airspace System Capital Investment Plan for Fiscal Years 2015–2019

1 Introduction

1.1 The Capital Investment Plan

The Federal Aviation Administration (FAA) Capital Investment Plan (CIP) describes the planned investments in the National Airspace System (NAS) for the next five years. The Consolidated Appropriations Act of 2014 (Public Law 113-76) requires submittal of a five year CIP. The language requiring the CIP states "That upon initial submission to the Congress of the fiscal year 2015 President's Budget, the Secretary of Transportation shall transmit to the Congress a comprehensive capital investment plan for the Federal Aviation Administration which includes funding for each budget line item for fiscal years 2015 through 2019, with total funding for each year of the plan constrained to the funding targets for those years as estimated and approved by the Office of Management and Budget."

Section 1 of this Introduction discusses the Agency's Strategic Priorities and important factors affecting the planning for the future. Section 2 "Key Considerations in Capital Planning" presents the main issues that must be addressed in developing a five year capital plan. Section 3 "Capital Investment Plan Summary" provides an overview of FAA's fiscal year (FY) 2015 budget request and the planned capital funding for FY 2016 through FY 2019. Section 4, "NextGen Portfolios and Implementations", describes the Next Generation Air Transportation System (NextGen) Portfolios and their planned Operational Improvements (OIs). Section 5, "Enterprise Architecture Infrastructure Roadmaps", contains the Infrastructure Roadmaps which outline the planned modernization of the NAS and describe the programs and systems included in the NAS architecture.

Appendix A links capital investment programs to FAA strategic priorities and performance metrics. Appendix B provides the capital investment program descriptions, links programs to performance metrics and provides program milestones and implementation schedules. Appendix C contains the FY 2015 President's budget request and the planned outyear funding amounts from FY 2016 through FY 2019 by Budget Line Item (BLI). Appendix D provides status on major capital investment programs. Major programs are those classified as Acquisition Category (ACAT) 1, 2 or 3 which typically are programs with total Facilities and Equipment (F&E) costs greater than $100M or have significant impact, complexity, risk, sensitivity, safety or security issues. For more information on ACAT see:
http://fast.faa.gov/AcquisitionCategories.cfm?p_title=Special Topics

Appendix E provides acronym and abbreviation definitions.

1.2 Strategic Priorities and the CIP

The FAA Administrator, in February 2014, established a new strategic framework to define where the agency will focus its efforts. This framework includes high-level Strategic Priorities, as well as Priority Initiatives and related Performance Metrics that will help achieve the priorities. The Administrator has defined four Strategic Priorities as follows:

- **Make Aviation Safer and Smarter –** There is an imperative to be smarter about how we ensure aviation safety because the aviation industry is growing more complex. At the same time, we have more safety data than we have ever had before. This provides us with the opportunity to be more proactive about safety and constantly raise the bar.

- **Deliver benefits through technology and infrastructure –** NextGen gives us the opportunity to redefine the National Airspace System for the future and prove that we can deliver benefits to the users of the system. We also need to safely integrate new types of user technologies into the airspace, as well as rebalance existing services and modernize our infrastructure, which will enable us to reduce our costs and become more efficient in the long run.

- **Enhance global leadership –** Aviation is a global industry. We have to continue our heritage as world leaders in aviation and set the safety standard for others to measure against. We need to be at the table to shape international standards to improve aviation safety and efficiency around the world.

- **Empower and innovate with the FAA's people –** The FAA's employees are the ultimate driver behind our success, and we need to have the best and the brightest talent with the appropriate leadership and technical skills to transform the FAA and the aviation system.

These Strategic Priorities are being used as the organizing principle for agency business plans beginning in FY 2014 and replace the framework of Destination 2025.
Capital programs support the FAA's Strategic Priorities and Performance Metrics. The Strategic Priorities guide the FAA in upgrading NAS systems and operating procedures to meet the demands of current and future growth. Performance Metrics are a tool the agency uses to track progress towards accomplishment of the Strategic Priorities. The agency frequently depends on capital investments to meet the Performance Metrics. Capital investment success is determined by comparing actual performance improvements to the Performance Metrics. The results can then be used to determine whether adjustments need to be made to the system design or its implementation schedule.

Each Budget Line Item capital investment program summary in Appendix B identifies the primary Strategic Priority and Performance Metric that the program supports. Many FAA programs will contribute to more than one Strategic Priority or Performance Metric; however, the program alignment in the CIP (appendices A and B) is for the program's most significant contribution. In the summary tables in appendix A, several programs normally appear under each performance metric because many programs are interdependent; one program may not be successful in meeting a performance metric without completing other supporting programs. Also, in the complex system used for air traffic control (ATC), system improvements must address several different operating conditions to reach the overall performance metric, and often it takes multiple programs to address each of the variables, which individually contribute to overall system improvements.

Each program in Appendix B has a section titled “Relationship of Program to FAA Performance Metric” which gives more specific information about how the program contributes to meeting a Performance Metric.

1.3 Important Factors Affecting Planning for the Future

1.3.1 Economic Considerations

Aviation plays a significant role in promoting economic growth and accounts for over five percent of the U.S. Gross Domestic Product. As NextGen modernizes the existing ATC system by introducing new technologies and advanced decision support tools to make air travel more efficient, safer and environmentally friendly, it supports growth in our economy. A study by the Air Traffic Organization (ATO) Performance Analysis Service Unit, “The Economic Impact of Civil Aviation on the U.S. Economy,” published in February 2014, estimated that aviation accounted for over $1.5 trillion in economic activity in 2012, which is 5.4 percent of the total U.S. economic activity. The spending on aviation-related activities supported an estimated 11.8 million jobs. In support of commercial activities, air carriers transported over 61.2 billion revenue ton-miles of air cargo. A reliable worldwide aviation network is essential for today’s economy. Domestic and international commerce rely on the access and passenger and freight capacity it provides to cities around the world to sustain economic growth.

Aviation spending also has a significant impact on the economy of most states as shown in figure 1-1 below. It encourages the growth of local economies and supports employment opportunities in a variety of occupations. Civil aviation’s contribution to state economies is as high as 20.1 percent in Hawaii. In several states, a large manufacturing base dedicated to producing aircraft and related aviation equipment provides a significant boost to their economies. Another significant factor in the amount of aviation’s economic impact is the contribution from tourism. Spending on air services and the related spending on food, hotels and entertainment provide a boost to several segments of local economies. In some states, such as Alaska, air service is an economic necessity for transporting a wide variety of goods and services due to a lack of other modes of transportation.

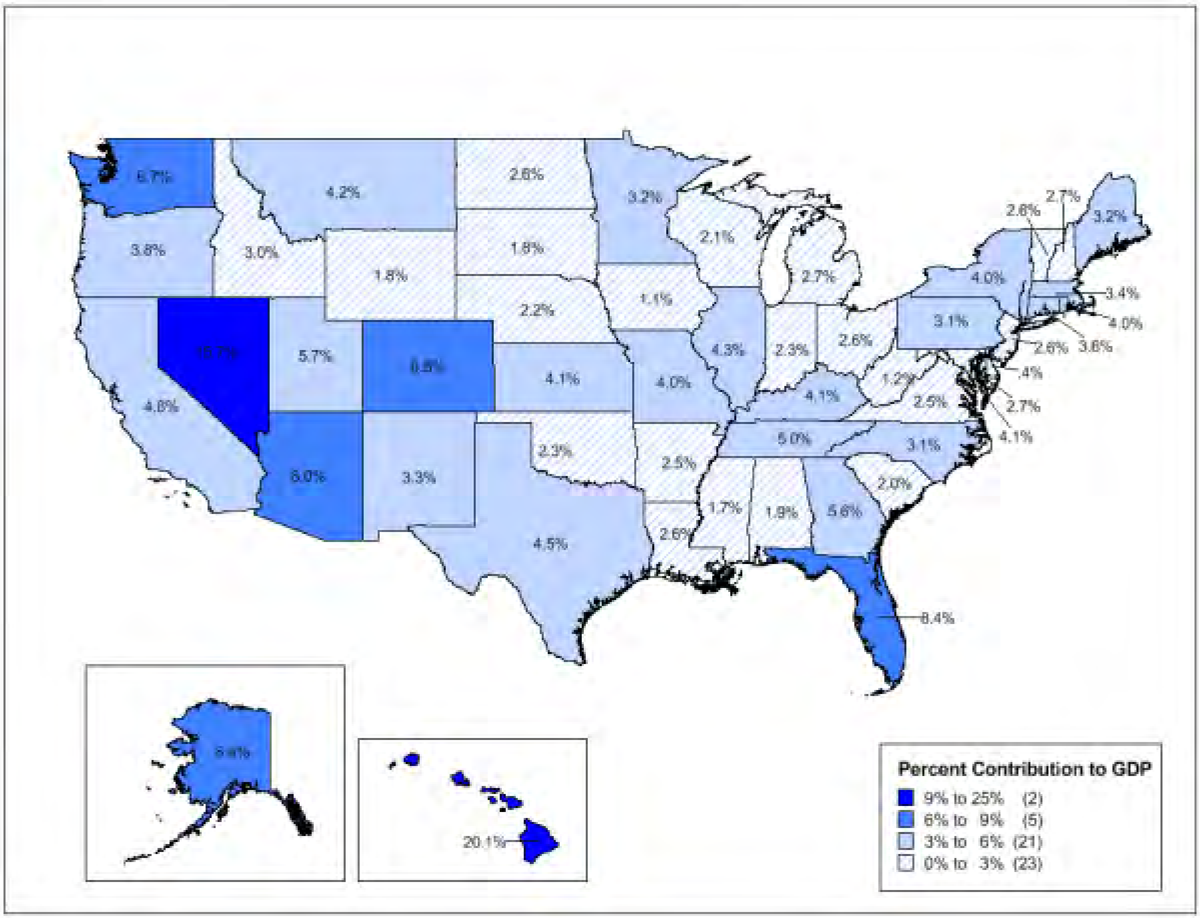

Figure 1-1 Aviation Percent of State Gross Domestic Product[1]

1.3.2 Air Travel Demand

Historically, the demand for air travel is closely related to changes in the economy. As figure 1-2 shows the growth trend in revenue passenger miles (RPM) over the last 30 years corresponds positively with the growth in Gross Domestic Product (GDP). The U.S. inflation-adjusted (real) economic output long-term growth trend has supported the continuing increases in the number of passengers and the miles traveled. There are some deviations in both GDP and RPM growth, which are caused by abnormal events, such as the terrorist attacks of September 11, 2001 and the slower than normal pace of economic recovery. Based on the data available for calendar year 2013, economic growth is positive. With the continuing growth in the economy, FAA expects future growth in demand for air travel, which ultimately will lead to more aircraft operations, and translate into increased workload for the FAA. It also translates into more pressure on the core airports to handle additional operations. Significant increases in operations at these airports

[1] Source: "The Economic Impact of Civil Aviation on the U.S. Economy," February 2014.

could increase delays, therefore advanced NextGen capabilities to provide the improved services must be implemented to handle this growth.

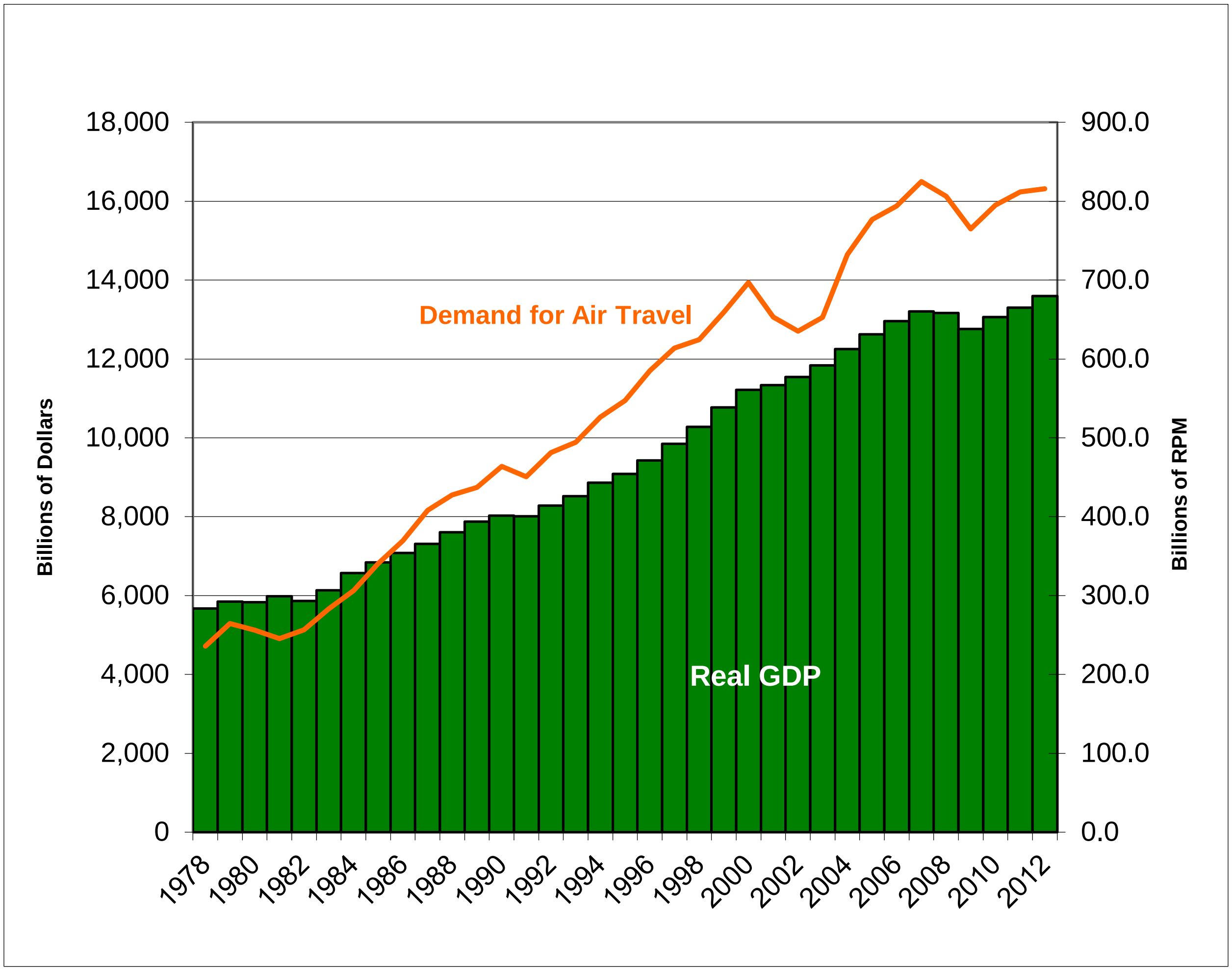

Figure 1-2 Air Travel Demand Growth Compared to Growth in GDP[2]

1.3.3 Airport Expansion Projects

Ongoing efforts to increase airport capacity also affect the need for capital investment, especially at the Core airports, which are experiencing delays. Fort Lauderdale/Hollywood International Airport has an active project to extend a runway to support air carrier operations. Port Columbus International Airport recently completed its runway relocation project. John F. Kennedy International Airport has a runway reconstruction, widening, and extension underway to accommodate new large aircraft and to reduce delays. Chicago O'Hare International Airport completed Phase I of the O'Hare Modernization Program and has begun the first of three projects in Phase II. Philadelphia International Airport is beginning a major airport

[2] Sources: U.S. Department of Commerce, Bureau of Economic Analysis and U.S. Department of Transportation, Bureau of Transportation Statistics

reconfiguration program. Anchorage, Atlanta, and San Antonio International Airports recently completed runway extensions to improve efficiency of operations. Increasing capacity at large, delay-prone airports is critical to overall NAS performance because delays at the large airports may propagate to other airports where passengers are waiting for incoming flights. The 29 large hub airports handle about 71% of airline enplanements. The combined total of 62 large and medium hubs supports about 88% of all U.S. passenger enplanements. Delays at these airports affect a significant number of passengers, and delayed flights at these airports may cause passengers to miss connections for their next flight.

When local airport authorities (in coordination with FAA) build new runways or otherwise expand capacity, additional supporting navigation and surveillance equipment and new procedures may be needed to make that capacity fully usable. New or relocated runways often require that airspace around the airports be reconfigured to accommodate new approach and departure patterns. This frequently requires installing new navigational aids and precision landing systems to help pilots in the approach patterns for the runways. To achieve the full benefits of precision approach guidance systems, approach lights must be installed and visibility sensors positioned along the runway so that precision guidance can be used down to the lowest visibility approved for that airport. Some airports need new surveillance systems to cover expanded departure and approach patterns. Capital investment may also be needed to expand or relocate air traffic control facilities. In cases where significant increases in demand result from the airport improvements, additional controller positions may eventually be needed.

2 Key Considerations in Capital Planning

Capital investments normally involve extensive planning and development time. They often take several years to implement because the systems being purchased are technologically complex and require development of both new software and hardware. New systems require extensive testing to ensure that they meet the reliability standards before they can be used for air traffic control. To be prepared for future increases in air traffic, capital investments to improve the capacity, as well as efficiency, predictability, or flexibility of the NAS must be made many years in advance of the anticipated growth.

Capital investing must also be balanced between adding new capabilities and ensuring the existing systems operate reliably until they can be replaced. FAA must provide adequate funding to sustain the performance of the current air traffic control system until a more capable system to handle future growth is in place.

2.1 Sustaining Current System Performance while transitioning to NextGen

The air traffic control system requires very high reliability and availability. Once an aircraft is airborne in controlled airspace, maintaining its separation from other aircraft for the entire flight from takeoff to landing depends on reliable operation of communication, navigation and surveillance systems. Each system in the NAS has a high level of redundancy to support system reliability and to minimize service disruptions. Much of this equipment must be replaced regularly to avoid the problems of obsolescence and to reduce the potential for system failures due to aging components that cause deterioration in system performance.

The air traffic control infrastructure is a complex system made up of several thousand components. There are 21 Air Route Traffic Control Centers (ARTCC) that house automation equipment used by air traffic controllers to control en route air traffic. There are over 500 towers and 167 Terminal Radar Control (TRACON) facilities that control air traffic approaching, landing at and departing airports. The flow of air traffic is assisted by several hundred surveillance and weather radars; navigation systems for en route and airport approach guidance, and thousands of communication radios that allow pilots and air traffic controllers to be in continuous contact during an aircraft's flight.

NextGen will incrementally replace and improve much of this equipment to introduce new efficiencies in handling air traffic control, but some existing systems such as communication, navigation and surveillance equipment will stay in operation in the future to supplement or back up NextGen capabilities. Many of the buildings housing existing ATC equipment will also remain in service to house the new replacement NextGen systems. To sustain the high level of reliability and availability required for the safety and efficiency of flight, a continued level of investment in this valuable infrastructure will be necessary.

There are ongoing reviews to identify the level of support needed to renovate and replace existing infrastructure so that the air traffic control system can continue to operate efficiently. Preliminary data indicates that:

- Many en route control facilities require renovations and physical plant upgrades to protect equipment and employees from potentially unsafe working conditions,
- Tower renovations and replacements to meet operational needs and correct material defects in existing facilities will have costs that exceed $100 million per year,
- Many of the radar systems that were installed in the 1990s will be retained as a backup for NextGen so they must be modernized and eventually replaced,
- Many navigation systems will be retained as either a back up to NextGen or to support operational improvements. These systems are old and a portion will have to be replaced over the next ten years,
- Radio communications between pilots and controllers is a key element of air traffic control and the radios must be updated with the newer technology that supports NextGen operations,
- Virtually all of the communications, navigation and surveillance systems are housed in shelters which must be renovated regularly. Defects that endanger the equipment inside must be addressed quickly to avoid disruptions to the flow of air traffic.

Reliable electrical power is critical for the operation of the ATC system. Super Storm Sandy is a recent example of commercial power failing and impacting the operation of the NAS, and how the FAA backup power equipment can minimize the impact. Massive commercial power outages occurred across the middle and northern Atlantic states starting on October 29, 2013. NAS facilities were without commercial power for a total of 9,438 hours. The FAA's backup power systems provided power to the NAS facilities for over 4,500 hours of those hours. Because of the backup power capability, no flight operations were affected and there were no delays due to power outages. Emergency power generators have been installed at most air traffic facilities, and maintaining this backup power requires constant attention and replacement of both the power generators and the systems that condition the power to protect ATC automation systems.

The air traffic control infrastructure has an estimated $4.7B backlog of requirements for sustaining its facilities which is a challenge in the current constrained budget environment. At current funding levels, the backlog is expected to grow to $7.5B by 2024. Goals, objectives, strategies, processes, and priorities are being established to meet this challenge. Eight systemic issues have been identified that need to be addressed across the ATO: Mold remediation, Fire Life Safety, Fall Protection, Arc Flash, Power Cable, Engine Generators, Fuel Storage Tanks, and ARTCC Chiller replacement. As requested in the FY 2015 Budget, a NAS Sustainment Strategy was developed to support the following 12 programs for emphasis in sustaining the NAS:

- ARTCC Building Improvements/Plant Improvements, BLI 2A05
- Air Traffic Control En Route Radar Facilities Improvements, BLI 2A08
- Terminal Air Traffic Control Facilities – Replace, BLI 2B06
- ATCT/Terminal Radar Approach Control (TRACON) Facilities – Improve, BLI 2B07
- NAS Facilities OSHA and Environmental Standards Compliance, BLI 2B09
- Fuel Storage Tank Replacement and Monitoring, BLI 2E01
- Unstaffed Infrastructure Sustainment, BLI 2E02
- Facilities Decommissioning, BLI 2E06
- Electrical Power Systems - Sustain/Support, BLI 2E07
- Energy Management and Compliance (EMC), BLI 2E08
- Hazardous Materials Management, BLI 3A01
- Mobile Assets Management Program, BLI 3A11

In addition to air traffic control infrastructure, the FAA has numerous other facilities that support operations and require periodic renewal and replacement including:

- A large training facility for new air traffic controllers and maintenance technicians,
- A logistics center that warehouses and ships parts to operational facilities,
- Repair shops that rebuild complex components that can be reused, and
- Several facilities that support research, test and evaluation of safety systems and new equipment.

2.2 Planning for the Future through NextGen Investments

NextGen is an umbrella term for the ongoing, wide-ranging transformation of the NAS to ensure that future safety, capacity and environmental needs are met. NextGen will fundamentally change the way air traffic is managed by combining new technologies for surveillance, navigation, and communications with automation system enhancements, workforce training, procedural changes, and airfield development, while facilitating the introduction and integration of new types of vehicles and operations, such as commercial space operations and unmanned aircraft systems. The movement to the next generation of aviation is being enabled by a shift from air traffic tactical control to strategic air traffic management, use of satellite-based navigation and surveillance, data communications, enhanced weather predictions and new procedures that combine to make air travel more convenient, predictable and environmentally friendly. NextGen will enhance safety, reduce delays, save fuel and reduce aviation's adverse environmental impact. NextGen advances will enable precise monitoring of aircraft on the ground and in flight, allow direct routes for travel between cities, improve decision support to manage traffic flows strategically on busy routes, and take advantage of precise navigation aids for fuller use of existing airspace and runway capacity. The transition to NextGen is proceeding and the FAA is making meaningful progress with the implementation of technologies and procedures on the ground and in the airspace.

