Federal Aviation Administration

National Airspace System Capital Investment Plan

for Fiscal Years 2009–2013

Table of Contents

1 INTRODUCTION 2

1.1 The Capital Investment Plan 2

1.2 Strategic Planning and the CIP 2
1.2.1 FAA Strategic Plan 3
1.2.2 The Strategic Management Process 3

1.3 Next Generation Air Transportation System (NextGen) 5
1.3.1 Need for NextGen 5
1.3.2 Transition to NextGen 6

1.4 Important Factors Affecting Planning for the Future 8
1.4.1 Nature of Capital Investment 8
1.4.2 Air Travel Demand 8
1.4.3 Growth in En Route Operations 9
1.4.4 Growth in Terminal Operations 10

2 SAFETY AND SECURITY 12

2.1 Aviation Safety Projects 13
2.1.1 Safety Databases 13
2.1.2 Runway Incursion Reduction Program 13
2.1.3 Airport Surface Surveillance 13
2.1.4 Weather Systems 13
2.1.5 Traffic Alert and Collision Avoidance System (TCAS) 14
2.1.6 Aeronautical Information Management (AIM) 14

2.2 Security 14
2.2.1 Facility Security Risk Management 14
2.2.2 Information Security 15
2.2.3 Emergency Communications 15
2.2.4 Automated Detection and Processing Terminal (ADAPT) 15

3 NEXT GENERATION AIR TRANSPORTATION SYSTEM 15

3.1 Demonstrations and Infrastructure Development 16

3.2 System Development 16

3.3 Initiate Trajectory Based Operations 18
3.3.1 Background 18

3.3.2 Operational Capability Description ... 19
3.3.3 Development of Capital Investments that Support Trajectory Based Operations ... 19

3.4 Reduce Weather Impact ... 19
3.4.1 Background ... 19
3.4.2 Operational Capability Description ... 20
3.4.3 Development of Capital Investments that Reduce Weather Impact ... 20

3.5 Increase Arrivals/Departures at High Density Airports ... 20
3.5.1 Background ... 21
3.5.2 Operational Capability Description ... 21
3.5.3 Development of Capital Investments that Support Increased Arrivals/Departures at High Density Airports ... 21

3.6 Improved Collaborative Air Traffic Management (CATM) ... 22
3.6.1 Background ... 22
3.6.2 Operational Capability Description ... 22
3.6.3 Development of Capital Investments that Support Improved Collaborative Air Traffic Management ... 23

3.7 Increase Flexibility in the Terminal Environment ... 23
3.7.1 Background ... 23
3.7.2 Operational Capability Description ... 23
3.7.3 Development of Capital Investments that Support Increased Flexibility in the Terminal Environment ... 24

3.8 Increase Safety, Security, and Environmental Performance ... 24
3.8.1 Background ... 24
3.8.2 Operational Capability Description ... 25
3.8.3 Development of Capital Investments that Support Increased Safety, Security and Environmental Performance ... 25

3.9 Networked Facilities ... 25
3.9.1 Background ... 25
3.9.2 Operational Capability Descriptions ... 25
3.9.3 Development of Capital Investments that Support Transform Facilities ... 26

3.10 Airport Development ... 26
3.10.1 Background ... 26
3.10.2 Operational Capability Description ... 26
3.10.3 Development of Capital Investments that Support Airport Development ... 26

3.11 Aircraft and Operator Requirements ... 27
3.11.1 Background ... 27
3.11.2 Operational Capability Description