The NextGen Implementation Plan provides more information concerning the vision, benefits and implementation details. http://www.faa.gov/nextgen/implementation

3 Capital Investment Plan Summary

3.1 FAA's FY 2015 President's Budget Request

Capital Investment is one component of the overall budget for FAA. FAA's total FY 2015 Budget Request is $15.4 billion, which includes $9.75 billion for Operations, $2.6 billion for Facilities and Equipment, $2.9 billion for Airport Improvement Grants and $156.75 million for Research, Engineering and Development. This capital investment plan discusses the F&E (capital programs) planned over the next five years. It begins with a base funding request of $2.604 billion in FY 2015 reflecting the President's Budget Request and outyear funding totals of $2.654 billion for FY 2016, $2.711 billion for FY 2017, $2.771 billion for FY 2018 and $2.833 billion for FY 2019. (See Appendix C)

The FAA's FY 2015 Budget Request can be found at the following web address: http://www.dot.gov/budget/dot-budget-and-performance

3.2 Five Year Capital Plan Overview

Capital investments are typically multi-year investments to support long-term Agency goals and objectives. New systems or facilities can take several years to plan, procure and implement. When a program is approved and baselined, the long term funding requirements to accomplish the program are identified and FAA management commits to funding these programs at the baseline levels. A program may have interdependencies with other programs and its success may depend upon the delivery of systems or interfaces implemented by other programs.

FAA's capital investment portfolio is divided into three categories:

- NextGen which will provide new capabilities ($727M, 28% of FY 2015 funding),
- Legacy Systems and Infrastructure which modernizes and sustains the current systems ($1,413M, 54% of FY 2015 funding), and
- Field Installation which provides program management and Personnel Compensation, Benefits, and Travel (PCB&T) supporting the installation of equipment for both legacy and NextGen systems ($463M, 18% of FY 2015 funding).

Figure 3-1 shows the balance between legacy systems and infrastructure investment and NextGen over the 5 year window of the CIP.

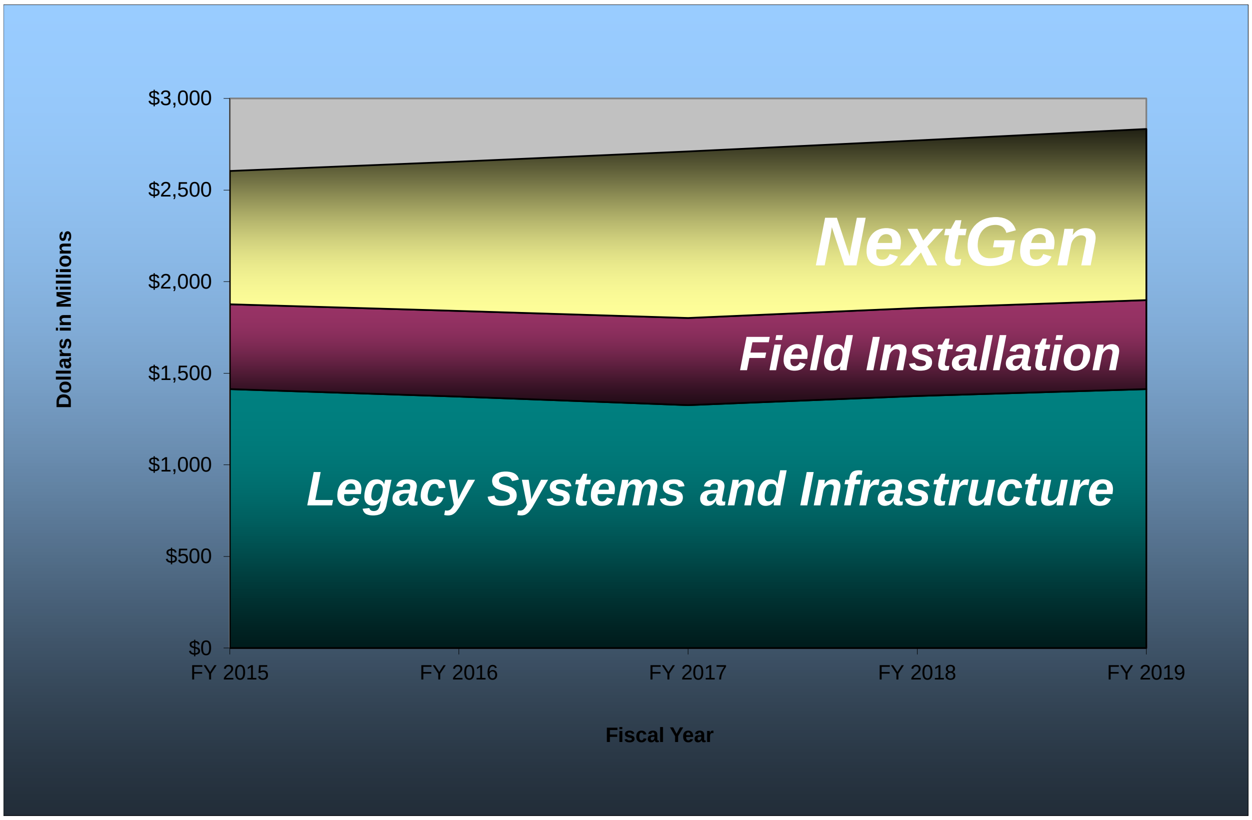

Figure 3-1 FAA's Capital Investment Portfolio

3.3 Facilities and Equipment Budget Activities

Within the F&E account, the budget is broken down into five different activities. Activity 1 programs support the initial design, engineering, development, test and evaluation activities associated with producing end-product systems, technologies and capabilities for the NAS. Activity 2 supports ATC major systems acquisitions and facilities infrastructure programs in the implementation phase. Activity 3 supports modernization of systems and support infrastructure for non-air traffic control facilities. Activity 4 provides mission support services across the FAA organization. Activity 5 covers PCB&T.

Activity 5 funding is included in Appendix C, but it is not described as a standalone program plan in Appendix B because this activity supports the management and implementation of most of the programs in the CIP.

Table 3-1 presents the Capital Investment Portfolio allocated to budget Activities. The breakout shows yearly funding amounts for Activities 1 through 4 by NextGen and Legacy Systems and Infrastructure. Activity 5 Field Installation is broken out by NextGen and Legacy for FY 2015 only. NextGen personnel costs are refined each year in support of the budget submission.

	FY 2015 Budget		FY 2016		FY 2017		FY2018		FY 2019	
	Legacy	NextGen	Legacy	NextGen	Legacy	NextGen	Legacy	NextGen	Legacy	NextGen
Activity 1	$55.1	$115.8	$50.1	$150.8	$59.6	$212.2	$59.2	$256.5	$56.8	$261.3
Activity 2	$1,007.3	$578.4	$977.8	$629.0	$929.2	$661.3	$975.0	$622.3	$1,022.3	$641.4
Activity 3	$139.6	$18.7	$129.7	$17.0	$111.2	$18.0	$107.4	$18.0	$103.7	$18.0
Activity 4	$211.2	$14.7	$215.5	$18.1	$225.9	$17.9	$234.2	$18.0	$230.2	$13.0
Activity 5	$416.5	$46.5	$467.0		$475.7		$480.5		$486.3	
Total	$1,829.7	$774.0	$1,840.1	$815.0	$1,801.6	$909.4	$1,856.3	$914.7	$1,899.3	$933.7

Table 3-1 Capital Investment Portfolio allocated to Budget Activities ($M)

A more detailed breakdown of funding amounts for each BLI within each Activity is provided in Appendix C. Outyear programs are grouped and aligned to the FY 2015 BLI structure. When the budget is revised each year, the BLI titles and numbers may change to adjust for programs that are ending or new programs that are added.

3.4 Legacy Systems and Infrastructure

The FAA has a large base of automation, navigation, surveillance, communications, and weather systems and thousands of facilities to house personnel and systems. These systems and facilities provide the basic infrastructure for the future NAS and must be modernized and replaced as they age or when operational needs change. The FY 2015 budget request provides $1,413M for legacy systems and infrastructure which is distributed to Activities 1 through 4 as shown in Table 3-1. The total funding amounts for legacy and infrastructure programs for FY 2016 through 2019 is $5,488M. Many of the programs requesting funding in FY 2015 have continuing funding requirements in the succeeding years.

Some key areas for investment in 2015 that support NAS long term system modernization are:

- **Terminal automation –** A long term effort is underway to upgrade all of the terminal automation systems. This effort is needed to replace systems that are not sustainable and do not provide the capability to support NextGen OI. Tower cab information systems will be upgraded and replaced to provide tower controllers information needed to better manage surface flow.
- **En route automation –** The new En Route Automation Modernization (ERAM) platform is planned to be installed and operational at all sites by the middle of FY 2015. This new platform will require continuing enhancements to support implementation of many NextGen operational enhancements.

- **Navigation/Landing –** The Wide Area Augmentation System (WAAS) program will continue to augment the Global Positioning System (GPS) to support the implementation of many OIs dependent on satellite navigation capabilities. Instrument Landing System (ILS) and other Navigation aids (Navaid) systems will be installed as necessary to replace older unreliable and unsupportable systems.
- **Surveillance/Weather –** Modernization of en route and terminal primary and secondary surveillance radars will be implemented to upgrade or replace aging unsupportable systems. Weather sensing and processing equipment will also be modernized.
- **Air Traffic Control Facilities –** Air Route Traffic Control Centers, Air Traffic Control Towers and Terminal Radar Approach Control Facilities need continual upgrading and modernization as those facilities age. These improvements are needed to support installation and operation of future systems.
- **Power systems –** NAS systems are dependent on reliable and high quality power. Emergency backup systems and power system components must be replaced as they age in order to maintain overall system reliability. New NAS systems supporting NextGen have increased sensitivity to power fluctuations so upgrading and replacing power systems is essential for future equipment investments.
- **Decommissioning –** The FAA has embarked on a concerted effort to eliminate those systems and facilities that are no longer needed. Decommissioning will reduce system maintenance, utilities and lease costs.

More details on all of the legacy systems and infrastructure are provided in Appendix B.

3.5 NextGen

The total NextGen F&E FY 2015 budget request includes $727.5M for NextGen programs and $46.5M for personnel costs totaling $774M. The $727.5M for NextGen programs is distributed to Activities 1 through 4 as shown in Tables 3-1 and 3-2. NextGen is structured into 11 portfolios for the development and implementation of OIs plus 8 NextGen programs. The total funding amount for FY 2016 through 2019 is $3,572M.

Development of NextGen OIs can include concept development, modeling, safety analyses, demonstrations, international coordination, standards development, and other pre-implementation activities. When a concept matures and a solution is determined, the improvement is implemented by procedure changes, system enhancements, air space changes, training, and upgrades to aircraft avionics as necessary to support the improvement. Development of OIs involves participation by Operations, Research and Development, and F&E organizations and NAS users. Capital investment programs develop the solutions for NextGen OIs and support the activities leading up to the initial investment management decisions for implementation. A solution, when fully developed, is baselined for acquisition and implementation. Activities 2 through 4 support the implementation of the solutions by developing system enhancements or new systems.

Developmental NextGen work is conducted in support of the following Portfolios. (More detailed descriptions of the portfolios and associated OIs are included in Section 4):

- Separation Management – BLI 1A05
- Improved Surface/Terminal Flight Data Manager (TFDM) – BLI 1A06
- On Demand NAS – BLI 1A07
- Environment – BLI 1A08
- Improved Multiple Runway Operations – BLI 1A09
- NAS Infrastructure – BLI 1A10
- NextGen Support at WJHTC – BLI 1A11
- Performance Based Navigation and Metroplex – BLI 1A12
- Collaborative ATM (CATM) – BLI 2A15
- Time Based Flow Management (TBFM) – BLI 2A16
- System Safety Management – BLI 3A09

In addition to the activities within the portfolios to develop OIs, NextGen programs implement core capabilities that provide the foundation for the introduction of new NextGen OIs. Each of these programs can support multiple OIs and are described below:

- **En Route Automation Modernization System Enhancements and Technology Refresh –** ERAM System Enhancements will be upgrading the ERAM platform to support NextGen OIs and provides software and hardware enhancements to the ERAM system for the En Route sector controller team (BLI 2A02);
- **System Wide Information Management (SWIM)** – SWIM provides the standards, hardware and software to enable information management and data sharing required to support NextGen OIs. This includes Common Support Services – Weather (CSS-Wx) which provides access for NAS users to a unified aviation weather picture (BLI 2A12);
- **ADS-B NAS Wide Implementation (ADS-B)** – Automatic Dependent Surveillance-Broadcast provides more accurate and timely surveillance data needed to improve NAS operations (BLI 2A13);
- **NextGen Weather Processor (NWP) –** This program will establish a common weather processing platform which will provide improved weather products and support operations (BLI 2A17);
- **Data Communications in support of NextGen –** Data Comm provides data link communications between controller and pilot to facilitate information transfer (BLI 2A19);
- **National Airspace System Voice System (NVS)** – NVS will provide a nationwide network of digital voice switches for terminal and en route air traffic facilities. These new systems will provide voice switch configuration flexibility required to support NextGen OIs (BLI 2B13);
- **Aeronautical Information Management (AIM) Program –** AIM provides digital aeronautical information to NAS users (BLI 4A09); and
- **Cross Agency NextGen Management –** This program provides for the continuation of the cross-agency planning and activities to support the long term objectives previously found in the Joint Planning and Development Office (JPDO). The program is being carried forward by the NextGen Organization and includes architecture, roadmapping, and technical analysis activities (BLI 4A10).

Table 3-2 below shows NextGen program funding by BLI from FY 2015 through 2019.

BLI Number	Program Name	FY 2015 Budget	FY 2016	FY 2017	FY 2018	FY 2019
	NextGen	**$194.7**	**$225.7**	**$283.1**	**$318.1**	**$319.5**
1A05	NextGen – Separation Management Portfolio	$13.0	$28.0	$42.5	$41.5	$36.5
1A06	NextGen – Improved Surface/Terminal Flight Data Manager (TFDM) Portfolio	$38.8	$40.3	$80.0	$124.0	$133.8
1A07	NextGen – On Demand NAS Portfolio	$6.0	$15.2	$16.0	$19.3	$24.0
1A08	NextGen – Environment Portfolio	$2.5	$3.5	$3.5	$3.5	$3.5
1A09	NextGen – Improved Multiple Runway Operations Portfolio	$3.5	$10.8	$11.5	$9.5	$7.0
1A10	NextGen – NAS Infrastructure Portfolio	$13.5	$22.4	$25.2	$25.2	$23.0
1A11	NextGen – Support Portfolio at WJHTC	$13.0	$11.0	$12.0	$12.0	$12.0
1A12	NextGen – Performance Based Navigation & Metroplex Portfolio	$25.5	$19.7	$21.5	$21.5	$21.5
2A02	NextGen – En Route Automation Modernization (ERAM) – System Enhancements and Technology Refresh	$45.2	$82.4	$70.0	$90.0	$100.0
2A12	NextGen – System-Wide Information Management (SWIM)	$60.3	$57.9	$52.9	$43.6	$40.2
2A13	NextGen – Automatic Dependent Surveillance - Broadcast (ADS-B) NAS Wide Implementation	$247.2	$183.9	$166.4	$155.8	$163.3
2A15	NextGen – Collaborative Air Traffic Management Portfolio	$13.5	$20.8	$22.7	$35.3	$36.3
2A16	NextGen – Time Based Flow Management (TBFM) Portfolio	$21.0	$22.2	$28.2	$35.8	$54.9
2A17	NextGen – Next Generation Weather Processor (NWP)	$23.3	$42.4	$48.1	$35.2	$22.7
2A19	NextGen – Data Communication in support of NextGen	$147.3	$194.4	$233.0	$186.6	$174.0
2B13	NextGen – National Airspace System Voice System (NVS)	$20.6	$25.0	$40.0	$40.0	$50.0
3A09	NextGen – System Safety Management Portfolio	$18.7	$17.0	$18.0	$18.0	$18.0
4A09	NextGen – Aeronautical Information Management Program	$12.7	$15.1	$14.9	$15.0	$10.0
4A10	NextGen – Cross Agency NextGen Management	$2.0	$3.0	$3.0	$3.0	$3.0
	Total	$727.5	$815.0	$909.4	$914.7	$933.7

Table 3-2 NextGen Program Summary

More details on all NextGen programs are provided in Section 5 and Appendix B.

4 NextGen Portfolios and Implementations

As NextGen has progressed, much of the pre-implementation work has transitioned into programs in the implementation phase. In keeping with this natural progression, NextGen's concept development and pre-implementation work is now focused on the next useful segments of capabilities utilizing these base programs. To deliver the next useful segment of capabilities, the NextGen pre-implementation efforts described in this section include the engineering and acquisition efforts to add functionality to these base systems and the complementary and necessary effort in standards, guidance and operational descriptions/procedures.

As part of this natural evolution towards implementation and to address RTCA Task Force 5 recommendations, the structure of NextGen planning documents has shifted to implementation portfolios in the NAS Segment Implementation Plan (NSIP) and the NextGen Implementation Plan (NGIP). This year both the budget request and the CIP contents have been realigned to this new portfolio structure. This structure provides clearer line-of-sight information across all NextGen budget documents, communications and plans and allows stakeholders to transparently move between documents and easily identify projected funding and find greater detail on when capabilities will be deployed and operational.

The NextGen implementation portfolios, listed in section 3.5 and below, will achieve increased levels of performance in delivery of ATM services. In each portfolio the next useful segment of capabilities are identified as a set of operational improvements (OI) that safely increase the efficiency of the air traffic control system. The OIs included in this section are targeted for implementation within the 2015-2019 timeframe. Each portfolio section and its corresponding OI descriptions are followed by a list of the portfolio programs that support the OIs. For information concerning the implementing systems, refer to the NAS Enterprise Architecture Infrastructure Roadmap descriptions in Section 5. To obtain more information on NextGen accomplishments visit the following site: http://www.faa.gov/nextgen/snapshots/

Each OI has a 6 digit number assigned and these numbers are included as a reference in the text below. The first 3 digits identify the NAS Service, for example, ATC Separation Assurance/ Separation Management. The second 3 digits are a unique ID. Additional information can be found on the NAS Enterprise Architecture Web site at: https://nasea.faa.gov

4.1 Separation Management Portfolio

This portfolio provides controllers and pilots with tools and procedures for performing separation management in all of the airspace and airports within the NAS. The aircraft separation assurance service is the cornerstone of ATC operations, and the investments tied to this portfolio provide the tools, procedures, standards and guidance to better manage aircraft in a mixed environment of varying navigation equipment and wake performance capabilities. The enhancements to this service are articulated in the following Operational Improvements:

Oceanic In-trail Climb and Descent

Air navigation service provider (ANSP) automation enhancements will take advantage of improved communication, navigation and surveillance coverage in the oceanic domain to allow climbs and descents with lower separation between aircraft. When authorized by the controller, pilots of equipped aircraft can use these established procedures for climbs and descents to more optimal flight altitudes. (OI: 102108)

Initial Conflict Resolution Advisories

The ANSP automation supports the controller in predicting and resolving conflicts. Automation is enhanced not only to recognize conflicts but also to provide rank-ordered resolution advisories to the ANSP. The ANSP may select one of the resolutions to issue to the aircraft. (OI: 102114)

Automation Support for Separation Management

ANSP automation provides the controller with tools to manage aircraft separation in a mixed navigation and wake performance environment. Advanced aircraft types with changing wake characteristics and new entrants such as UAS with widely varying operational performance envelopes may lead to the use of multiple separation minima in the enroute and the need for advisory support to the controller. (OI: 102137)

Wake Turbulence Mitigation for Arrivals: CSPR

Initially, dependent separation between aircraft on parallel approach paths to Closely Spaced Parallel Runways (CSPRs) will be procedurally reduced in Instrument Meteorological Conditions (IMC) in all crosswind conditions to something less than today's wake separation behind Heavy or B757and larger aircraft based on a safety analysis of the airport geometry, local meteorology and other factors at each airport. (OI: 102144)

Wake Re-Categorization

The current set of pairwise wake separation requirements are updated and expanded based on analysis of wake generation, wake decay and encounter effects for the current fleet of aircraft. This refines the required controller applied separation to increase both flight efficiency and runway capacity utilization. (OI: 102154)

Interactive Planning Using 4D Trajectory Information in the Oceanic Environment

Interactive planning between the airspace user and FAA automation both before and after departure enhances the ability of the flight to fly closer to the user's preferred 4D trajectory. Given the long duration of oceanic flights, there are often changes to wind and weather conditions. This flexibility allows the user to more easily request trajectory changes to better fi the new conditions. FAA automation supports coordination and feedback on contention as well as planning and management for congested oceanic airspace. (OI: 104102)

Integrated Arrival/Departure Airspace Management

This capability expands the use of terminal separation standards and procedures within the newly defined transition airspace. It extends further into current en route airspace (horizontally and vertically). A redesign of the airspace will permit a greater number of RNAV and RNP procedures within the transition airspace to allow for increased throughput. (OI: 104122)

Reduced Horizontal Separation Standards, En Route - 3 Miles

By taking advantage of advances in surveillance and surveillance data processing, the ANSP provides reduced separation (down to 3 miles) in greater portions of en route airspace other than operations in oceanic airspace. These reductions will allow the controller to use more flight efficient clearances to manage conflict resolution and the aircraft (OI: 102117)

Automated Support for Conflict Resolution

ANSPs are responsible for separation management. Automated assistance is provided to probe pilot 4D trajectory change requests, consider flow requirements and constraint, and identify conflicts. By including flow constraints into consideration, the resolution alternatives provided to the ANSP to resolve the safely conflict will support both tactical and strategic objective. (OI: 104127)

Improved Management of Special Activity Airspace (SAA)

Assignments, schedules, coordination, and changes to status of SAA are made readily available for operators and ANSPs using automation systems. Airspace use is optimized and managed in real-time, based on actual flight profiles and real-time operational use parameters. Airspace reservations for military operations, unmanned aircraft system flights, space flight and re-entry, restricted or warning areas, and flight training areas are managed on an as-needed basis. (OI: 108212)

Flexible Routing

Leveraging enhanced flight capabilities based on RNP, flight operators can operate along preferred and dynamic flight trajectories based on an optimized and economical route for a specific flight, accommodating user preferred flight trajectories. (OI: 102146)

Capital Investments That Support Separation Management

The Separation Management Portfolio is implemented through programs described in Section 5. Pre-implementation activities which provide developmental engineering, standards, implementation guidance and investment support include these programs which are described in Appendix B.

- ADS-B In Applications – Flight Interval Management, G01S.02-01
- Modern Procedures, G01A.01-01
- Alternative Positioning Navigation and Timing, G06N.01-06
- Wake Turbulence Re-Categorization, G06M.02-02
- Oceanic Tactical Trajectory Management, G01A.02-02
- NextGen Oceanic Capabilities, G01A.01-07
- Separation Automation System Engineering, G01A.01-06

4.2 Improved Surface/ Terminal Flight Data Manager (TFDM) Portfolio

The NextGen Improved Surface/TFDM portfolio addresses airport surface/tower shortfalls associated with the lack of timely and accurate operational data exchange and the inability to effectively manage traffic flows into, on, and departing from airports. The portfolio focuses on improved airport surveillance information, automation to support airport configuration management and runway assignments, and enhanced cockpit displays to provide increased situational awareness for controllers and pilots.

Provide Full Surface Situation Information

Automated broadcast of aircraft and vehicle position to ground and aircraft sensors/receivers provides a digital display of the airport environment. Aircraft and vehicles are identified and tracked to provide a full comprehensive picture of the surface environment to ANSPs, equipped aircraft, and flight operations centers. (OI: 102406)

Improved Runway Safety Situational Awareness for Controllers

At large airports, current controller tools provide surface displays and can alert controllers when aircraft taxi into areas where a runway incursion could result.

Additional ground-based capabilities, including expansion of runway surveillance technology, to additional airports, will be developed to improve runway safety. (OI: 103207)

Enhanced Surface Traffic Operations

Tower automation provides the ability to transmit automated terminal information, departure clearances and amendments and taxi route instructions via Data Communications (Data Comm), including hold-short instructions. (OI: 104207)

Initial Surface Traffic Management

Departures are sequenced and staged to maintain throughput. ANSP uses automation to integrate surface movement operations with departure sequencing to ensure aircraft meet departure schedule times while optimizing the physical queue in the movement area. (OI: 104209)

Capital Investments That Support Improved Surface/TFDM

The Improved Surface/TFDM Portfolio is implemented through programs described in Section 5. Pre-implementation activities which provide developmental engineering, standards, implementation guidance and investment support include these programs which are described in Appendix B.

- Terminal Flight Data Manager (TFDM), G06A.03-01
- Surface Tactical Flow, G02A.01-01
- Surface Conformance Monitoring, G02A.01-02

4.3 On-Demand NAS Portfolio

This portfolio ensures that NAS and aeronautical information are consistently provided across all NAS applications and locations using common net enabled access of aeronautical and flight information utilizing global standards – Aeronautical Information Exchange Model (AIXM) and Flight Information Exchange Model (FIXM).

Improved Management of Special Activity Airspace

Changes regarding whether special use airspace is active or not in use are readily available for operators and the ANSP. The status changes are transmitted to the flight deck via voice or Data Communications. Flight trajectory planning is managed dynamically based on real-time use of airspace. (OI: 108212)

On-Demand NAS Information

NAS and aeronautical information will be available to users on demand. NAS and aeronautical information is consistent across applications and locations which are available to authorized subscribers and equipped aircraft. Proprietary and security-sensitive information is not shared with unauthorized agencies or individuals. (OI: 103305)

Capital Investments That Support On-Demand NAS

The On-Demand NAS Portfolio is implemented through programs described in Section 5. Pre-implementation activities and future programs which provide developmental engineering, standards, implementation guidance and investment support include these programs which are described in Appendix B.

- Flight Object, G05A.02-03
- International Harmonization Demonstration, G08M.01-01
- Common Status and Structure Data, G05A.02-01
- Advanced Methods, G05A.02-02
- Collaborative Information Management, G05M.02-01
- Flight Object Exchange Services (FOXS), G05A.02-08
- Dynamic Airspace, G05A.04-01
- Airspace Resource Management System (ARMS), G05A.02-09

4.4 Environment Portfolio

This portfolio focuses on explorations, demonstrations, and development of methods to integrate environmental impact mitigation and energy efficiency in the NextGen infrastructure including enabling activities leading to the establishment and implementation of the NextGen Environmental Management System, the strategy for ensuring compliance with the National Environmental Policy Act and technologies that support NextGen environmental goals.

Implement EMS Framework - Phase I

Enable the use of the Environmental Management System (EMS) framework, including environmental goals and decision support tools, to address, plan and mitigate environmental issues, through development of an initial EMS framework, pilot analysis, and outreach programs. (OI: 109309)

Implement EMS Framework - Phase II

Establish NextGen EMS in initial stakeholder organizations and FAA, including environmental goals, targets, and performance evaluation, pilot activities and communications programs. It will include multiple increments delivered over time. (OI: 109310)

Implement NextGen Environmental Engine and Aircraft Technologies - Phase I

Mature technologies will be developed to reduce noise, emissions, and fuel burn of commercial subsonic jet aircraft. Demonstrate these technologies at sufficient readiness levels to achieve goals of the FAA's Continuous Lower Energy, Emissions, and Noise (CLEEN) program. It will include multiple time sequenced deliverables. (OI: 109315)

Increased Use of Alternative Aviation Fuels - Phase I

Determine the feasibility and market viability of alternative aviation fuels for commercial aviation use. Obtain American Society for Testing and Materials (ASTM) International approval of Hydrotreated Renewable Jet (HRJ) blends and other advanced sustainable fuel blends from renewable resources that are compatible with existing infrastructure and fleet, thus meeting requirement to be a drop-in fuel. (OI: 109316)

Implement NextGen Environmental Engine and Aircraft Technologies - Phase II

Support certification and commercialization of aircraft technologies for enhanced environmental and energy efficiency improvements demonstrated during Phase I. Demonstrate additional technologies meeting CLEEN goals, including wing laminar flow, advanced aircraft noise reduction, and a lower drag vertical tail. It will include multiple increments delivered over time. (OI: 109318)

Increased Use of Commercial Aviation Alternative Fuels - Phase II

Obtain ASTM International approval of "drop-in" blends as well as other advanced sustainable alternative fuels. These advanced "drop-in" fuels may dramatically reduce fuel production time and cost and will reduce environmental impacts, improve energy security, and enable carbon neutral growth by 2020. It will include multiple increments delivered over time. (OI: 109321)

Capital Investments That Support Environment

The Environment Portfolio is a combination of research related to fuels, engines and airframes and F&E funding which includes implementation with the NAS and investigates the impact on air traffic management. Pre-implementation activities in F&E which provide developmental engineering, standards, implementation guidance include this program which is described in Appendix B.

- Environmental Management System and Noise/Emission Reduction, G06M.02-01

4.5 Improved Multiple Runway Operations Portfolio

The Improved Multiple Runway Operations portfolio enables the FAA to improve runway access through the use of improved technology, updated standards, safety analysis, and air traffic tools and operating procedures to enable more arrival and departure operations.

Wake Turbulence Mitigation for Departures (WTMD): Wind-Based Wake Procedures

Procedures are developed at applicable locations based on the results of analysis of wake measurements and safety analysis using wake modeling and visualization. During peak-demand periods, these procedures allow airports to maintain airport departure throughput during favorable wind conditions. (OI: 102140)

Improved Parallel Runway Operations

This improvement will explore concepts to recover lost capacity through reduced separation standards, increased applications of dependent and independent operations, enabled operations in lower-visibility conditions and changes in separation responsibility between air traffic control and the flight deck. (OI: 102141)

Wake Turbulence Mitigation for Arrivals: CSPRs

Initially, dependent separation between aircraft on parallel approach courses to Closely Spaced Parallel Runways (CSPRs) will be procedurally reduced in Instrument Meteorological Conditions (IMC) in all crosswind conditions to something less than today's wake separation behind large aircraft based on a safety analysis of the airport geometry, local meteorology and other factors at each airport. (OI: 102144)

Ground Based Augmentation System (GBAS) Precision Approaches

Global Positioning System (GPS)/GBAS support precision approaches to Cat I and eventually Cat II/III minima for properly equipped runways and aircraft. GBAS can support approach minima 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. (OI: 107107)

Capital Investments That Support Improved Multiple Runway Operations

The Improved Multiple Runway Portfolio is implemented through programs described in Section 5. Pre-implementation activities which provide developmental engineering, standards, implementation guidance and investment support include these programs which are described in Appendix B.

- Closely Spaced Parallel Runway Operations, G06N.01-02
- Wake Turbulence Mitigation for Arrivals (WTMA), G06A.01-02
- Ground Based Augmentation System, G06N.01-01
- Enhanced Service Small Communities (ESSC), G03M.04-02

4.6 NAS Infrastructure Portfolio

Success in the functional portfolios is often dependent upon changes made to existing systems or the implementation of new systems. This portfolio provides cross-cutting research, early system engineering activities, development, and analysis of capabilities that have substantial cross-portfolio dependencies.

Initial Integration of Weather Information into NAS Automation and Decision Making

Advances in weather information content and dissemination provide users and/or their decision support tools with the ability to identify specific weather impacts on operations (e.g., trajectory management and impacts on specific airframes, arrival/departure planning) to ensure continued safe and efficient flight. (OI: 103119)

Capital Investments That Support NAS Infrastructure

The NAS Infrastructure Portfolio is implemented through programs described in Section 5. Pre-implementation activities which provide developmental engineering, standards, implementation guidance and operational descriptions/procedures include these programs which are described in Appendix B.

- Weather Observation Improvements, G04W.02-01
- Weather Forecast Improvements, G04W.03-01
- Surface/Tower/Terminal Systems Engineering, G06A.02-01
- NextGen Navigation Engineering, G06N.01-03
- New ATM Requirements, G01M.02-02
- Information Management, G05M.03-01

4.7 NextGen Support Portfolio at WJHTC

This portfolio will continue to explore new technologies at the NextGen laboratories and support operational assessment for system performance.

Capital Investments That Support NextGen Support Portfolio at WJHTC

The NextGen Support Portfolio provides the laboratories and test beds needed for the development of systems to support operational improvements. The portfolio also provides for the assessment of operational benefits from the NextGen implementation. The program is described in detail in Appendix B.

- NextGen Laboratories at WJHTC, G03M.02-01

4.8 Performance-Based Navigation & Metroplex Portfolio

The PBN portfolio leverages emerging satellite navigation technology and improved aircraft navigation performance to improve access and flexibility for point-to-point navigation using RNAV and RNP.

Area Navigation (RNAV) Standard Instrument Departure (SID), Standard Terminal Arrival Routes (STAR), and Approaches

RNAV is available throughout the NAS using satellite-based avionics equipment and systems. This improvement will develop RNAV routes, SIDs and STARs to allow more efficient flights, saving fuel and time. (OI: 107103)

Increase Capacity and Efficiency Using RNAV and Required Navigation Performance (RNP)

This improvement will allow RNAV and RNP to enable more efficient aircraft trajectories. Combined with airspace changes, RNAV and RNP increase airspace efficiency and capacity. RNAV and RNP will permit the flexibility of point-to-point operations and allow for the development of routes, procedures, and approaches. (OI: 108209)

Capital Investments That Support Performance Based Navigation & Metroplex

The Performance Based Navigation & Metroplex Portfolio is implemented through these programs described in Appendix B.

- NextGen Performance Based Navigation (PBN) – Metroplex Area Navigation (RNAV)/Required Navigation Performance (RNP), G05N.01-01
- NextGen Performance Based Navigation (PBN) – Nav Lean, G05N.01-02
- Concept Development for Integrated NAS Design and Procedure Planning, G05A.02-04

4.9 Collaborative Air Traffic Management Portfolio

The Collaborative Air Traffic Management portfolio addresses shortfalls in the areas of modeling strategic traffic management initiatives, decision support tools, collaboration between traffic managers and airspace users and capabilities to manage traffic flow strategically. It involves helping NAS operators and FAA traffic managers, using advanced automation to manage daily airspace and airport capacity issues such as congestion, special activity airspace and weather. Updated automation will deliver routine information digitally.

Provide Full Flight Plan Constraint Evaluation with Feedback

Constraint information that impacts the proposed route of flight is incorporated into ANSP automation, and is available to users. (OI: 101102)

Interactive Planning Using 4D Trajectory Information in the Oceanic Environment

Flexible entry times into oceanic tracks or flows allow greater use of user-preferred trajectories. (OI: 104102)

Full Collaborative Decision Making

Timely, effective, and informed decision-making based on shared situational awareness is achieved through advanced communication and information sharing systems. (OI: 105207)

Traffic Management Initiatives with Flight Specific Trajectories

This capability will increase the agility of the NAS in adjusting and responding to dynamically changing conditions such as impacting weather, congestion and system outages. (OI: 105208)

Continuous Flight Day Evaluation

Continuous (real-time) constraints are provided to ANSP traffic management decision-support tools and the NAS users. (OI: 105302)

Capital Investments That Support Collaborative Air Traffic Management

The Collaborative Air Traffic Management Portfolio is implemented through programs described in Section 5. Pre-implementation activities which provide developmental engineering, standards, implementation guidance and investment support include these programs which are described in Appendix B.

- Collaborative Air Traffic Management Technologies (CATMT) – Work Package 3, G05A.05-02
- Strategic Flow Management Application, G05A.01-01
- Strategic Flow Management Engineering Enhancement, G05A.01-02
- Collaborative Air Traffic Management (CATM) – Work Package 4, G05A.05-03

4.10 Time-Based Flow Management (TBFM) Portfolio

This Time-Based Flow Management portfolio enhances system efficiency by transitioning improvements in Time-Based Metering (TBM) capability and its trajectory modeler to additional locations; by enhancing departure capabilities; and by expanding air traffic merging into the terminal environment to enhance efficiency of PBN procedures and optimize balancing demand with capacity.

Current Tactical Management Of Flow in the En Route for Arrivals/Departures

Proper spacing and sequencing of air traffic maximizes NAS efficiency and capacity in the arrival and departure phases of flight. (OI: 104115)

Improved Management of Arrival/Surface/Departure Flow Operations

This improvement integrates advanced arrival/departure flow management with advanced surface operation functions to improve overall airport capacity and efficiency. (OI: 104117)

Point-in-Space Metering

The ANSP uses scheduling tools and trajectory-based operations to assure smooth flow of traffic and increase the efficient use of airspace. The interval management concept is designed to improve aircraft spacing by precisely managing the distance between aircraft whose trajectories are common or merging. This concept increases airspace throughput while enabling aircraft to reduce fuel burn and environmental impacts. (OI: 104120)

Time Based Metering Using RNAV and RNP Route Assignments

RNAV, RNP and time-based metering provide efficient use of runways and airspace in high-density airport environments. Metering automation will manage the flow of aircraft to meter fixes, thus permitting efficient use of runways and airspace. (OI: 104123)

Time-Based Metering in the Terminal Environment

This OI extends current metering capabilities into the terminal environment and furthers the pursuit of end-to-end metering and trajectory-based operations. It also supports capabilities designed to expand the use of terminal separation standards in transition airspace, and solidifies the foundation for future advanced airborne-based applications that will depend upon ground-based automation to maintain the complete sequence of aircraft into and out of high density terminal locations. (OI: 104128)

Interval Management-Spacing (IM-S)

This OI enables controllers to identify, initiate, and monitor the spacing between aircraft, with the aid of ground automation and a new set of voice or datalink procedures. The controllers will direct flight crews to establish and maintain a given time or distance from a designated aircraft. (OI: 102118)

Capital Investments That Support Time Based Flow Management

The Time Based Flow Management Portfolio is implemented through programs described in Section 5. Pre-implementation activities which provide developmental engineering, standards, implementation guidance and investment support include these programs which are described in Appendix B.

- Time Based Flow Management Work Package 3, G02A.01-06
- Time Based Flow Management Technology Refresh, G02A.01-07
- Time Based Flow Management Work Package 4, G02A.01-08

4.11 System Safety Management Portfolio

This portfolio contains activities that ensure that changes introduced with NextGen enhance or do not degrade safety while delivering benefits which result from the development and implementation of policies, processes and analytical tools that the FAA and industry will use for more efficient operations.

Safety Information Sharing and Emergent Trend Detection

Information analysis and sharing directly supports safety promotion and safety assurance initiatives with analytical results such as the comparison of baseline information and trends. It also indirectly supports safety risk management through issue identification, information and tools for analysis of hazards. (OI: 109303)

Enhanced Safety Information Analysis and Sharing

Aviation Safety Information Analysis and Sharing (ASIAS) will improve system-wide risk identification, integrated risk analysis and modeling and implementation of emergent risk management. (OI: 109304)

Integrated Safety Analysis and Modeling

This OI mitigates safety risk associated with the design, evolution and implementation of NextGen by providing enhanced integrated safety methods. It will provide tailored, domain-specific baseline and predictive risk models including automated operational anomaly detection, analysis and forecasting models. (OI: 109326)

Capital Investments That Support System Safety Management

The System Safety Management Portfolio is implemented through these programs described in Appendix B.

- Aviation Safety Information Analysis and Sharing (ASIAS), G07A.02-01
- Systems Safety Management Transformation, G07M.02-01

5 Enterprise Architecture Infrastructure Roadmaps

The detailed infrastructure roadmaps appearing in the following subsections are an integral part of the NAS Enterprise Architecture and show the existing systems in the NAS, and the planned capital programs for legacy and NextGen systems to modernize the NAS. The roadmaps show planned modernization that extends beyond the 5-year financial horizon covered in the CIP, because planning to meet new demands and technology improvements to the NAS must look beyond near term improvements. The roadmaps present an executive view of the schedule for programs that modernize or replace systems and the length of time those systems or their replacements will remain in service. They help FAA anticipate future engineering and financial challenges and integrate the modernization efforts by showing program managers how updating other systems will impact their program.

Many changes shown in the roadmaps will also require aviation users to add equipment to their aircraft and adopt new procedures, so the roadmaps serve to inform them what they should expect regarding changes to their equipment and crew training. These roadmaps are updated annually to reflect results of studies, demonstration projects, and economic analysis related to programs; however, the roadmaps are, and should be reasonably stable from year-to-year. For more detailed information on the roadmaps, view the Enterprise Architecture and Infrastructure Roadmaps at: https://nasea.faa.gov

The infrastructure roadmaps in this section organize the architecture based on functional areas. The systems on the left side in each of the diagrams are currently in service, as shown under the CY column. Funding to maintain and operate the in-service systems is provided by the Operations account. Capital investments to upgrade or replace systems are shown by the program boxes within the timeline; the box reflects the timeframe for funding the programs. Legacy programs are shown as gray bars and NextGen programs are shown as orange bars. The funding tables within each roadmap subsection contain the F&E BLIs for that functional area. The tables depict the FY 2015 budget request and outyear estimates for FY 2016-2019. To associate the BLIs with the programs and systems in the FAA Enterprise Architecture, BLI number references are included at the end of each of the descriptions contained within this section.

The functional areas are shown in the following sections:

- Automation
- Communications
- Surveillance
- Navigation
- Weather
- Facilities

Figure 5-1 shows and defines the symbols used in the infrastructure roadmaps. The solid red lines indicate the time the systems, or their replacements will remain in operation and the dashed lines indicate that a system is scheduled to be replaced or taken out of service; ending with an X. The boxes with names identify programs, functions or systems, which are either described in the text or, when they are not described, their acronyms are spelled out in Appendix E.

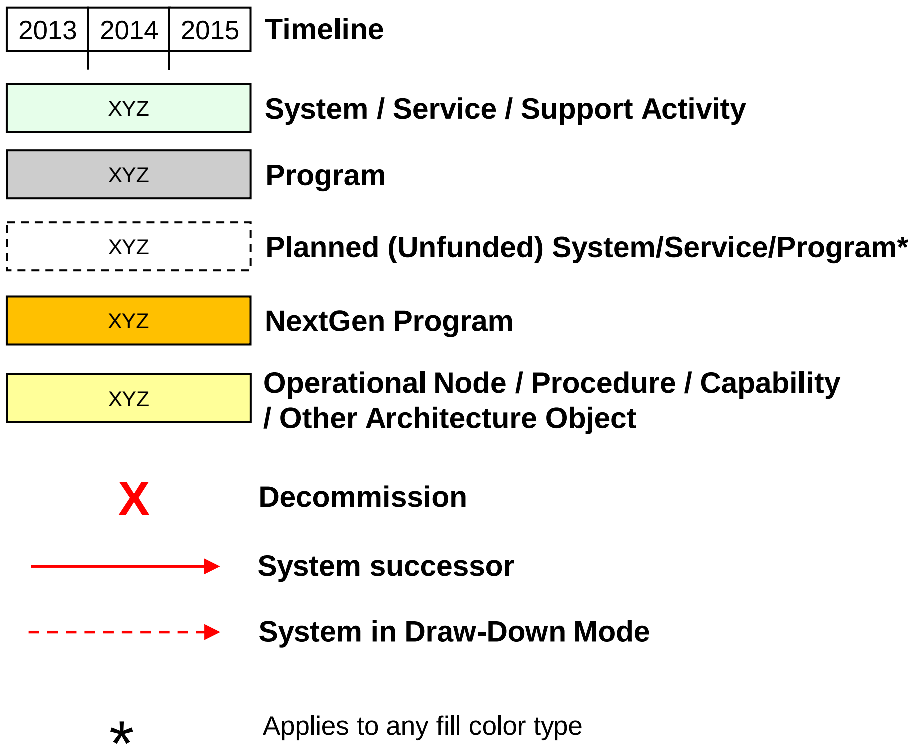

Figure 5-1 Infrastructure Roadmap Legend

5.1 Automation Roadmaps

Automation is a core element of the air traffic control system. Controllers require a real-time display of aircraft location as well as information about the operating characteristics of aircraft they are tracking—such as speed and altitude—to keep the approximately 50,000 daily flights safely separated. Automation gives controllers continuously updated displays of aircraft position, identification, speed, and altitude as well as whether the aircraft is level, climbing, or descending. Automation systems can also continue to show an aircraft's track when there is a temporary loss of surveillance information. It does this by calculating an aircraft's ground speed and then uses that data to project an aircraft's future position.

Other important features of automation include the following:

- Maintaining flight information and controller-in-charge data from pre-flight to post-flight, which supports coordination between air traffic controllers as they hand off responsibility of the flight from the tower to the terminal control facility to the en route sector and then back to terminal and tower as the aircraft approaches its destination.

- Generating symbols displaying information on routes, restricted areas, and several other fixed features of the controller's sector.
- Providing automated alerts to controllers regarding potential aircraft conflicts and warnings that an aircraft may be approaching a terrain hazard.
- Displaying data from weather sensors, giving the status of runway lights and navigational aids, and providing flight plan information on monitored aircraft.
- Providing traffic management capabilities and decision support tools to forecast and provide solutions for future demand. The solutions may involve adjusting routes or speed, controlling airport departures, or other actions.

Automation systems provide the platform for implementation of many of the NextGen OIs. NextGen programs provide the necessary automation system enhancements to support the improvements. Program descriptions in Appendix B provide details on those enhancements.

Automation implementation, including the plans to sustain, upgrade, replace or decommission current systems is planned out from 2013 through 2026 based on the following three different NAS EA roadmaps:

1. Roadmap 1 (figure 5-2) - Air Traffic Control and Air Traffic Management
2. Roadmap 2 (figure 5-3) - Oceanic Air Traffic Control and NAS Information Management
3. Roadmap 2 (figure 5-4) - Information Support Systems

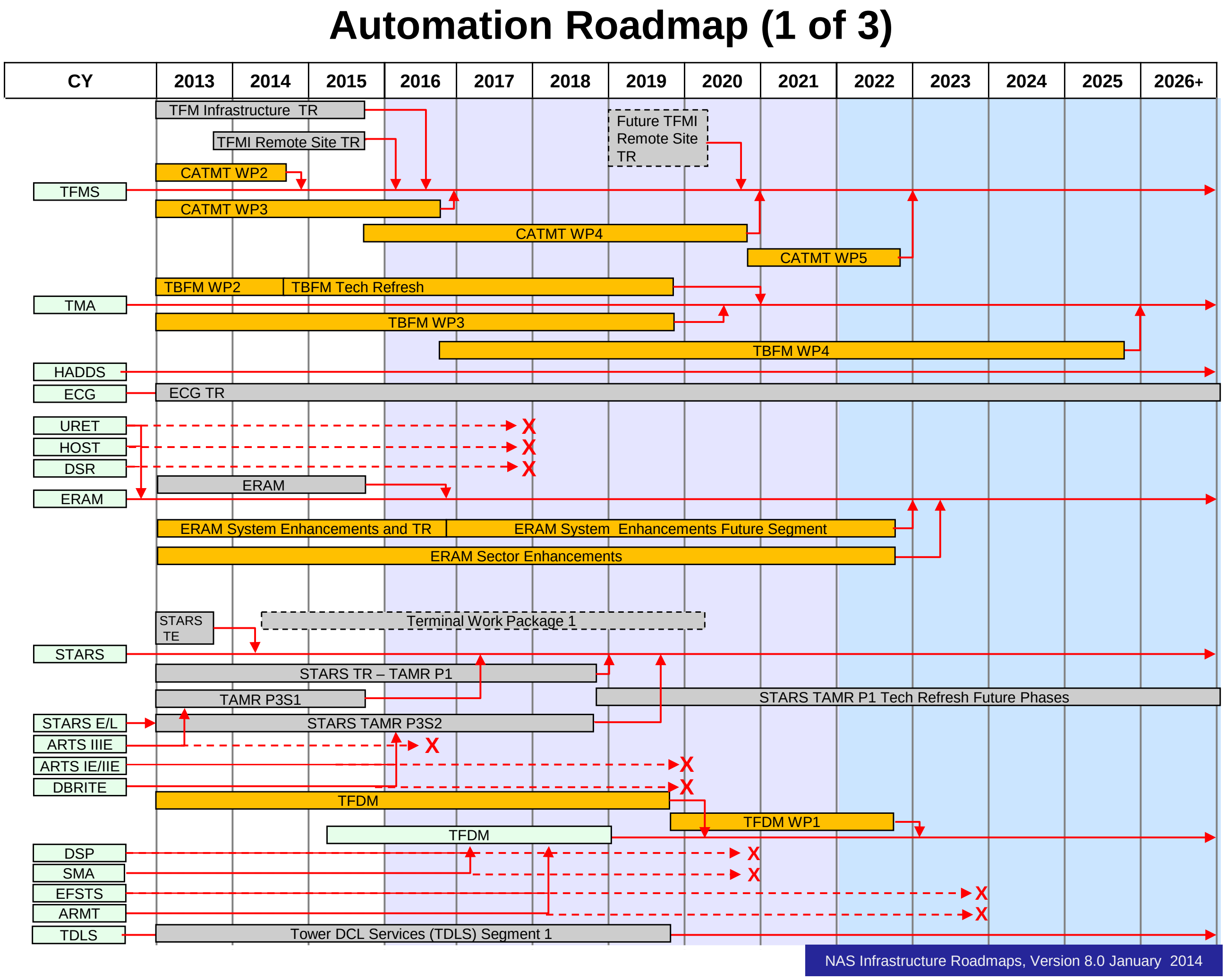

Figure 5-2 Air Traffic Control and Air Traffic Management Roadmap

The first two systems on the left side of the roadmap are used for traffic management. The Traffic Flow Management System (TFMS) and the Traffic Management Advisor (TMA) are installed at air traffic control facilities including the Air Traffic Control System Command Center (ATCSCC), en route centers, and major terminal control facilities. They are used to analyze future demand for en route and terminal services and to strategically plan for how to best accommodate that demand. These systems use real-time displays both of aircraft in flight and of weather affecting aviation to assess which routes are best and to prevent severe congestion at airports. The FAA will continue to improve TFMS and TMA with the Collaborative Air Traffic Management Technologies (CATMT) and the Time Based Flow Management (TBFM) work packages which will expand collaboration to individual pilots and improve information exchange between the FAA and airline dispatch offices. TMA will be enhanced to support the introduction of NextGen trajectory based operations, which allow aircraft to fly more direct routes with fewer deviations for conflicting air traffic. TFM Infrastructure and Remote Site Technology Refresh and TBFM Technology Refresh programs will upgrade the hardware that supports those systems.

TFMS infrastructure and software enhancements are funded through BLIs 2A06 and 2A15. TMA infrastructure and software enhancements are funded through BLIs 1A10E and 2A16.

The next six blocks on the left side are components of the en route control system. The Host ATM Data Distribution System (HADDS) supplies data to the air traffic management systems discussed above and will remain in operation throughout the roadmap timeframe. The En Route Communication Gateway (ECG), which formats data for the en route automation system, remains a separate program and will receive a technology refresh. The En Route Automation Modernization (ERAM) program incorporates three of the en route system component pieces: User request Evaluation Tool (URET), Host Computer, and Display System Replacement (DSR). These systems are being replaced with new hardware and revised ATC software and integrated into ERAM. ERAM is being installed and, when fully operational, it will be the foundation for the agency's transition to NextGen. ERAM and ECG are funded through BLIs 2A01 and 2A03 respectively.

Improvements to ERAM will include ERAM System Enhancements and Technology Refresh and ERAM Sector Enhancements. The System Enhancements segment is intended to improve aircraft separation services by reducing levels of missed and false alerts from tactical and strategic conflict alerting functions. ERAM Technology Refresh consists of any necessary upgrades or modernization of system components; as well as enhancements outside the scope of the original core ERAM system. ERAM system enhancements and technology refresh are funded through BLI 2A02. ERAM System Enhancements Future Segment will continue the enhancement and technology refresh activities starting in FY 2017.

ERAM Sector Enhancements provides software and hardware enhancements to the ERAM system for the En Route sector controller team. It is a multi-year effort to improve the efficiency and effectiveness of En-Route Sector operations by facilitating increased strategic and tactical cooperation between the Radar Controller position (R-Position) and the Radar Associate position (D-Position) as well as establish a common processing platform, with similar tool sets, that may be tailored for either position. ERAM Sector Enhancements is funded through BLI 2A02.

The next four systems provide ATC automation for the terminal domain: Standard Terminal Automation Replacement System (STARS), STARS Enhanced Local Integrated Tower Equipment (ELITE)/ Local Integrated Tower Equipment (LITE) (STARS E/L), Automated Radar Terminal System model IIIE (ARTS IIIE), and ARTS 1E/IIE. There are several phases to the STARS Terminal Automation Modernization and Replacement (TAMR) program for upgrading and modernizing these systems:

- The first phase replaced 47 existing ARTS with STARS. The STARS systems were installed at medium activity level airports;
- The STARS Technology Refresh (TAMR Phase 1) is modernizing the 47 sites installed under the STARS program as well as sites installed under TAMR Phase 2.
- TAMR Phase 2 involved the installation of STARS at five TRACONs and the modernization of existing four ARTS at large TRACONs. Phase 2 is completed and not shown on the roadmap;
- STARS TAMR Phase 3 Segment 1 (P3S1) is replacing 11 ARTS IIIE systems, which are the most sophisticated terminal automation systems located at high activity TRACONs.

- STARS TAMR Phase 3 Segment 2 (P3S2) will replace 91 ARTS IIE systems (at medium and small airports) with STARS ELITE and 6 ARTS IE systems (at the smallest airports) with STARS LITE. The upgraded STARS systems will be able to process position information from the ADS-B system along with information from terminal radars; and
- STARS Technology Refresh Future Phases will continue to address the technology refresh updates needed to modernize the STARS at all sites.

STARS is funded through BLIs 2B03 and 2B04.

Digital Bright Radar Indicator Tower Equipment (DBRITE) is a terminal automation and display model in current use. DBRITE has a tower display that allows tower cab controllers to determine the location of approaching traffic before it becomes visible to them.

Terminal Work Package 1 funds system engineering to develop concepts which address issues relating to system performance in the terminal domain. Proposed technical changes to automation and updated air traffic procedures will be delivered to the appropriate program offices for further development and implementation.

The Terminal Flight Data Manager (TFDM) system supports a phased implementation of a new terminal local area network (LAN) based infrastructure to reduce redundant displays and integrate flight data functions. TFDM will provide System Wide Information Management (SWIM) enabled flight data exchanges with other NAS subsystems. TFDM initially will integrate data from three existing systems, and it will be enhanced in TFDM Work Package 1. TFDM is funded through BLI 1A06A.

The Departure Spacing Program (DSP) is used by tower controllers to optimize taxi and takeoff clearances in order to efficiently use available runway and airspace capacity.

The Surface Movement Advisor (SMA) provides the status of aircraft moving from the gates to the runways; and it improves taxiing efficiency. The Electronic Flight Strip Transfer System (EFSTS) is a system to transfer flight information to towers and TRACONs electronically rather than by paper. The Airport Resource Management Tool (ARMT) provides an assessment of available airport capacity.

The Tower Data Link Services (TDLS) provides datalink route clearances to pilots preparing to depart an airport. Data Communications Segment 1 Phase 1will be providing upgrades to the TDLS system.

Automation Roadmap (2 of 3)

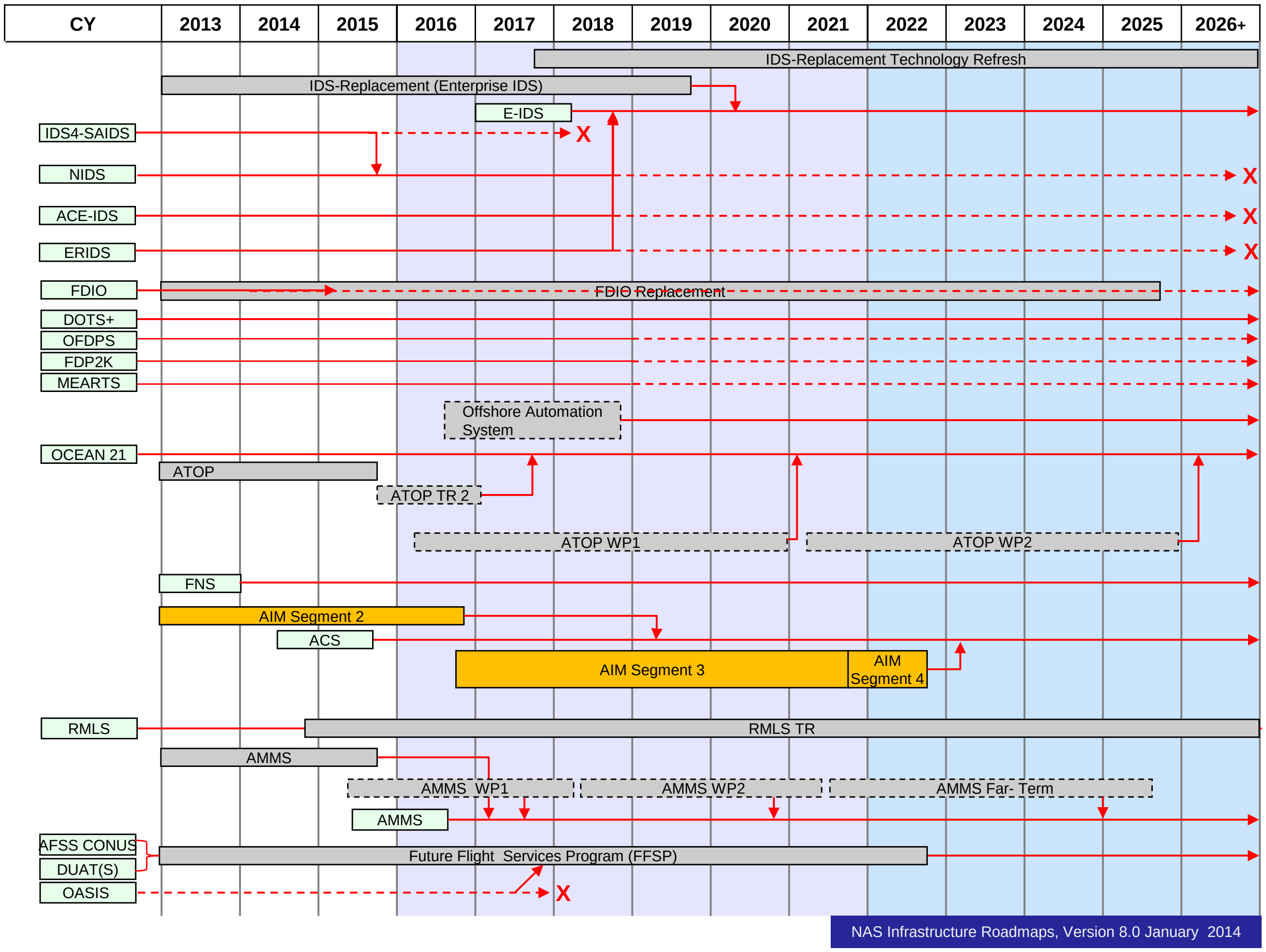

Figure 5-3 Oceanic Air Traffic Control and NAS Information Management Roadmap

The Integrated Display Systems model 4 (IDS-4), the System Atlanta Information Display System (SAIDS) and NAS IDS (NIDS) provide weather and other information to tower controllers. These systems will be modernized by the IDS Replacement program beginning in 2013 and completing in 2017. IDS Replacement Technology Refresh will provide system sustainment and upgrades starting in 2017. The proposed Enterprise IDS (E-IDS) program will continue the upgrade/replacement of systems not included in the IDS replacement program. IDS Replacement is funded through BLI 2B14.

The Automated Surface Observing System (ASOS) Controller Equipment-Information Display System (ACE-IDS) displays weather information collected by ASOS to tower controllers. These services will begin a transition to the proposed Enhanced IDS (E-IDS) in 2018.

The En Route Information Display System (ERIDS) will be transitioned to the proposed E-IDS system in 2018. ERIDS is an information display system that provides access to aeronautical data including weather, airspace charts, ATC procedures, Notice to Airmen (NOTAMS), and pilot reports (PIREPS).

Flight Data Input/Output (FDIO) provides flight plan and other data to operational facilities. It will be replaced incrementally throughout the roadmap timeframe. FDIO is funded through BLI 2B05.

The next group of five systems on the left side support oceanic ATC. The Dynamic Ocean Tracking System plus (DOTS+) system uses weather information to determine the most fuel-efficient routes based on wind velocity and direction. It will continue in operation through the timeframe of the roadmap. The other oceanic automation systems process data regarding the position of aircraft on oceanic and offshore flights to aid controllers in separating flights in FAA controlled airspace. The FAA plans to decide in 2017 whether to continue operating the Offshore Flight Data Processing System (OFDPS), Flight Data Processing 2000 (FDP2K), and the Microprocessor En route Automated Radar Tracking System (MEARTS) or transition their functions to a new Offshore Automation System. Three centers (New York, Oakland and Anchorage) house Ocean 21, the oceanic control system, which has been developed by the Advanced Technologies and Oceanic Procedures (ATOP) program. Upgraded versions of ATOP will remain in operation throughout the roadmap timeframe. ATOP Technology Refresh and Work Packages 1 and 2 will sustain and upgrade the system. The enhanced ATOP systems will allow controllers to apply NextGen concepts such as assigning optimal routes and allowing reduced separation between aircraft to oceanic air traffic control. ATOP is funded through BLI 2A10.

The Aeronautical Information Management (AIM) Segments 2, 3 and 4 are funded through BLI 4A09 to consolidate and automate the storage and dissemination of aeronautical data used by pilots and aviation planners. They will upgrade the two systems shown on the roadmap:

- Federal NOTAM System (FNS) – collects and provides access to NOTAMs, which are notices of temporary changes, such as temporary flight restrictions and runway closures for construction.
- Aeronautical Common Services (ACS) – stores information about airports, navigational aids and other aeronautical data.

The Remote Maintenance Logging System (RMLS) serves two functions. It allows the maintenance staff to monitor equipment performance electronically from a central location, and it provides software for management of workforce hours and maintenance actions. The existing system is undergoing a technology refresh and will be supplemented by the Automated Maintenance Management System (AMMS). RMLS technology refresh and AMMS are funded through BLI 2B15.

Automated Flight Service Station Continental United States (AFSS CONUS), Direct User Access Terminal System (DUATS) and Operational And Supportability Implementation System (OASIS) are automation systems that provide aeronautical and weather data to support flight services. Flight services include flight planning and pilot weather briefings, which are primarily used by general aviation pilots. Flight services in the lower 48 States and Puerto Rico are provided by contractor flight service personnel using the AFSS CONUS. The DUATS is a web-based service that allows pilots to access weather and aeronautical data for self-briefings and to file flight plans. The OASIS automation system is used at the Flight Service Stations in Alaska by FAA flight service specialists to provide flight services to general aviation pilots.

The Future Flight Service Program (FFSP) will provide continued availability of accurate and consistent flight service information currently provided by DUATS, AFSS and OASIS, whose contracts end in 2016. The acquisition strategy is being developed and a future initial investment decision is planned. FFSP is funded through BLI 2C02.

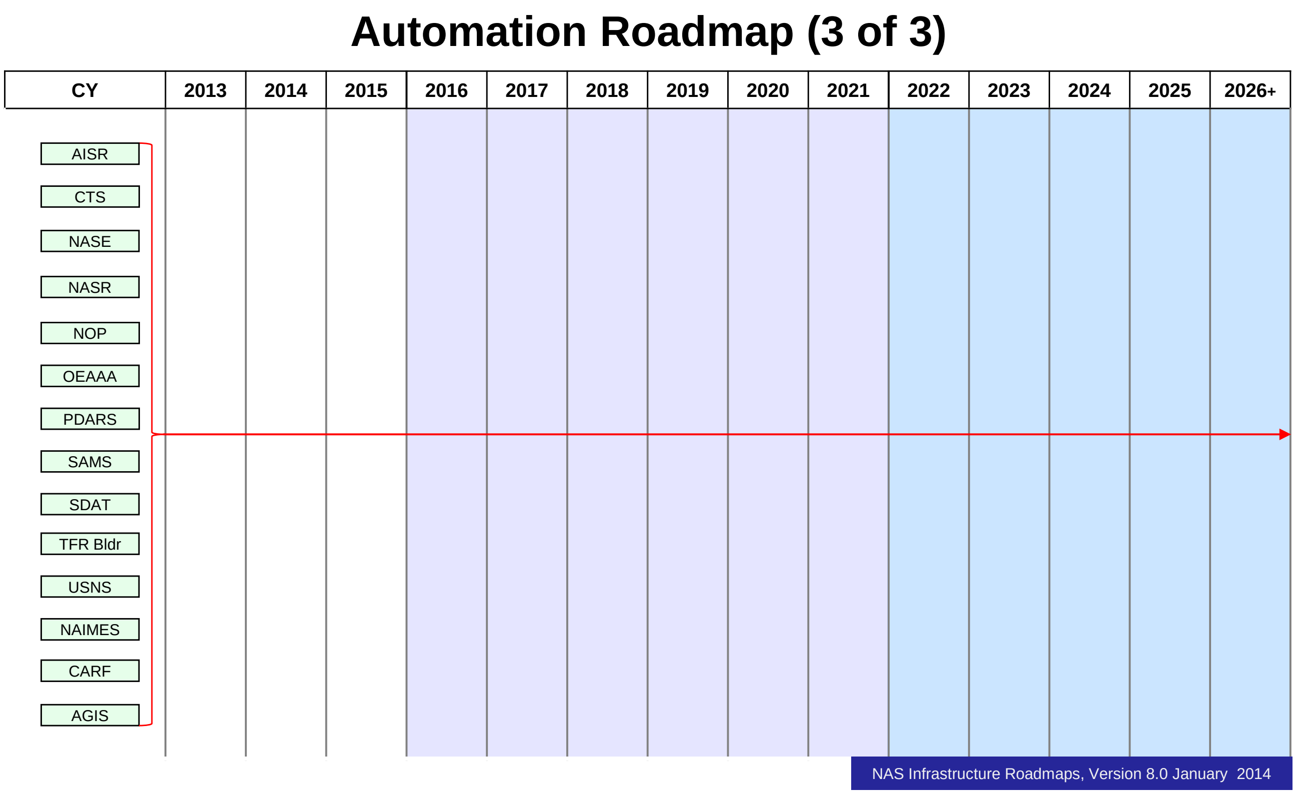

Figure 5-4 Information Support Systems Roadmap

Figure 5-4 shows fourteen systems that continue in operation, with technology refreshes, through the roadmap timeframe. A brief description of each system's capability and impact of providing service for airports, airspace, and navigation facilities is provided below:

- Aeronautical Information System Replacement (AISR) – distributes information on weather, flight plans, NOTAMS, Pilot Reports and other NAS status items to FAA facilities, Department of Defense, and pilots;
- Coded Time Source (CTS) –provides the official source of time that synchronizes the information flows in the air traffic control equipment;
- NAS Adaptation Services Environment (NASE) –contains detailed information about the airspace, geography, equipment, and procedures required to make each ATC system work properly;

- National Airspace System Resources (NASR) –contains information pertaining to Instrument Approach Procedures (IAPs), Departure Procedures (DPs), Standard Terminal Arrival Routes (STARs), and Military Training Routes (MTRs);
- National Offload Program (NOP) – allows FAA to download radar information from en route automation systems for analysis and review;
- Obstruction Evaluation/Airport Airspace Analysis (OEAAA) –contains data about obstructions around airports that would present a hazard for aircraft taking off and landing;
- Performance Data Analysis and Reporting System (PDARS) – is a fully integrated performance measurement tool designed to help the FAA improve the NAS by tracking the daily operations of the ATC system and its environmental impact. PDARS is funded through BLI 1A01B;
- Special Airspace Management System (SAMS) – informs controllers when airspace ordinarily reserved for military use is available for civilian use;
- Sector Design and Analysis Tool (SDAT) – this is a visualization and analysis tool used to evaluate the impact on controller workload when sector and route changes are being considered during major airspace redesign efforts;
- Temporary Flight Restriction Builder (TFR Bldr) – an automated system for establishing temporary flight restrictions that prohibit aircraft from flying over areas where special events such as the Super Bowl are being held;
- United States NOTAM (Notice to Airmen) System (USNS) – an automated system used to process, store and distribute NOTAM information. NOTAM information is that aeronautical information that could affect a pilot's decision to make a flight;
- NAS Aeronautical Information Management Enterprise System (NAIMES) – consists of a suite of NAS safety/mission critical systems and services that directly support the collection, validation, management, and dissemination of aeronautical information in the NAS;
- Central Altitude Reservation Function (CARF) – a system used by military and civilian pilots to reserve altitudes for their planned flights; and
- Airport Geographic Information System (AGIS) – stores data on airport configuration and physical location and size of all elements of the airport. It is used to develop airport modernization plans, and it is necessary for developing new approach and departure procedures.

Figure 5-5 shows future capital investments for automation programs. Funding amounts are in Millions of Dollars.

BLI Number	Program Name	FY 2015 Budget	FY 2016	FY 2017	FY 2018	FY 2019
	Automation Functional Area	**$332.0**	**$354.5**	**$339.0**	**$303.5**	**$308.5**
2A01	En Route Automation Modernization (ERAM)	$10.5	$0.0	$0.0	$0.0	$0.0
2A02	NextGen – En Route Automation Modernization (ERAM) – System Enhancements and Technology Refresh	$45.2	$82.4	$70.0	$90.0	$100.0
2A03	En Route Communications Gateway (ECG)	$6.6	$2.8	$2.0	$2.0	$4.1
2A06	Air Traffic Management (ATM) – Traffic Flow Management (TFM)	$5.7	$0.0	$8.0	$7.0	$5.0
2A10	Oceanic Automation System (OAS)	$3.5	$0.0	$0.0	$0.0	$0.0
2A15	NextGen – Collaborative Air Traffic Management Portfolio	$13.5	$20.8	$22.7	$35.3	$36.3
2A16	NextGen – Time Based Flow Management (TBFM) Portfolio	$21.0	$22.2	$28.2	$35.8	$54.9
2B03	Standard Terminal Automation Replacement System (STARS) (TAMR Phase 1)	$50.7	$81.1	$60.0	$52.8	$56.0
2B04	Terminal Automation Modernization/ Replacement Program (TAMR Phase 3)	$136.2	$110.0	$111.9	$35.5	$0.0
2B05	Terminal Automation Program	$1.6	$2.7	$2.7	$2.8	$2.8
2B14	Integrated Display System (IDS)	$16.9	$13.3	$5.7	$1.1	$7.1
2B15	Remote Monitoring and Logging System (RMLS)	$3.9	$1.1	$3.4	$4.5	$5.2
2C02	Future Flight Services Program (FFSP)	$1.0	$3.0	$9.5	$21.8	$27.0
3A13	Tower Simulation System (TSS) Technology Refresh	$3.0	$0.0	$0.0	$0.0	$0.0
4A09	NextGen – Aeronautical Information Management Program	$12.7	$15.1	$14.9	$15.0	$10.0

Note: BLI numbers with X represent outyear programs not requested in the FY 2015 President's Budget.

Note: FY 2016-2019 outyear funding amounts are estimates.

Figure 5-5 Funding amounts in the Automation Functional Area

5.2 Communications Roadmaps

Communication between pilots and controllers is an essential element of air traffic control. Pilots and controllers primarily use radios for communication. Because en route control sectors cover areas that extend beyond direct radio range, remotely located radio sites are used to provide extended coverage. The controller activates radios at remote sites and ground telecommunication lines carry the verbal exchange to and from air traffic control facilities. If ground links are not available, communication satellite links can be used to connect pilots with controllers. Backup systems are always available to provide the continued ability to maintain communications when the primary systems fail.

NextGen improvements will require improved voice switching and A/G data communications as shown on the diagrams. Details on those investments can be found in the program descriptions in Appendix B.

Communication system implementation is broken down into four different NAS EA roadmaps:

1. Roadmap 1 (figure 5-6) - Telecom and Other Communications
2. Roadmap 2 (figure 5-7) - Voice Switches and Recorders
3. Roadmap 3 (figure 5-8) - Air to Ground Voice and Oceanic Communications
4. Roadmap 4 (figure 5-9) - Air to Ground Data Communications

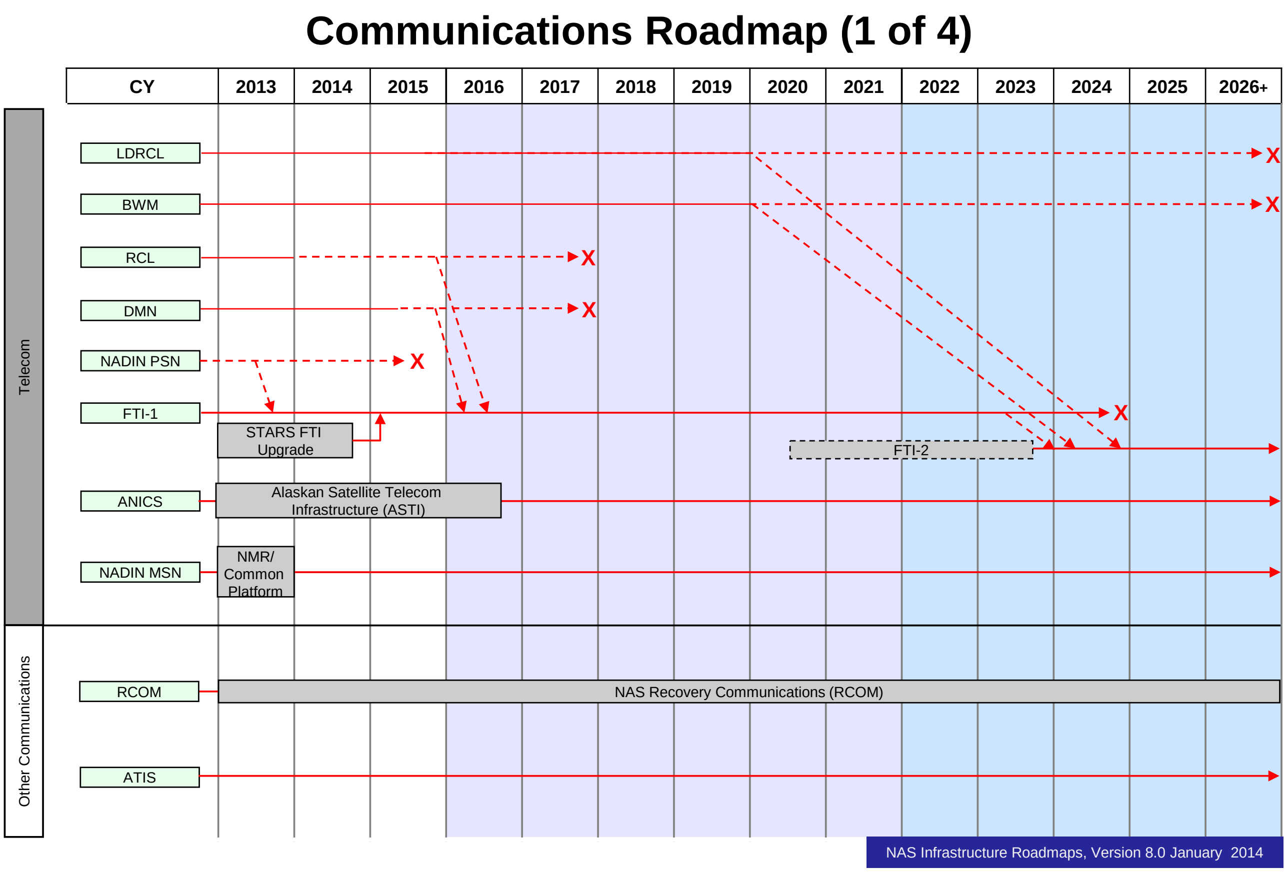

Figure 5-6 Telecom and Other Communications Roadmap

The Low Density Radio Communication Link (LDRCL) and the Radio Communication Link (RCL) are microwave systems that were created to transmit radar data from remote radar sites to FAA air traffic control facilities, and these systems were linked in a national network to transmit operational and administrative information to and from air traffic control facilities. Many of the RCL communication links have already transitioned their functions to the FAA Telecommunications Infrastructure (FTI) to carry this data. The LDRCL will remain in service for areas with limited commercial services, but their functions will be transitioned to the newly awarded FTI contract beginning in 2020. The Band Width Manager (BWM) improves efficiency of information flow on the microwave network. It will not be needed when microwave links are no longer used. The Data Multiplexing Network (DMN) and National Airspace Data Interchange Network – Package Switching Network (NADIN PSN) transmit flight plans and other important aeronautical information to air traffic facilities. The FAA is transitioning functions of DMN and NADIN PSN to the FTI network and a new contract to continue the service. NADIN Message Switching Network (MSN) will be improved by the NMR (NADIN MSN Rehost) to comply with international standards for transmitting flight plans and remain available for that purpose.

The FTI is a contract service to provide communications services between FAA facilities. In 2020, work will begin on preparing for a transition to a new FTI - Phase 2 (FTI-2) contract. The

STARS FTI Upgrade is establishing a diverse and redundant core Internet Protocol infrastructure across the FTI telecommunications backbone that will significantly reduce the impact of any unforeseen events on service.

The Alaska National Airspace System Interfacility Communications System (ANICS) consists of ground stations that send and receive data from communications satellites to connect the operational facilities in Alaska. The Alaska Satellite Telecommunications Infrastructure (ASTI) program modernizes the ANICS infrastructure. Because there are far fewer ground telecommunications connections in Alaska, a satellite system is used to ensure that important air traffic information is reliably transmitted between smaller and larger facilities. ASTI is funded through BLI 2E05.

Recovery Communications (RCOM) is an emergency network to be used for command and control of the ATC system when all other communications systems fail. RCOM is funded through BLI 3A04.

The Automated Terminal Information System (ATIS) broadcasts weather and other pertinent information to pilots as they approach an airport. ATIS functions will be maintained during the entire timeframe of the roadmap.

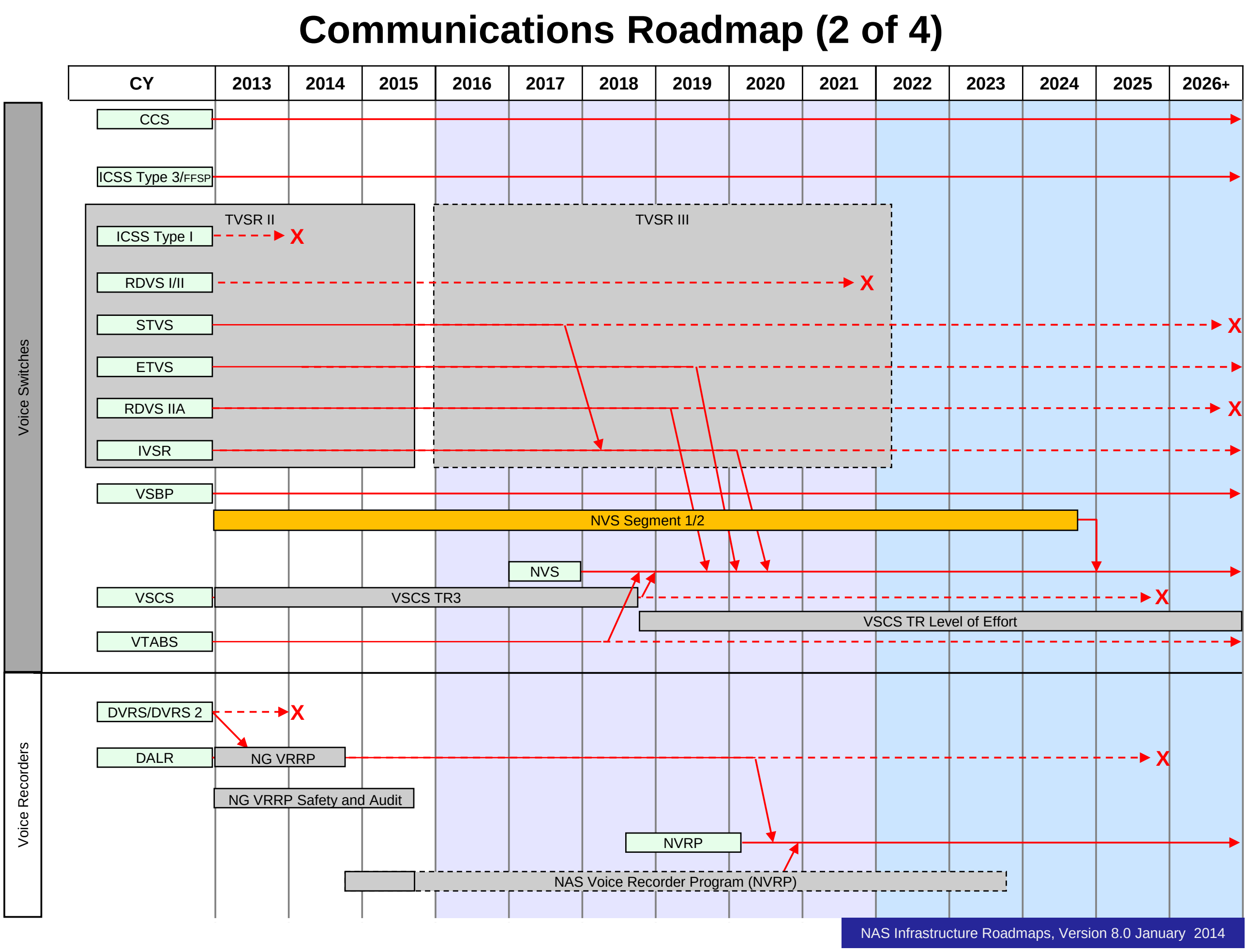

Figure 5-7 Voice Switches and Recorders Roadmap

Figure 5-7 shows the roadmap for NAS Voice Switches and Recorders. Voice switches in air traffic facilities enable controllers to select among the different channels they need to communicate with one another, with traffic management and weather specialists, with emergency services, and with pilots.

The Command Center Conference Control Switch (CCS) installed at the Air Traffic Control System Command Center (ATCSCC) facility allows the FAA specialists to stay in contact with air traffic control facilities and external users of the NAS. They can coordinate with centers, TRACONs, and users to decide how best to implement traffic management initiatives and when to use severe weather avoidance programs.

The voice switches shown below the CCS are used in terminal and flight service facilities. Voice switches enable air traffic controllers to select lines to communicate with pilots as well as other air traffic control facilities. They are:

- Integrated Communication Switching System (ICSS) Type 1 and 3 – The ICSS Type 3 will remain in operation at flight service stations;

- The Terminal Voice Switch Replacement (TVSR) II program, funded through BLI 2B08, is an umbrella program to replace terminal voice switches at the rate of about 5 per year, refurbish approximately 2 voice switches per year and install voice switches in newly constructed airport traffic control towers. This effort will be continued starting in 2016 by the planned TVSR III program. The switches are:
  - Rapid Deployment Voice Switch (RDVS) I, II and IIA;
  - Small Tower Voice Switch (STVS);
  - Enhanced Terminal Voice Switch (ETVS); and
  - Interim Voice Switch Replacement (IVSR).
- The Voice Switch By Pass (VSBP) is a backup voice switch that terminal controllers can use to stay in communication with pilots if there is a failure in the primary voice switch installed in their facility.

The FAA has awarded the contract for a two segment procurement of the NAS Voice System (NVS). The first segment will buy and test prototype new voice switches to determine operational suitability. The second segment will be for the full scale procurement of both en route and terminal voice switches to replace existing switches. The NVS program will include voice switches and remote radio control equipment. NVS will provide flexible networking for voice switch-to-voice switch connectivity as well as for voice switch to Air-to-Ground (A/G) radio connectivity. This architecture will facilitate meeting NextGen requirements for ATC workload sharing, unmanned aircraft system (UAS) operations, virtual tower operations, and business continuity. NVS will replace ARTCC, ATCT and TRACON voice switches and is funded through BLI 2B13.

The Voice Switching and Communications System (VSCS) is the voice switch currently used in ARTCCs. The FAA is upgrading VSCS with a technology refresh to replace components that have a high failure rate until the NVS program can replace the switches. The VSCS Training and Backup Switch (VTABS) can maintain critical A/G and ground-to-ground communications if the main communications system becomes inoperable as a result of a power outage, a catastrophic system failure, or during system maintenance or upgrade activities. VSCS is funded through BLI 2A09.

The Digital Audio Legal Recorder (DALR) is the voice recorder that is replacing Digital Voice Recorder Systems (DVRS). DALR is also installed in newly constructed airport traffic control towers. These voice recorders provide a legally accepted recording capability for conversations between air traffic controllers, pilots, and ground-based air traffic facilities in all ATC domains and are used in the investigation of accidents and incidents and routine evaluation of ATC operations. DALR is funded through BLI 2B18. NAS Voice Recorder Program (NVRP) is proposed to develop the next generation of recorders.

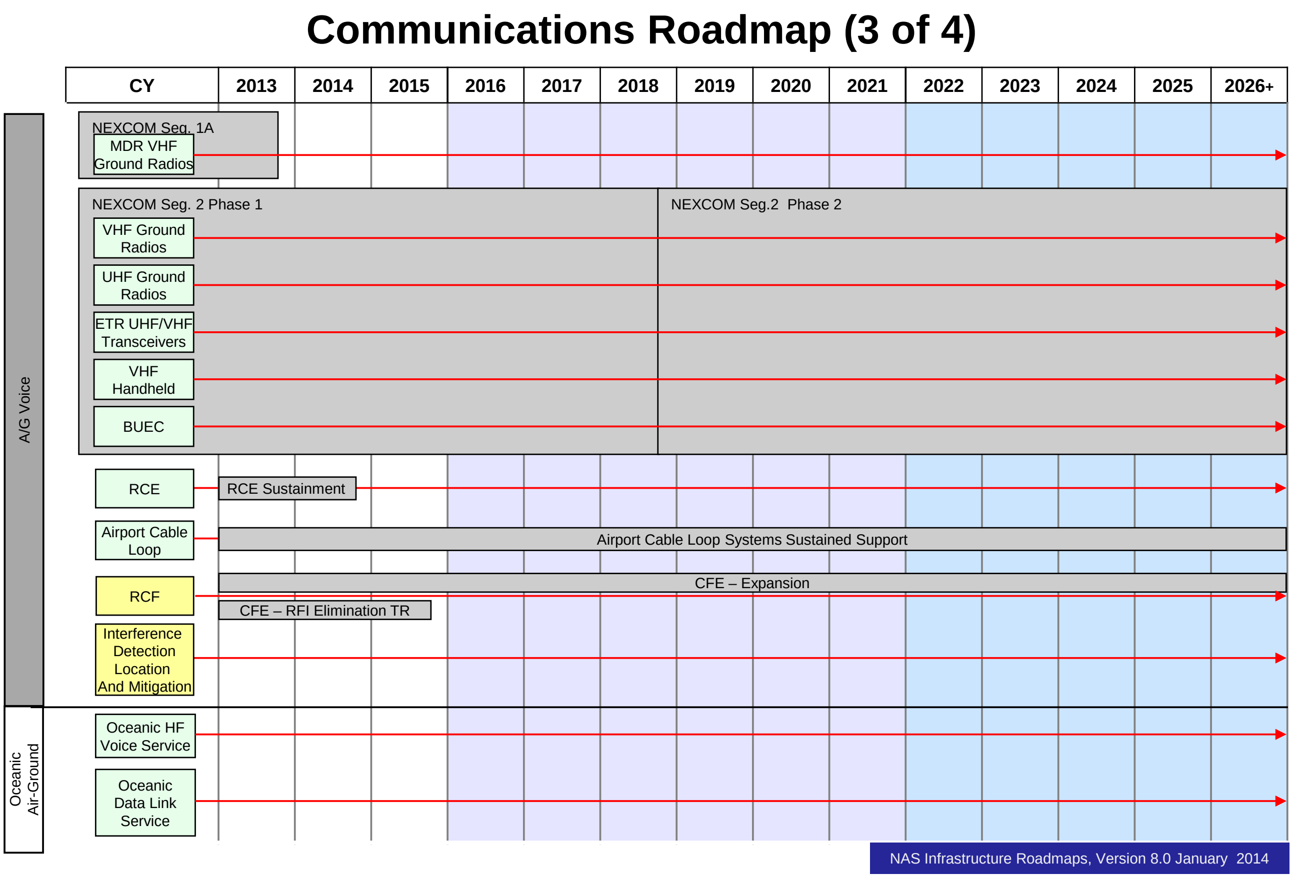

Figure 5-8 Air to Ground Voice and Oceanic Communications Roadmap

The third communications roadmap (figure 5-8) shows the replacement programs for the radios used for A/G communications and some of the supporting services to sustain NAS operations.

The Next Generation Air/Ground Communications (NEXCOM) program is upgrading Very High Frequency (VHF) radios used by civil aviation and Ultra High Frequency (UHF) radios used by FAA to communicate with military aircraft. NEXCOM Segment 1A replaced the radios used for high and ultrahigh en route sectors. Segment 2 will use a combined contract for both VHF and UHF radios to replace the radios that terminal facilities use. It will also replace emergency backup radios (emergency transmitter replacement (ETR)) that provide service when primary radios are not working. The Back Up Emergency Communication (BUEC) consists of radios installed at remote sites that back-up the primary radios that controllers use. NEXCOM is funded through BLI 2A11.

The Radio Control Equipment (RCE) program modernized the electronic equipment that allows controllers to control the radios they use at remote sites.

The Airport Cable Loop program replaces the communications cables that control and report the condition of equipment necessary for airport operations such as the Airport Surveillance Radar.

FAA is replacing copper wires with fiber optics and adding dual path operations so that a break in the cable does not stop the flow of information. The Airport Cable Loop program is funded through BLI 2E04.

The Communications Facility Expansion (CFE) program enhances operational efficiency and effectiveness by establishing, replacing and upgrading radio equipment at Remote Communication Facilities (RCF) that provide connections to air traffic facilities. The program also installs equipment to eliminate radio frequency interference (RFI) between radio frequencies. The program is funded through BLI 2A07.

The Interference Detection, Location and Mitigation (IDLM) program investigate occurrences of non-FAA transmitters interfering with FAA radios and navigation systems, locates the source, and ensures that they no longer interfere with FAA controlled frequencies. The FAA has specially equipped vehicles that detect and locate the sources of interference.

The last two items on the roadmap are communications systems used for oceanic air traffic control. The first one is the high frequency (HF) radio. HF radio allows the FAA to stay in touch with aircraft that are out of range of VHF radios. Oceanic Satellite Data Link Services is used by equipped aircraft and relies on communications satellites to transfer messages to and from aircraft flying over the oceans.

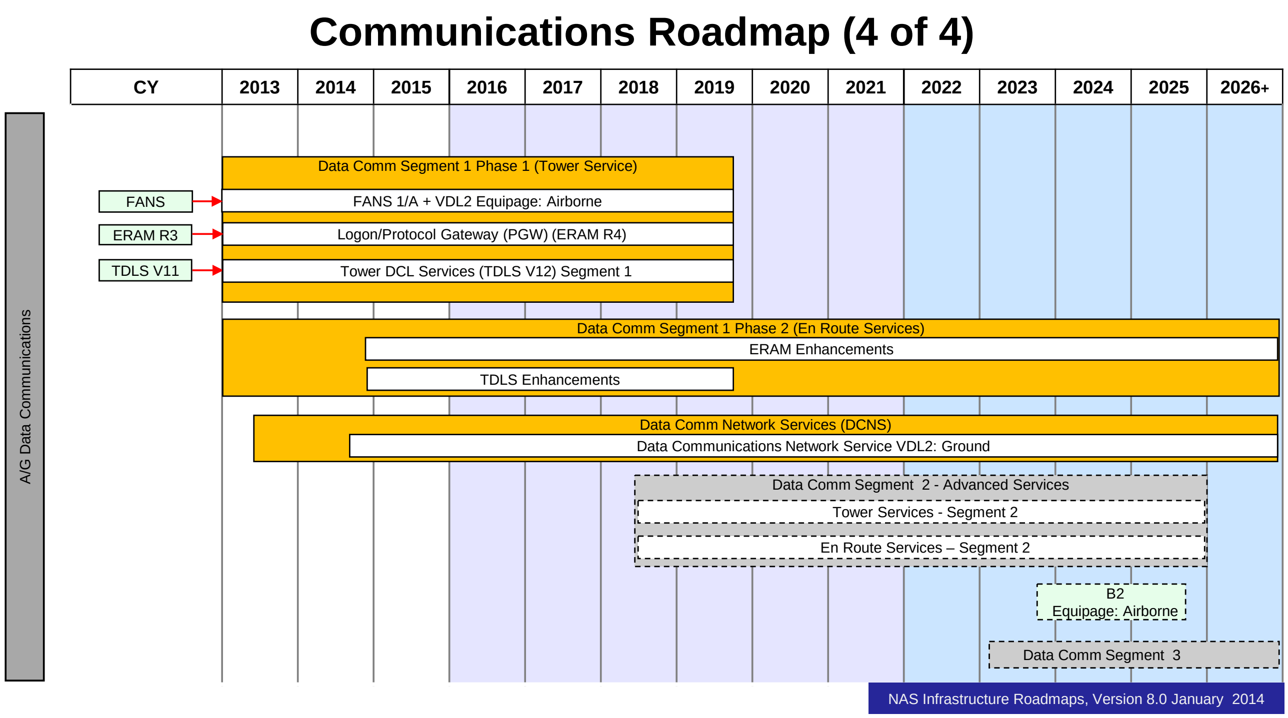

Figure 5-9 Air-to-Ground (A/G) Data Communications Roadmap

The fourth communications roadmap (figure 5-9) shows the planned transition from voice to data communications services for routine communications between controllers and pilots that can be transmitted by data link from en route and terminal ATC automation system.

Data Comm Segment 1 Phase 1 will provide service for three existing communication protocols. Future Air Navigation System (FANS), a generic term for capabilities mainly used for oceanic operations, will take advantage of already installed datalink capability. Aircraft that are FANS equipped will experience more sophisticated data link connections with ATC facilities as new systems evolve during the roadmap timeframe. The Logon/Protocol Gateway (PGW) upgrade began development in 2012 to assure security of transmissions to pilots. The Terminal Data Link System (TDLS) is currently used to transmit departure clearances (DCL) and other information to aircraft preparing to depart the airport. It is being upgraded and modernized by the Data Comm Segment 1 program.

Data Comm Segment 1 Phase 2 will provide en route services to pilots. More sophisticated applications will be developed through the entire period to 2025.

Data Comm Network Services (DCNS) will establish the ground infrastructure necessary to support communication between aircraft and FAA facilities. Data Comm programs are funded through BLI 2A19.

Data Comm Segments 2 and 3 will add enhanced services to the terminal and en route capabilities developed in segment 1.

B2 Equipage Airborne is the Aeronautical Telecommunications Network Baseline 2 which is aircraft equipage to enable enhanced data communications in en route services leading to full trajectory based operations.

Figure 5-10 shows the future capital investments for replacing communications systems and improving and modernizing communications channels. Funding amounts are in Millions of Dollars.

BLI Number	Program Name	FY 2015 Budget	FY 2016	FY 2017	FY 2018	FY 2019
	Communication Functional Area	**$257.0**	**$301.1**	**$356.0**	**$314.6**	**$310.7**
2A07	Air/Ground Communications Infrastructure	$3.9	$3.0	$3.2	$3.2	$3.3
2A09	Voice Switching Control System (VSCS)	$13.8	$9.9	$11.3	$12.8	$11.4
2A11	Next Generation Very High Frequency Air/Ground Communications System (NEXCOM)	$40.0	$43.3	$50.0	$50.0	$50.0
2A19	NextGen – Data Communication in support of NextGen	$147.3	$190.4	$233.0	$186.6	$174.0
2B08	Terminal Voice Switch Replacement (TVSR)	$2.0	$0.0	$0.0	$0.0	$0.0
2B13	NextGen – National Airspace System Voice System (NVS)	$20.6	$25.0	$40.0	$40.0	$50.0
2B18	Voice Recorder Replacement Program (VRRP)	$1.0	$0.0	$0.0	$0.0	$0.0
2E04	Airport Cable Loop Systems – Sustained Support	$5.0	$5.0	$5.0	$10.0	$10.0
2E05	Alaskan Satellite Telecommunication Infrastructure (ASTI)	$11.4	$12.5	$1.5	$0.0	$0.0
3A04	National Airspace System (NAS) Recovery Communications (RCOM)	$12.0	$12.0	$12.0	$12.0	$12.0

Note: BLI numbers with X represent outyear programs not requested in the FY 2015 President's Budget.

Note: FY 2016-2019 outyear funding amounts are estimates.

Figure 5-10 Funding amounts in the Communications Functional Area

5.3 Surveillance Roadmaps

To provide separation services to aircraft, air traffic controllers must have an accurate display of all aircraft under their control. Controller displays use a variety of inputs, including radar and transponder information, to show the location of aircraft. Surveillance data is provided by the following technologies:

- Primary radar – the radar beam is bounced off the aircraft and reflected back to the radar receiver;
- Secondary radar – a reply is generated by the aircraft transponder and sent back to the radar in response to a secondary radar signal;
- Multilateration – multiple ground sensors receive aircraft electronic signals and triangulate this information to determine aircraft position; and
- ADS-B – the aircraft determines its location using GPS or other navigation equipment and broadcasts that information to an ADS-B ground station. Position data determined by these sensors is relayed to automation systems which process the data and send it to the displays.

NextGen operational improvements will rely on advanced surveillance capabilities provided by ADS-B and Wide Area Multilateration which will provide more accurate information for controllers and better situational awareness for pilots. See Appendix B for more details on program activities.

Surveillance systems are shown in three different roadmaps:

1. Roadmap 1 (figure 5-11) - En Route Surveillance
2. Roadmap 2 (figure 5-12) - Terminal Surveillance
3. Roadmap 3 (figure 5-13) - Surface, Approach and Cross Domain Surveillance

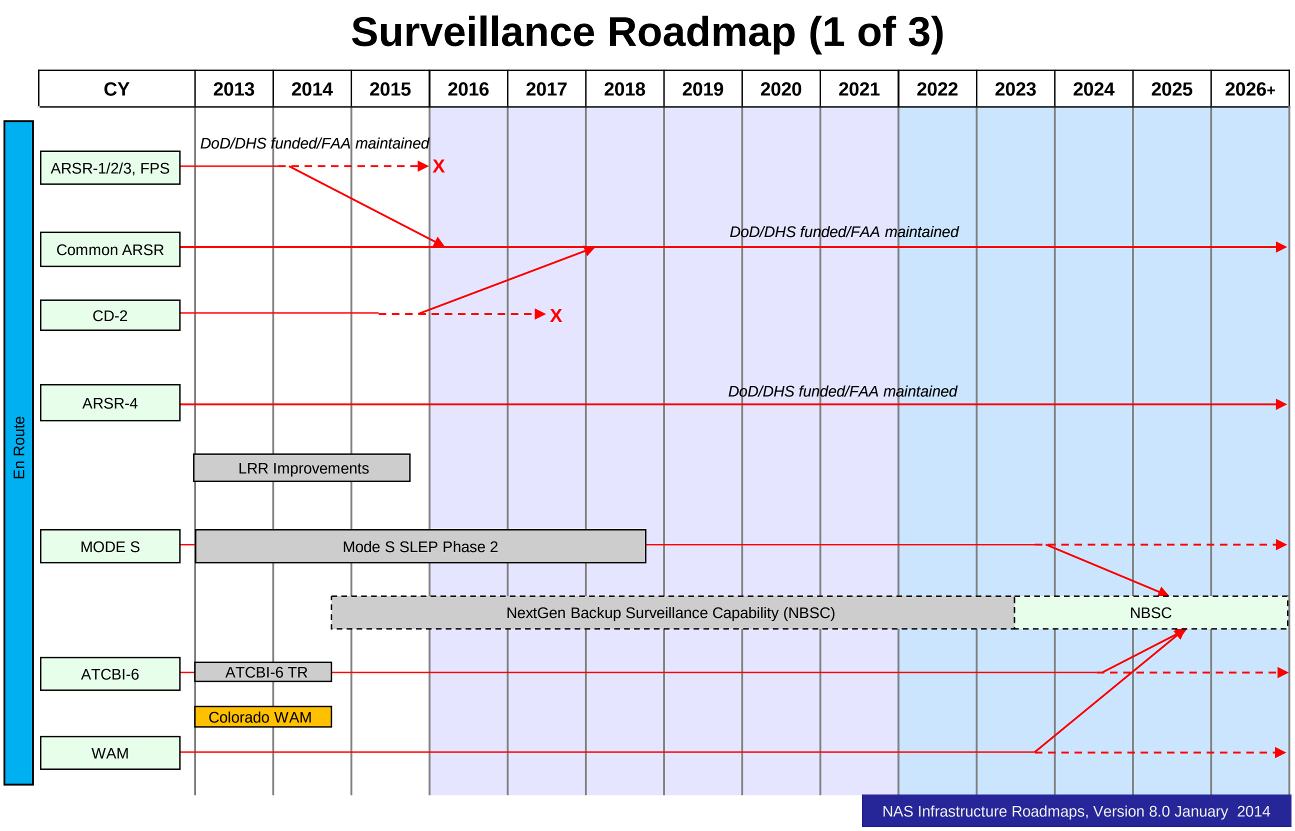

Figure 5-11 En Route Surveillance Roadmap

En route facilities use the Air Route Surveillance Radar (ARSR), and terminal facilities use Airport Surveillance Radar (ASR) as primary radars. The ARSR and ASR radars do not require a cooperative transmission from an aircraft to detect and track its location. En route and terminal facilities normally use secondary radars called the Air Traffic Control Beacon Interrogators (ATCBI) or the Mode Select (Mode S) for traffic separation. Secondary radar sends a signal to aircraft equipped with a transponder. The transponder reply contains the aircraft call sign, altitude, speed and can be processed to determine its position. Using ATCBI or Mode S enhances the controller’s ability to separate traffic because speed and altitude information supplement the position display for each aircraft.

The major en route systems are the various ARSR models, the Fixed Position Surveillance (FPS) system, Common Digitizer (CD-2), the Air Traffic Control Beacon Interrogator (ATCBI), and the Mode S.

The ARSR and FPS have a range exceeding 200 miles and provide aircraft location information to the en route centers. They are “skin-paint” radars (do not require cooperation from the detected aircraft) that transmit radio frequency pulses and process the reflected energy to determine aircraft range based on the total time for the signal to reach and return from the target, and the direction from the radar based on the antenna position. Existing early model long range radars are being converted to the Common Air Route Surveillance Radar (CARSR) configuration. Features of the existing Common Digitizers (CD-2), which convert analog information to digital, will be incorporated in the CARSR. The Department of Defense will fund system upgrades of the ARSR through 2025 due to national security concerns. ARSR infrastructure upgrades (buildings, power, towers, roads) are funded by the LRR Improvements program through BLI 2A08.

The ATCBI and the more advanced Mode S transmit an electronic signal to aircraft, which triggers a transponder. An ATCBI triggers all transponders within its beam, while the Mode S is able to address each aircraft within its beam separately. The NextGen Surveillance and Weather Radar Capability will replace the ASR systems; an investment decision is scheduled for 2017. ATCBI technology refresh and Mode S service life extension programs are funded through BLI 2B16. The NextGen Backup Surveillance Capability (NBSC) is a planned activity to identify and implement a backup surveillance capability to ADS-B which will allow for potential decommissioning of secondary radar systems. An initial investment decision is planned for 2016.

The Colorado Wide Area Multilateration (WAM) system uses electronic transmissions from an aircraft and multilateration technology to detect aircraft position in areas where the radar signal may be unavailable or blocked by mountainous terrain.

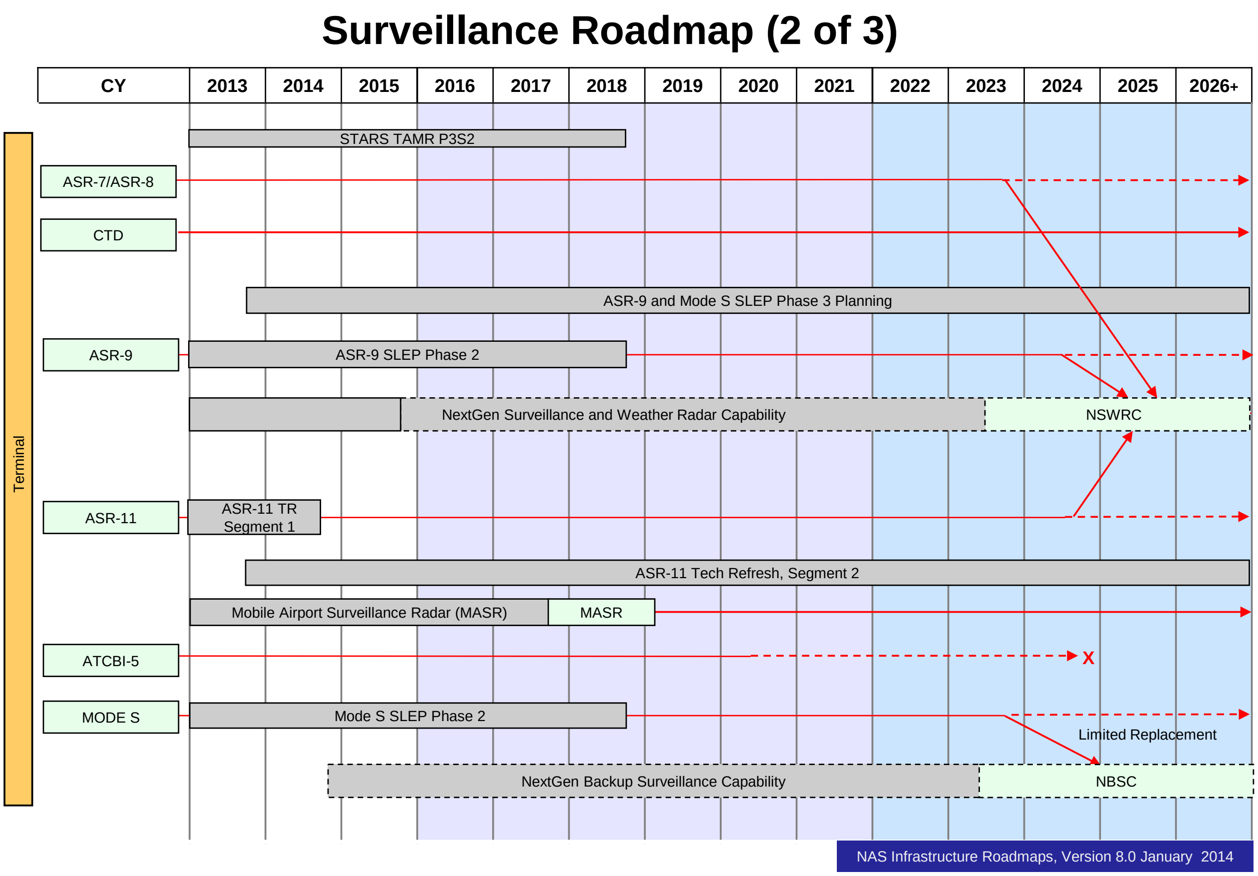

Figure 5-12   Terminal Surveillance Radar

Figure 5-12 shows that there are four models of terminal radars currently in use. The Airport Surveillance Radar Model 11 (ASR-11) is the newest and has replaced several of the radars that were not replaced by an earlier ASR-9 program. The ASR-9, which serves larger airports, will have a Service Life Extension Programs (SLEP) to update and modernize its components. The existing ASR 7/8 systems will require a Common Terminal Digitizer (CTD) be installed to convert their analog outputs to digital as older terminal automation systems are replaced by STARS, which requires a digital input of radar information. A decision will be made in 2023 whether to replace all 4 terminal radar systems with new systems providing NextGen Surveillance and Weather Radar Capability (NSWRC).

ASR-9 and Mode S SLEP Phase 3 Planning will develop the strategies for providing primary radar backup while addressing needs for safety, security, and weather detection requirements. ASR-9 service life extension and ASR-11 technology refresh programs Segments 1 and 2 are funded through BLI 2B10 and 2B11 respectively. Development of NSWRC is funded through BLI 1A01I.

The Mobile Airport Surveillance Radar (MASR) is a terminal surveillance radar that can be moved from site to site to support radar relocations, temporary planned outages of an existing radar for installation of upgrades and emergency operations when existing systems are damaged. MASR is funded through BLI 2B11.

The NextGen Backup Surveillance Capability (NBSC) is proposed to replace terminal ATCBI and Mode S systems with an investment decision scheduled for 2017. ATCBI technology refresh and Mode S service live extension programs are funded through BLI 2B16.

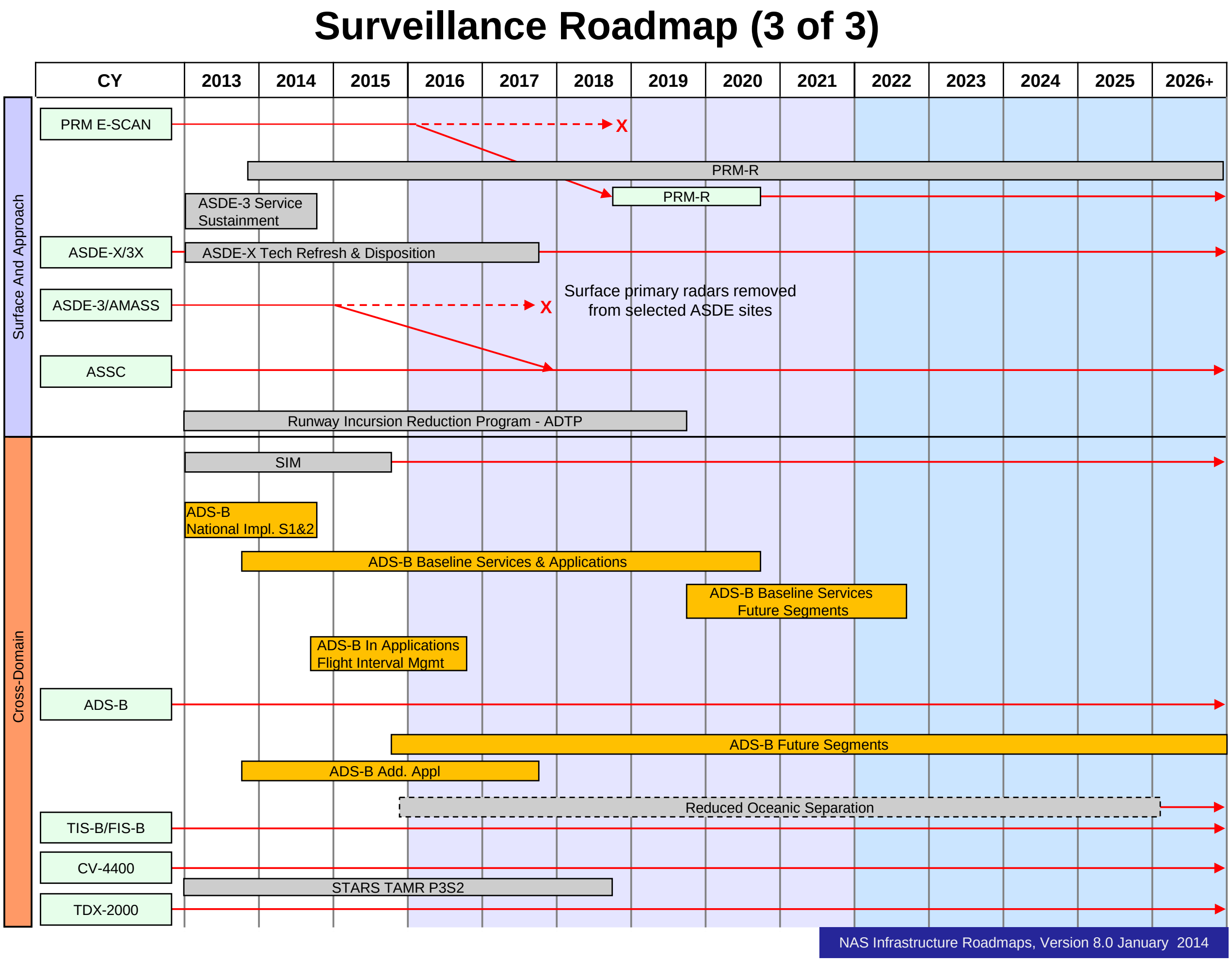

Figure 5-13 Surface, Approach and Cross Domain Surveillance Roadmap

The block titled Surface and Approach in the third Surveillance roadmap (figure 5-13) shows the systems used to track aircraft and vehicles on the airport surface and aircraft approaching the runway. The Automatic Dependent Surveillance-Broadcast (ADS-B) system shown in the lower area called Cross-Domain also is used on the airport surface and approach areas.

The Precision Runway Monitor (PRM) is used to monitor the safety of side-by-side simultaneous approaches to closely spaced parallel runways during IFR conditions. It is a secondary rapid update radar that provides the precision that controllers need to ensure that two aircraft maintain safe clearance between them while approaching closely spaced runways. The electronic scan (E-SCAN) version achieves the rapid update by moving the beam electronically rather than relying on turning the antenna. The PRM-Replacement (PRM-R) program is evaluating alternatives for continuing PRM system operations at San Francisco and Atlanta. PRM-R is funded through the Precision Runway Monitor Alternate (PRMA) BLI 2B19.

The FAA uses several systems for tracking aircraft on or near the airport surface. The ASDE-3 is a primary radar system that provides a display of aircraft and ground vehicles in the airport operating areas (runways and taxiways). This helps controllers manage aircraft on the ground and warn them of potential runway collisions. The ASDE-X merges primary and secondary radar, multilateration and ADS-B information to improve detection of aircraft and provide a clear display of the positions of aircraft and vehicles on or near taxiways and runways. A third system which uses multilateration is the Airport Surface Surveillance Capability (ASSC), and it will replace nine of the ASDE-3 radars.

Controllers currently use two systems to maintain aircraft separation on the airport surface. Some airports have ASDE-3/AMASS, which uses radar and a display in the tower to depict the location of aircraft on or approaching the taxiways and runways. These displays help controllers determine aircraft location when weather or darkness makes it difficult to see the entire airport surface. ASDE-X uses several technologies to perform the same function, and 18 of the 35 ASDE-X sites use an existing ASDE-3 radar. Seven ASDE 3 sites have been replaced by ASDE-X, and the Airport Surface Surveillance Capability (ASSC) program has replaced nine of the ASDE-3 radar systems. The ASSC will use multilateration and ADS-B aircraft information to display aircraft location for the airport tower controllers. ASDE-X will have a technology refresh to update some of its components. The technology refresh program is funded through BLI 2B01. The ASSC program is funded through BLI 2A13.

The Runway Incursion Reduction Program (RIRP) is evaluating other technologies that could be used to track aircraft surface and approach movements. RIRP is funded through BLI 1A01A.

In FY 2016, the FAA will begin fielding Surveillance Interface Modernization (SIM) equipment to replace legacy serial point to point interfaces and implement flexible Internet Protocol (IP) addressable interfaces between FAA radars and automation systems. The SIM IP transmission formats will simplify circuit management, support data security policies, provide higher reporting precision and target information which will reduce life cycle costs, enable efficient distribution of radar data in the NAS and support future FAA operational improvements. SIM is funded through BLI 2B17.

ADS-B implementation supports the NextGen operational improvements that use GPS aircraft position information as the basis for surveillance data provided to controllers. Nationwide implementation of ADS-B will enable a more frequent transmission of location and other flight information from the aircraft to air traffic control facilities. ADS-B has a faster update rate (1 second versus 5 seconds for a radar), and unlike radar technology, the accuracy remains constant regardless of the distance from the aircraft to the receiving site. The Traffic Information Service (TIS-B) broadcasts information on the location of nearby aircraft, and the Flight Information Service (FIS-B) broadcasts weather and airspace information to aircraft that are equipped with the capability to receive it. The Baseline Services and Applications program provides the ADS-B services as provided in the program baseline. Additional applications using ADS-B information will also be developed by the Flight Interval Management program and others to be funded in the Future Segments program. Implementation of ADS-B, TIS-B and FIS-B are funded through BLI 2A13.

The CV-4400 is a legacy system that allows use of terminal radar information for en route automation systems, e.g., using terminal radar to fill gaps in en route radar coverage at selected en route centers. The TDX-2000 is also a legacy system that digitizes the output of legacy analog radars (for example, ASR-8) for use by more modern digital automation systems, such as STARS. These adaptations will need to be continued until TAMR Phase 3 Segment 2 installs STARS to replace existing terminal automation systems.

Figure 5-14 shows the future capital investments associated with upgrading the surveillance systems. Funding amounts are in Millions of Dollars.

BLI Number	Program Name	FY 2015 Budget	FY 2016	FY 2017	FY 2018	FY 2019
	Surveillance Functional Area	**$305.5**	**$219.4**	**$198.4**	**$177.2**	**$179.7**
2A08	Air Traffic Control En Route Radar Facilities Improvements	$5.1	$0.0	$0.0	$0.0	$0.0
2A13	NextGen – Automatic Dependent Surveillance - Broadcast (ADS-B) NAS Wide Implementation	$247.2	$183.9	$166.4	$155.8	$163.3
2B01	Airport Surface Detection Equipment - Model X (ASDE-X)	$5.4	$10.5	$8.4	$0.0	$0.0
2B10	Airport Surveillance Radar (ASR-9) Service Life Extension Program (SLEP)	$13.6	$3.8	$3.5	$1.2	$0.0
2B11	Terminal Digital Radar (ASR-11) Technology Refresh and Mobile Airport Surveillance Radar (MASR)	$21.1	$9.9	$6.1	$3.2	$4.4
2B16	Mode S Service Life Extension Program (SLEP)	$8.1	$11.3	$14.0	$17.0	$12.0
2B17	Surveillance Interface Modernization (SIM)	$4.0	$0.0	$0.0	$0.0	$0.0
2B19	Precision Runway Monitor Alternate (PRMA)	$1.0	$0.0	$0.0	$0.0	$0.0

Note: BLI numbers with X represent outyear programs not requested in the FY 2015 President's Budget.
Note: FY 2016-2019 outyear funding amounts are estimates.

Figure 5-14 Funding amounts in the Surveillance Functional Area

5.4 Navigation Roadmaps

Navigation aids provide pilots the information needed for them to safely arrive at their destination. Navigation aids (also Navaids) can be both electronic and visual. Electronic aids have traditionally been radio transmitters with associated aircraft avionics that provide pilots direction and/or distance from their location. Visual Navaids are ground based lighting systems that provide pilots the path they need to follow or give visual queues of their position and direction of flight relative to the aid. Navigational aids are used to assist pilots while operating in all domains (en route, terminal, and surface) during clear or low visibility conditions.

Precision and non-precision approaches allow pilots to land on a runway when the visibility is limited. Precision approaches allow descents to lower minimum altitudes than are possible with non-precision approaches. Non-precision approaches only provide lateral guidance, not vertical guidance. Ground based landing systems, aircraft avionics and approach lighting systems help the pilot to conduct precision or non-precision approaches and land safely.

Many NextGen OIs to improve pilots navigation capabilities rely on improved position information provided by the Global Positioning System (GPS) satellite navigation system. See descriptions in Appendix B which provide more information on program activities.

Navigational aid programs are portrayed in two different roadmaps:

1. Roadmap 1 (figure 5-15) - Precision Approach/Surface Navigation and Safety and Enhancements

2. Roadmap 2 (figure 5-16) - Infrastructure and En Route/ Terminal/Non-Precision Approach

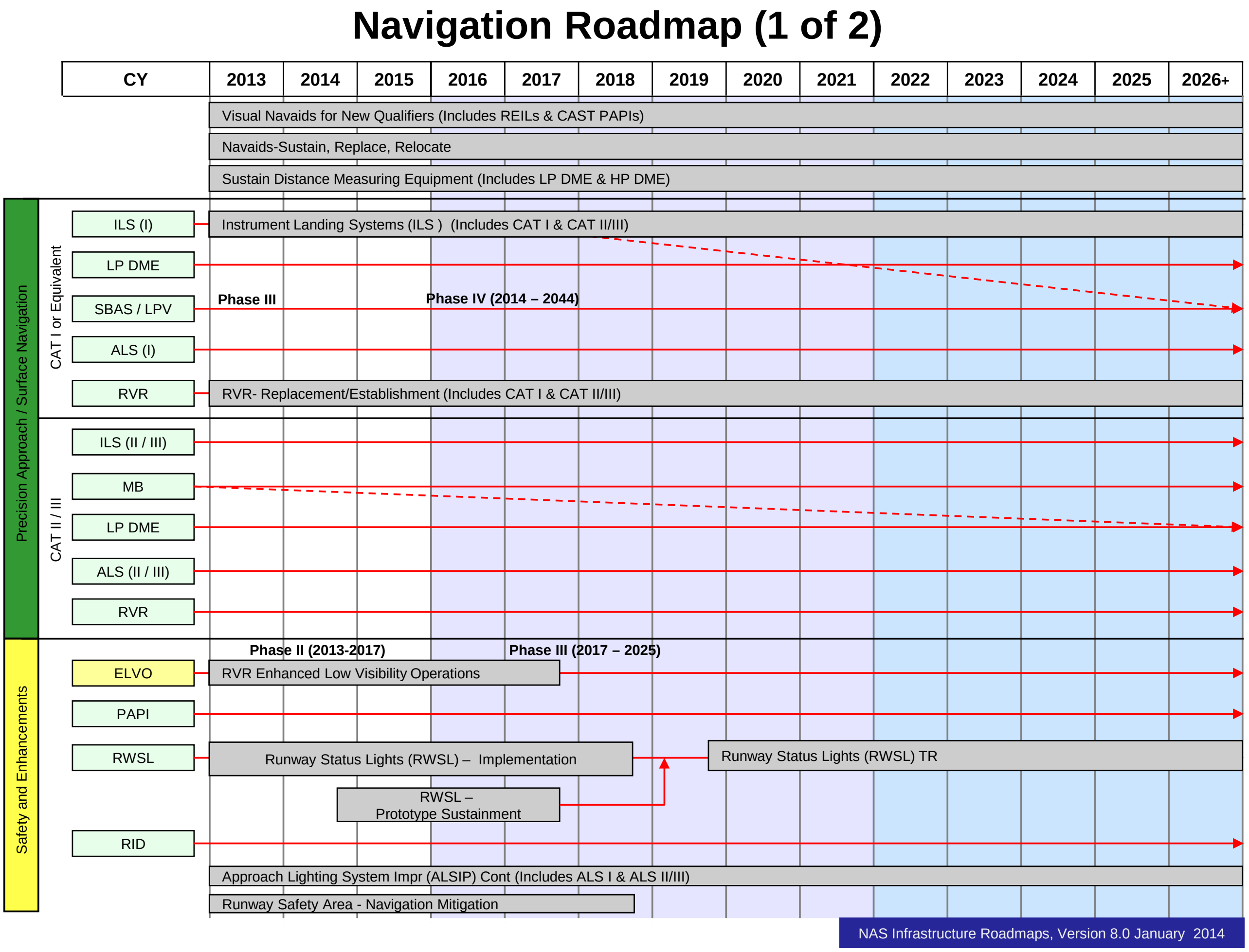

Figure 5-15 Precision Approach, Surface Navigation and Safety and Enhancements Roadmap

At the top of the roadmap (figure 5-15) are 3 programs that support the continued operation of existing systems. Visual Navaids assist pilots in staying on the proper glide path. The Visual Navaids for New Qualifiers, and the Navaids Sustain, Replace, Relocate programs update, replace and augment the existing inventory of navigational aids. The Sustain Distance Measuring Equipment (DME) program both renovates and increases the number of low power (LP) and high power (HP) installed DMEs. Visual Navaids, navigation aids and DMEs are funded through BLIs 2D06, 2D07 and 2D09.

The current most widely used precision landing aids are Instrument Landing Systems (ILS) that guide pilots to runway ends using a pair of radio beams—one for lateral guidance and the other for vertical guidance—to define the approach glidepath, so that pilots can follow it to the runway using cockpit instrumentation. ILS systems provide three categories of precision approach which provide the ability for aircraft to land in low visibility conditions. Category I is the most common. It guides the pilot to the runway end, but it typically requires that the pilot be able to see the runway when the aircraft is no less than 200 feet above the field elevation, and the horizontal visibility is one-half mile or more. The Category II and III approaches allow aircraft to descend to lower minimums (i.e., less vertical and horizontal visibility is required). Currently, ILS is the primary system used for precision approaches. Category II and III ILS have higher redundancy and reliability levels that reduce the risk of equipment failures and allow lower minimums. There are more than 1,200 ILSs installed in the United States. The ILS program provides for the replacement of aging ILS systems. ILSs are funded through BLI 2D02.

The Low Power DME (LPDME) is being installed to support advanced procedures requiring performance based navigation equipage and allow specially trained pilots to minimize the length of approach paths and, as discussed below, to replace marker beacons. LPDMEs are funded through BLI 2D06.

The Space Based Augmentation System (SBAS) is implemented by the Wide Area Augmentation System (WAAS) that uses a network of 38 ground monitors to calculate corrections to the GPS signals and broadcast those corrections from telecommunications satellites. WAAS-equipped aircraft can use the information to fly a precision approach to a runway in low-visibility conditions. There are a total of 3,404 WAAS Localizer Performance with Vertical Guidance (LPV) based precision approaches in place. WAAS is funded through BLI 2D03.

An alternative for precision approach guidance to a 200 foot decision height is the SBAS/LPV-200 which is enabled by GPS/WAAS. As this alternative comes into broader use, the FAA can consider decommissioning ILS. The FAA plans to make an initial decision in 2016 on the drawdown of Category I ILS.

In both Category I and II/III sections of the roadmap, the Approach Light System (ALS) and the Runway Visual Range (RVR) systems are shown. The ALS helps the pilot see the end of the runway and transition from instrument to visual flight for landing before reaching runway minimums. The RVR informs the tower of the measured visibility so that controllers can inform the pilot whether the runway visibility is above or below minimums. In the Category II section the existing MB (Marker Beacon) installations are being evaluated to determine how many can be replaced by LP DMEs. The FAA is also testing use of light-emitting diodes (LED) to replace the incandescent lamps currently in use in ALS to reduce both maintenance and operating costs. The approach lights and visibility sensors will need to be sustained and remain in operation for precision approach guidance regardless of any decision on decommissioning ILSs. ALSs, RVRs and other approaching lighting systems are funded through BLI 2D04 and 2D05.

The Safety and Enhancements section of the roadmap shows several systems designed to assist pilots to operate safely in low visibility conditions. They are:

- Enhanced Low Visibility Operations (ELVO) – allows pilots to land with lower limited visibility conditions than standard procedures. Additional RVRs to support this capability are funded through BLI 2D04;

- Precision Approach Path Indicator (PAPI) – allows pilots to determine visually that they are on the proper glideslope for landing and are funded through BLI 2D10;
- Runway Status Lights (RWSL) – are designed to give pilots a stop signal if it is dangerous to enter or cross a runway, funded through BLI 2B12;
- Runway Incursion Device (RID) – is a system in the tower that alerts controllers when a runway is occupied;
- Airport Lighting System Improvement Program (ALSIP) – a response to the National Transportation Safety Board recommendation to replace steel airport light supports with frangible structures to minimize damage to aircraft that descend below the glidepath, funded through BLI 2D05; and
- Runway Safety Area (RSA) – a program to replace structures in the safety area surrounding a runway with low-impact supports to minimize damage to aircraft that veer off the runway, funded through BLI 2D12.

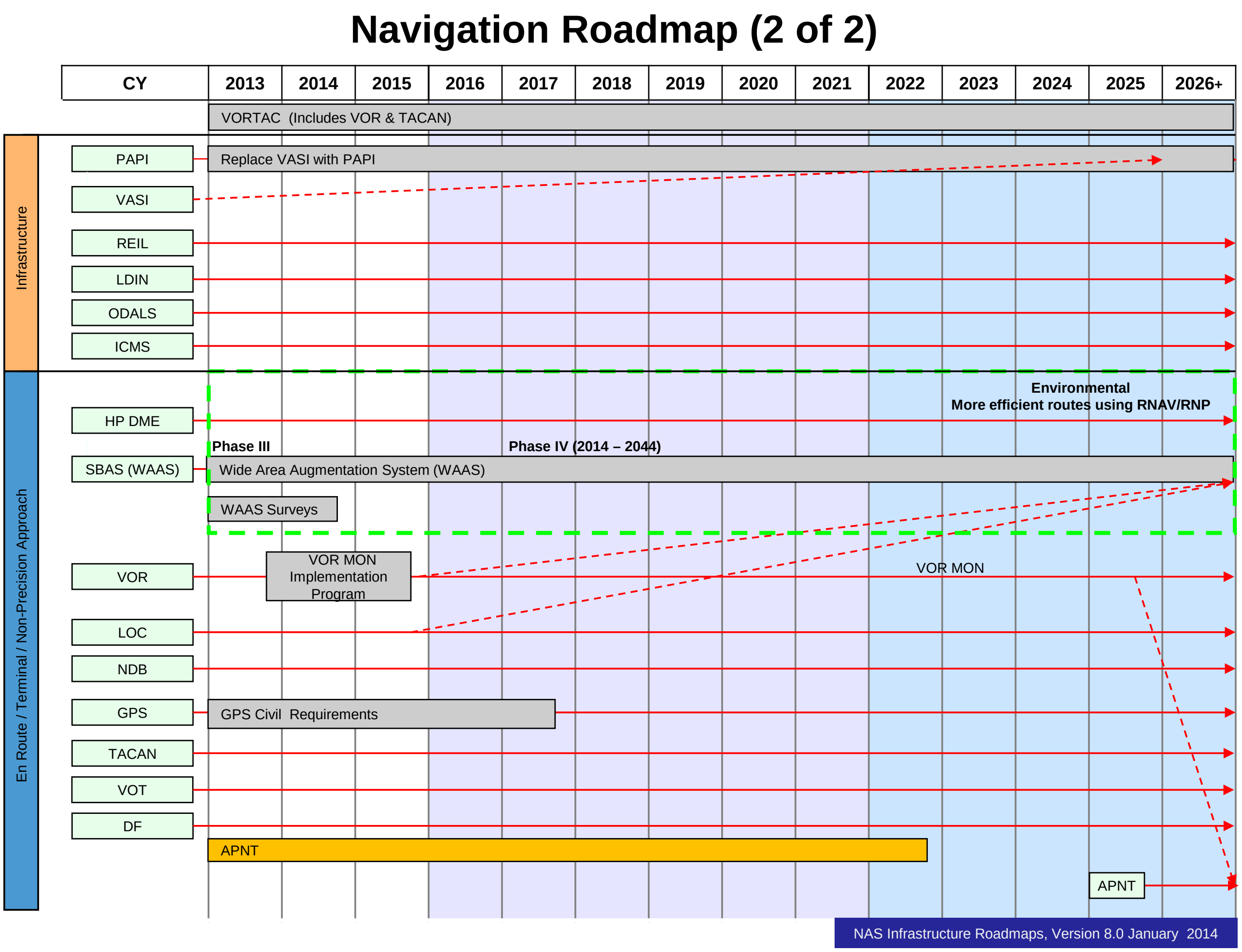

Figure 5-16 Approach and Runway Lights and En Route, Terminal and Non-Precision Approach Roadmap

En route navigation has traditionally been provided by radio transmitters that provide pilots direction and/or distance from their location. The ground-based system commonly used for en route navigation is the Very High Frequency Omnidirectional Range with Distance Measuring Equipment (VOR with DME). There are more than 1,000 VORs spread across the United States. They enable pilots to determine an accurate position and also define the Victor and Jet airways, which are published routes based on straight lines from VOR to VOR. With GPS capabilities, pilots are now able to navigate without the ground based aids.

The VORTAC program at the top of the roadmap (Figure 5-16) shows that combined VOR and Tactical Navigation System (TACAN) sites will be supported indefinitely based on the need to retain them. TACAN is the military equivalent of VOR and DME systems installed jointly. VORTAC is a site with a VOR and the military TACAN co-located, and the VOR uses the TACAN for DME information. The VORTAC program is funded through BLI 2D01.

Vertical Approach Slope Indicator (VASI) is being replaced by Precision Approach Path Indicator (PAPI) program to meet international standards. The replacement program will be continued until the PAPI replaces all of the current VASI systems, at a time well into the future. The PAPI system is funded through 2D10.

The Runway End Identification Lights (REIL) help pilots to visually align with the runway for both precision and non-precision approaches. The REIL will continue operating throughout the roadmap timeframe. The LDIN (Lead In Light System) and the ODALS (Omnidirectional Airport Lighting System) are installed at the end of runways to help pilots determine the active runway for landing. The Interlock Control and Monitoring System (ICMS) lets controllers rapidly activate and deactivate the navigational aids at an airport.

High Power DME supports navigation for both en route and terminal operations. Analysis is being performed by the NextGen Navigation Engineering program to determine the DME expansion needed to meet future requirements.   NextGen Navigation Engineering is funded through BLI 1A10D.

The Space Based Augmentation System (SBAS) is implemented by the Wide Area Augmentation System (WAAS) that uses a network of 38 ground monitors to calculate corrections to the GPS signals and broadcast those corrections from telecommunications satellites. The FAA also has more than 5,800 Lateral Navigation (LNAV) GPS-WAAS non-precision approach procedures in place. WAAS is funded through BLI 2D03.

As GPS replaces the VOR as a navigation aid, FAA will decrease the number of VORs to a Minimum Operational Network (MON). The MON will serve as a backup for GPS and will be available for those aircraft that have not equipped with GPS navigation systems. The VOR MON program is funded through BLI 2D01.

The Localizer (LOC) is an ILS component that provides horizontal guidance to a runway end. When used as a stand-alone system without a Glideslope component, LOC supports non-precision approach operations; SBAS (WAAS) will begin to replace that functionality at airports where only localizers are installed.

The FAA will continue operating Non-Directional Beacons (NDB), because NDBs are still used at some remote areas, where it is not economically justified to install modern navigational equipment.

The Department of Defense operates GPS. There are typically 24 to 30 active satellites in orbit, and a navigation receiver can determine an aircraft's position by interpreting the data transmitted by the satellites in view of the aircraft's antenna. Two GPS upgrades are expected in future years. The next generation of satellites will have a second frequency (L5) for civilian safety-of-life use. An aircraft receiver that receives both the existing L1 signal and the new L5 signal can internally calculate corrections that enhance the accuracy of the position calculation and eliminate the errors caused by ionospheric distortion. The GPS III family of satellites will be upgraded with an additional civil signal (L1C) and increased transmitting power. The GPS Civil Requirements BLI 2D11 will fund the ground monitoring stations to measure the accuracy and reliability of the new civil frequencies.

The VOT (VOR Test Range) is used to check and calibrate VOR receivers in aircraft. The Direction Finder (DF) was used to help locate lost pilots, but it is being decommissioned because better technology is now available.

The Alternate Positioning Navigation and Timing System (APNT) is a program to determine the appropriate back up navigation system in case GPS service is disrupted. It is a NextGen initiative to ensure continuity of service if GPS is disrupted. The APNT program is funded through BLI 1A05C.

Figure 5-17 shows the future capital investments for navigation systems. Funding amounts are in Millions of Dollars.

BLI Number	Program Name	FY 2015 Budget	FY 2016	FY 2017	FY 2018	FY 2019
	Navigation Functional Area	**$244.6**	**$215.9**	**$171.8**	**$145.2**	**$151.3**
2B12	Runway Status Lights (RWSL)	$41.7	$23.7	$4.3	$1.2	$0.0
2D01	VHF Omnidirectional Radio Range (VOR) with Distance Measuring Equipment (DME)	$8.3	$2.5	$2.5	$2.5	$8.9
2D02	Instrument Landing Systems (ILS) – Establish	$7.0	$7.0	$7.0	$7.0	$10.0
2D03	Wide Area Augmentation System (WAAS) for GPS	$103.6	$105.7	$105.0	$104.9	$97.4
2D04	Runway Visual Range (RVR) & Enhanced Low Visibility Operations (ELVO)	$6.0	$6.0	$6.5	$4.0	$6.0
2D05	Approach Lighting System Improvement Program (ALSIP)	$3.0	$3.0	$3.0	$3.0	$5.0
2D06	Distance Measuring Equipment (DME)	$3.0	$3.0	$3.0	$3.0	$5.0
2D07	Visual Navaids - Establish/Expand	$2.0	$2.0	$2.0	$2.0	$2.0
2D09	Navigation and Landing Aids – Service Life Extension Program (SLEP)	$3.0	$3.0	$3.0	$6.0	$7.0
2D10	VASI Replacement – Replace with Precision Approach Path Indicator	$5.0	$5.0	$5.0	$5.0	$10.0
2D11	Global Positioning System (GPS) Civil Requirements	$27.0	$25.0	$11.0	$0.0	$0.0
2D12	Runway Safety Areas – Navigation Mitigation	$35.0	$30.0	$19.5	$6.6	$0.0

Note: BLI numbers with X represent outyear programs not requested in the FY 2015 President's Budget.

Note: FY 2016-2019 outyear funding amounts are estimates.

Figure 5-17 Funding amounts in the Navigation Functional Area

5.5 Weather Roadmaps

Timely and accurate weather observations and forecasts are essential to aviation safety and for making the best use of aviation capacity. Weather information will be even more important when NextGen direct or user chosen trajectory routing becomes routine. Pilots need to know the direction and speed of winds aloft so that they can take advantage of tailwinds and minimize the effect of headwinds. They also need to know if there will be obstructions to visibility that restrict landings at their destination airport, and whether the runway is wet or dry and how that will affect braking action. Traffic flow managers and pilots use weather observations and forecasts to determine when they need to plan alternative routes to avoid severe weather. Pilots must avoid thunderstorms with hail and heavy rain, turbulence, and icing to avoid damage to the aircraft and potentially injuring passengers. The FAA has a lead role in collecting and distributing aviation weather data – particularly hazardous weather. The FAA distributes weather hazard information from its own systems and uses both the FAA and National Weather Service (NWS) computer forecast models based on data available from FAA and NWS sensors to develop forecasts for use by air traffic control facilities, pilots, airline operations centers, and other aviation-related facilities.

NextGen operational improvements will rely on improved access to weather information provided by Common Support Services – Weather (CSS - Wx) and better weather processing and forecasting provided by NextGen Weather Processor (NWP).

Weather system implementation is broken down into two different roadmaps:

1. Roadmap 1 (figure 5-18) - Weather Sensors
2. Roadmap 2 (figure 5-19) - Weather Dissemination, Processing, and Display

Weather Roadmap (1 of 2)

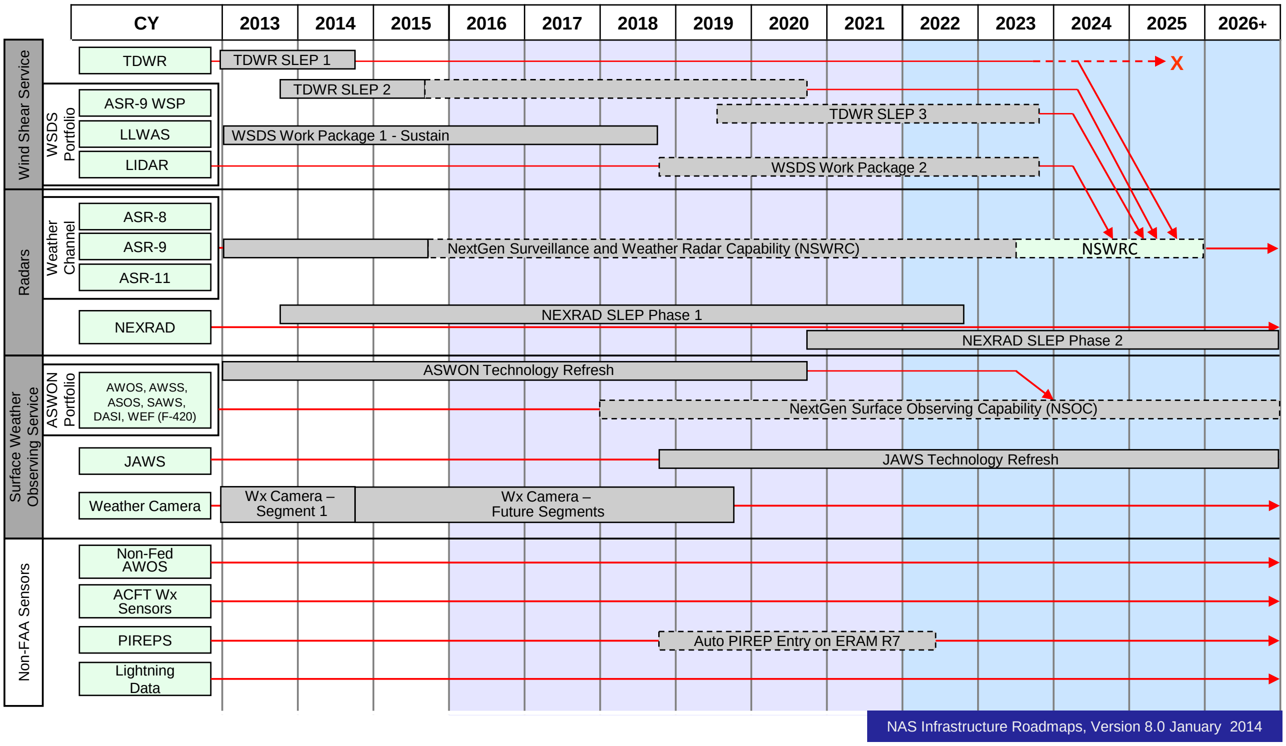

Figure 5-18 Weather Sensors Roadmap

Weather sensors include weather radars and surface observation systems that measure atmospheric parameters, such as surface temperature, prevailing wind speed and direction, relative humidity, and cloud bases and tops, as well as wind shear and microbursts. These weather sensors provide real-time information to air traffic facilities and to centralized weather-forecasting models.

Figure 5-18 shows the current and planned status of weather sensors. The Terminal Doppler Weather Radar (TDWR) is installed at 46 airports and detects wind shear and microbursts, so controllers can warn pilots of these hazards as they approach the runways and begin landing procedures. TDWR is the most sophisticated wind shear detection system. Using Doppler technology, the radars can detect the rapid changes in wind speed and direction that indicate existence of wind shear hazards for an aircraft approaching or departing a runway. The TDWR service life extension program is funded through BLI 2B02.

The Wind Shear Detection Services (WSDS) Portfolio includes: the Airport Surveillance Radar-9 (ASR-9) Wind Shear Processor (WSP); the Low Level Wind Shear Alerting System (LLWAS); and the Light Detection and Ranging (LIDAR) system. ASR-9 radars, wind sensors and lasers are used to detect wind shear conditions near the runways and approach areas of airport. Airports with significant wind shear risk that have a lower volume of air traffic are served by the ASR-9 WSP, a lower cost alternative to TDWR. The ASR-9 WSP processes weather from the two dimensional Doppler search radar signals, which are its standard format to detect wind shear which approximates the output of the TDWR. The Wind Shear Detection Portfolio is funded through BLI 2A14.

LLWAS consists of wind sensors located at 6 to 29 points around the runway thresholds to measure surface wind direction and velocity. The LLWAS computer systems compare the wind velocity and direction detected by these sensors at different locations to determine whether wind shear events are occurring at or near the runways. The sensors can only measure surface winds and do not detect wind shear in the approach or departure paths. LLWAS serves airports that may also have a TDWR or ASR-9 because the system supplements the weather radars with point-specific wind measurements to verify the presence and location of wind shear.

The LIDAR system uses lasers to detect dry microbursts and gust fronts that radar systems such as TDWR may not detect. Evaluation of LIDAR is underway at airports located in dry high plains or mountain environments, where wind shear is not always accompanied by sufficient precipitation for the TDWR to detect it with 90 percent reliability.

The WSDS Work Package 1 sustain program will provide for modernization of these systems. The Wind Shear Detection Portfolio is funded through BLI 2A14.

The ASR-8/9/11 Weather Channel and the Next Generation Weather Radar (NEXRAD) detect precipitation, wind, and thunderstorms that affect aircraft in flight. Replacing the weather information that the ASR-8/9 radars generate will be necessary if these radars are decommissioned. The FAA is evaluating the potential to combine these functions into a NextGen Surveillance and Weather Radar Capability (NSWRC) if the business case shows that solution to be viable. Development of NSWRC is funded through BLI 1A01I.

Development of NEXRAD occurred under a joint program of the Department of Commerce's National Weather Service, Department of Defense, and FAA. These systems are Doppler weather radars that detect and produce over 100 different long-range and high-altitude weather observations and products, including areas of precipitation, winds, thunderstorms, turbulence, and icing. The NEXRAD radars are essential for forecasting future weather. A cooperative program with the partner agencies will upgrade the NEXRAD radars with a Service Life Extension Program (SLEP) to modernize and renovate the existing system of radars. The NEXRAD SLEP program is funded through 2A04.

The Automated Surface Weather Observation Network (ASWON) Portfolio includes several surface sensors (AWOS/ASOS/AWSS/SAWS/DASI/F-420) that measure weather parameters on the surface and report conditions to air traffic facilities and pilots. The data collected is important to pilots and dispatchers as they prepare and file flight plans, and it is vital for weather forecasting. The Automated Surface Observing Systems (ASOS) and other variants (such as the Automated Weather Observing System (AWOS); the Automated Weather Sensor Systems (AWSS); and the Stand Alone Weather Sensing (SAWS) system) have up to 14 sensors that measure surface weather data, including temperature, barometric pressure, humidity, type and amount of precipitation, and cloud bases and amount of sky cover. The Digital Altimeter Setting Indicator (DASI) shows tower controllers the current barometric pressure, so they can inform pilots of the proper aircraft altimeter setting so it will display the correct ground elevation of the runway at touchdown. The F-420 is an indicator that shows the wind direction and velocity on the runways. These systems feed data directly to air traffic control facilities and support automated broadcast of weather information to pilots. They also provide regular updates for the forecast models that predict future weather conditions including adverse weather. These systems will remain in operation until a decision is made to implement the NextGen Surface Observing Capability. The ASWON Technology Refresh program will provide upgrades and replacements needed to address obsolescence, supportability, and maintainability issues. The ASWON Portfolio is funded through BLI 2C01.

The Juneau Airport Weather System (JAWS) is unique to Juneau, Alaska. It uses mountain-peak wind sensors located around Juneau to provide wind hazard information to the Flight Service Station and Alaska Airlines to improve the safety of aircraft arriving at and departing the airport. The Technology Refresh program will provide upgrades and replacements needed to address obsolescence, supportability and maintainability issues. The JAWS program is funded through BLI 2A14.

The Weather Camera program installs cameras along flight routes in Alaska, so pilots have a visual picture of the weather they might encounter as they file their flight plans for a specific route. Flights can be cancelled if the cameras show poor weather along the planned route. The Weather Camera program will replace cameras as they fail or reach end of life. The program is funded through 2C04.

The non-FAA sensors shown at the bottom of the roadmap are sources of weather information that improve FAA’s overall knowledge of weather conditions. Some states and smaller airports operate AWOS for weather observations. Inputs from these systems provide supplemental data to FAA sensors. Aircraft weather sensors can provide humidity, wind speed and atmospheric pressure readings that are helpful in forecasting weather conditions. Pilot Reports (PIREPS) provide real time reports on the weather along major flight routes. A planned activity would enhance ERAM to allow automatic entry of pilot reports into the automation system. Lightning Data provides air traffic facilities important information about the location and intensity of thunderstorms.

Weather Roadmap (2 of 2)

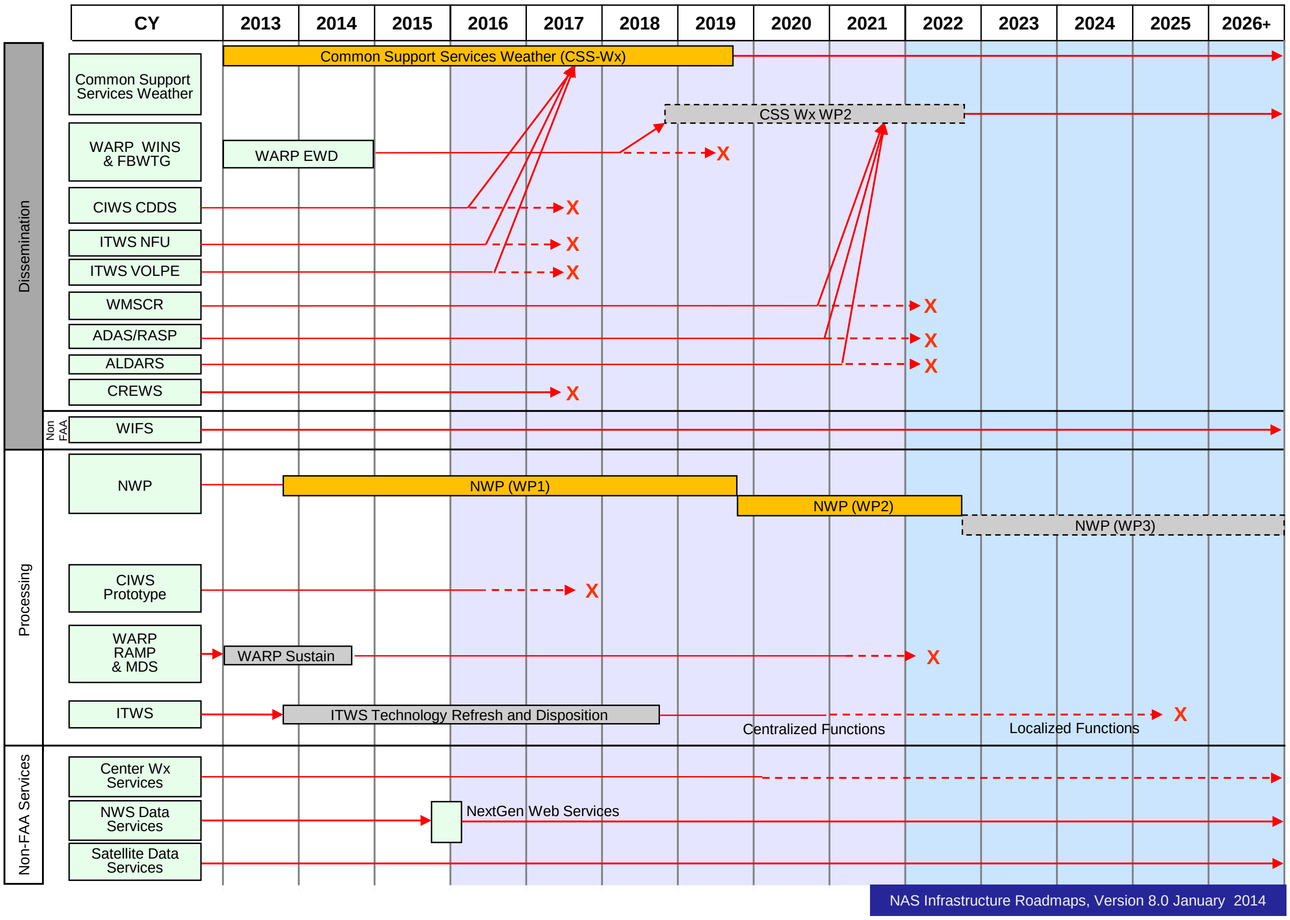

Figure 5-19 Weather Dissemination, Processing, and Display Roadmap

Weather processing/dissemination/ display systems organize and process the sensor's observed data. Data from multiple sensors feed forecast models whose output can be disseminated and integrated in national and local processing and display systems that interpret broad weather trends affecting aviation operations. This information can then be sent to air traffic controllers, traffic flow managers, dispatchers, and pilots.

Figure 5-19 shows the systems that process, display, and disseminate weather observations and forecast information. Weather forecasts are integrated into decision support system algorithms to produce more sophisticated forecasts of how weather will impact NAS operations. Common Support Services – Weather (CSS - Wx) which is supported by the SWIM program will be the source for weather information and provide access to all users throughout the NAS. This capability is planned to initiate in 2017. The CCS-Wx program is funded through BLI 2A12C.

Currently, the Weather and Radar Processor Weather Information Network Server (WARP WINS) processes and stores data from multiple NEXRAD radars for use by en route control facilities. The information is used by the Center Weather Service Unit to develop forecasts.

WARP also provides NEXRAD precipitation intensity data to controllers' displays. The WARP FAA Bulk Weather Communications Gateway (FBWTG) provides NWS data to the center weather service units to aid in their forecast of weather conditions in the center's airspace. The roadmap shows that WARP will be upgraded with an Enhanced WINS distribution (WARP EWD) before the WARP functions are incorporated in CSS – Wx.

The Corridor Integrated Weather System (CIWS) gathers weather information along the busiest air traffic corridors to help air traffic specialists select the most efficient routes when they must divert traffic to avoid severe weather conditions. The CIWS Data Distribution System (CDDS) program enabled the existing CIWS system to distribute data to external NAS users so traffic management participants have the same information for daily route planning.

The Integrated Terminal Weather System (ITWS) consolidates weather information from automated sensors and surrounding radars (TDWR and NEXRAD) to provide real-time weather information for terminal control facilities. The system also projects movement of thunderstorms and gust fronts up to 20 minutes into the future. ITWS has been installed at 23 airports. Tower and Terminal Radar Approach Control (TRACON) controllers use the information to make more precise estimates of when runways should be closed and subsequently reopened. They also use the information to plan for a switch in terminal arrival patterns to avoid inefficient maneuvering to accommodate a runway change as aircraft approach an airport. The ITWS will have two enhancements. The National Weather Service Filter Unit (ITWS NFU) will send data collected by FAA to the National Weather Service to use for weather forecasting. The ITWS Volpe will establish an internet connection to the ITWS weather data for external users.

ITWS will receive technology refresh to sustain the function for the near term. After 2017, its data collection functions will be incorporated into the CSS-Wx. ITWS is funded through BLI 2B20.

The FAA-operated Weather Message Switching Center Replacement (WMSCR) is a network with distribution nodes in Salt Lake City and Atlanta that collects and distributes nationwide weather information. The FAA will integrate WMSCR functionality into the CSS-Wx for weather information distribution.

The Automated Weather Observation System (AWOS) Data Acquisition System/Regional ADAS Service Processor (ADAS/RASP) is a communications link that transmits AWOS/ASOS/AWSS data to air traffic facilities. ADAS also correlates cloud-to-ground lightning strike information to AWOS/ASOS/AWSS data to better determine the location of nearby thunderstorm activity.

The Automated Lightning Detection and Reporting System (ALDARS) will become part of the CSS-Wx after 2021 and its information will be consolidated with other weather inputs.

The Center/TRACON automation system (CTAS) Remote Weather System (CREWS) collects data to help center and terminal facility controllers coordinate the flows of air traffic into busy terminal facilities.

The World Area Forecast System (WAFS) Internet File Service (WIFS) is a commercial service that provides weather information to support global flight operations.

The NextGen Weather Processor (NWP) will process the weather information collected on CSS-Wx and take over the processing functions of the existing Weather and Radar Processing (WARP), CIWS and ITWS systems. The NWP program will enhance the display of weather information by using new algorithms to portray icing conditions, turbulence, and other hazards. Further upgrades of weather-predicting algorithms will also be added to include Wind Shear/Microburst and Wake Vortex Detection and prediction advisories. The WARP RAMP (Radar and Mosaic Processor) and MDS (Meteorological Data Server) are components which process weather data and will remain in service until their functions can be incorporated in NextGen systems. The NWP program is funded through BLI 2A17.

The non-FAA services provide data from the NWS ground and satellite sensors to FAA for use by the NWS meteorologist who interpret and forecast weather at the FAA en route centers.

NextGen Web Services is a distributed "virtual" database that will receive weather data directly from sensors, NWS, National Oceanic and Atmospheric Administration (NOAA) and other sources and, either automatically or by request, send data to FAA facilities and users so that observations and forecasts can be more widely and consistently distributed via network-enabled communications. Decision support tools will use this weather information to assist users in understanding weather constraints and taking actions to reduce risk for aviation operations. Integration of NextGen Web Services into the NAS is funded through the CSS-Wx program as part of the SWIM BLI under 2A12.

Figure 5-20 shows the future capital investments for weather sensors and weather dissemination and processing systems. Funding amounts are in Millions of Dollars.

BLI Number	Program Name	FY 2015 Budget	FY 2016	FY 2017	FY 2018	FY 2019
	Weather Functional Area	**$49.2**	**$68.6**	**$77.1**	**$59.0**	**$41.1**
2A04	Next Generation Weather Radar (NEXRAD)	$7.1	$6.5	$6.3	$5.5	$5.5
2B02	Terminal Doppler Weather Radar (TDWR) – Provide	$1.9	$0.0	$0.0	$0.0	$0.0
2B20	Integrated Terminal Weather System (ITWS) Technology Refresh	$4.4	$5.4	$5.0	$3.8	$0.0
2A14	Windshear Detection Service (WDS)	$4.3	$5.2	$4.5	$1.0	$2.8
2A17	NextGen – Next Generation Weather Processor (NWP)	$23.3	$42.4	$48.1	$35.2	$22.7
2C01	Aviation Surface Weather Observation System	$8.0	$8.0	$10.0	$10.0	$10.0
2C04	Weather Camera Program	$0.2	$1.1	$3.2	$3.5	$0.1

Note: BLI numbers with X represent outyear programs not requested in the FY 2015 President's Budget.

Note: FY 2016-2019 outyear funding amounts are estimates.

Figure 5-20 Funding amounts in the Weather Functional Area

5.6 Facilities

The Air Traffic Organization maintains and operates thousands of staffed and unstaffed operational facilities that must regularly be upgraded and modernized. The largest facilities are the 21 en route centers, that house hundreds of employees and the equipment they use to control aircraft flying in the en route airspace. The other operational facilities with significant staffing are the more than 500 towers and 167 TRACON facilities that control arrival and departure traffic to and from airports.

There are more than 16,000 unstaffed facilities—many in very remote locations—sheltering communications, navigation, surveillance equipment and weather sensors. Much of this equipment is housed in buildings that have exceeded service live and need renovation. Many have deteriorating steel towers and foundations. Some newer unstaffed buildings and structures frequently need renovation because they are in remote and/or hazardous locations near the ocean or on mountaintops. Replacing roofing, electric power generators, heating/cooling, and structural and security components of these structures is essential to successful operation of the NAS. Modernization of unstaffed facilities is funded through BLI 2E02.

The William J. Hughes Technical Center (WJHTC) in Atlantic City, NJ, and the Mike Monroney Aeronautical Center (MMAC) in Oklahoma City, OK, each have many buildings. Each year, these complexes receive funds to both upgrade and replace infrastructure, and to improve and modernize buildings to support training, logistics, research, and management functions. The MMAC operates under a lease from the Oklahoma City Airport Trust, and funds are requested to pay the annual lease costs. The MMAC also receives funding for building renovation and updated infrastructure. The WJHTC supports research programs to determine the feasibility of NextGen concepts, and it also supports the testing of new equipment that will be installed in the NAS. The FAA has requested funding for 2015 and beyond to upgrade buildings and supporting infrastructure, such as roads. Annual funding is provided to reconfigure the research laboratories to accommodate acceptance testing for new equipment and to test modifications to existing equipment. The WJHTC is funded through BLI 1A02, 1A03 and 1A04. The MMAC is funded through BLI 3B01 and 4A04.

The Terminal Air Traffic Control Facilities – Replace program includes funding for replacement of existing airport traffic control towers (ATCT) and TRACON facilities. Projects are funded in five segments and are scheduled based on FAA priorities. A project typically spans a period of 5-10 years from inception to completion depending on the size of the project. Each segment of a project is fully funded in the year requested, but it may take more than one year to complete that segment. Funding is allocated to the segments based on FAA priorities while maintaining the overall 5 year funding estimates for the program. ATCT/TRACON replace program is funded through BLI 2B06.

The Future Facilities program has been refocused to replace the New York TRACON with a new extensible facility at a new location on Long Island. The existing N90 facility is old, does not meet operational requirements and needs to be replaced. FAA is currently developing site selection and facility requirements for the new facility. This program is funded through BLI 2B06.

The Terminal Air Traffic Control Facilities – Modernize program renovates or replaces specific exterior or interior components of existing towers, such as elevators, heating ventilation and cooling equipment, roofs, or other infrastructure that the FAA must upgrade to keep towers functioning. ATCT/TRACON modernization program is funded through BLI 2B07.

The FAA upgrades and improves Air Route Traffic Control Center (ARTCC) facilities by replacing heating and cooling systems, upgrading electrical power distribution systems, and providing other facility needs to meet mission requirements. ARTCC modernization program is funded through BLI 2A05.

Figure 5-21 shows the future capital investments for facilities programs for the air traffic control system. Funding amounts are in Millions of Dollars.

BLI Number	Program Name	FY 2015 Budget	FY 2016	FY 2017	FY 2018	FY 2019
	Facilities Functional Area	**$457.4**	**$491.9**	**$507.0**	**$666.8**	**$739.4**
1A02	NAS Improvement of System Support Laboratory	$1.0	$1.0	$1.0	$1.0	$1.0
1A03	William J. Hughes Technical Center Facilities	$12.0	$12.0	$12.0	$12.0	$12.0
1A04	William J. Hughes Technical Center Infrastructure Sustainment	$12.2	$9.2	$10.3	$10.0	$10.0
2A05	ARTCC Building Improvements/Plant Improvements	$63.7	$60.8	$63.5	$63.5	$63.8
2B06	Terminal Air Traffic Control Facilities - Replace	$29.8	$86.0	$97.0	$213.2	$262.5
2B07	ATCT/Terminal Radar Approach Control (TRACON) Facilities - Improve	$45.0	$52.9	$53.7	$53.7	$53.9
2B09	NAS Facilities OSHA and Environmental Standards Compliance	$43.5	$26.0	$26.0	$29.0	$26.0
2C03	Alaska Flight Service Facility Modernization (AFSFM)	$2.8	$2.8	$2.8	$2.8	$2.8
2E01	Fuel Storage Tank Replacement and Management	$15.5	$14.0	$14.0	$16.0	$14.0
2E02	Unstaffed Infrastructure Sustainment	$32.3	$32.9	$33.8	$43.8	$44.1
2E03	Aircraft Related Equipment Program	$9.0	$11.4	$9.0	$9.0	$9.0
2E06	Facilities Decommissioning	$5.7	$6.0	$6.0	$10.0	$10.0
2E07	Electrical Power Systems – Sustain/Support	$102.0	$100.0	$100.0	$125.0	$150.0
2E08	Energy Management and Compliance (EMC)	$1.0	$2.0	$2.0	$2.0	$2.0
3A01	Hazardous Materials Management	$22.0	$20.0	$20.0	$20.0	$20.0
3A03	Logistics Support System and Facilities (LSSF)	$8.0	$1.0	$1.5	$0.0	$1.4
3A05	Facility Security Risk Management	$14.3	$15.0	$15.1	$15.1	$15.9
3A10	National Test Equipment Program	$2.0	$4.0	$4.0	$4.0	$5.0
3A11	Mobile Assets Management Program	$4.0	$2.0	$2.0	$3.0	$1.8
3B01	Aeronautical Center Infrastructure Modernization	$13.2	$14.1	$14.0	$14.0	$14.0
4A04	Mike Monroney Aeronautical Center Leases	$18.4	$18.8	$19.3	$19.7	$20.2

Note: BLI numbers with X represent outyear programs not requested in the FY 2015 President's Budget.

Note: FY 2016-2019 outyear funding amounts are estimates.

Figure 5-21 Funding amounts in the Facilities Functional Area

6 Conclusion

The capital investment plan contains an annual summary of the ongoing planning to modernize and expand the air traffic control and supporting systems. It balances planned improvements between maintaining legacy facilities and equipment and investing in the future capabilities of NextGen. That balance is necessary to ensure reliable and safe operation of the NAS while the planned NextGen operational improvements are implemented. Investment in legacy equipment, facilities and IT systems cannot be suspended, because these systems must continue to provide services during and after the transition. Computer systems and other technology that FAA uses for air traffic control continue to face obsolescence issues. As legacy systems age, reliability becomes an issue and they must be replaced because manufacturers no longer produce replacement parts.

The capital investment plan draws on several layers of planning integral to building the system of the future. System engineers develop a concept of operations and projected operational improvements to air traffic control consistent with the FAA’s Strategic Priorities. The resulting functional requirements are used to create a system architecture that supports those operational improvements and NextGen concepts. The next step is determining how fast modernization can proceed by evaluating the financial resources available to build the systems shown in the NAS Enterprise Architecture. It is important to note that these improvements often take several years after the appropriation of funding to be integrated into daily operations. The complex equipment necessary to support operational improvements takes time to develop, build, install, and test to ensure it will operate error free. Allowing adequate time to train controllers in the use of the new equipment and procedures is critical to successful implementation.

FAA is focusing on implementing NextGen capabilities that produce the greatest benefits. The delivery of ADS-B services throughout much the United States is already providing safety and efficiency benefits to operators. The ADS-B ground station network is complete and services are available for pilots giving them information on weather conditions and surrounding traffic. Sharing airport surface information with airline operators using SWIM has improved both the FAA and carriers ability to plan for surface operations at congested airports, especially in inclement weather where there are large surface delays and operational complexity. The expansion of the Time Based Flow Management Capability to more airports and across greater distance assures that the airport capacity is more efficiently used resulting in minimum delay cost for the users. The Metroplex approach to developing new RNP routes and procedures for terminal approach paths coupled with ongoing development of advanced decision tools has resulted in significant fuel savings for the air carriers that routinely use these approaches and optimum profile descents. These successes demonstrate that NextGen operational improvements can be implemented, and they do produce benefits. As time progresses, more enhanced procedures associated with NextGen advanced tools will result in greater efficiencies and support the expected long-term future growth in aviation activity.

7 Appendices

The CIP contains five appendices.

Appendix A

- Lists FAA strategic priorities and metrics.
- Associates CIP programs with performance metrics.

Appendix B

- Provides CIP program descriptions and the alignment of programs to strategic priorities.
- Describes the programs contribution to meeting the performance metric.
- Lists performance output goals for FY 2015–2019.
- Shows system implementation schedules.

Appendix C

- Provides funding amounts from FY 2015 through FY 2019 by Budget Line Item (BLI). Funding amounts are in Millions of Dollars.

Appendix D

- Response to GAO Report 08-42 - Identifies major programs with cost and schedule changes from the original baseline and explains the causes of those changes.

Appendix E

- Defines acronyms and abbreviations.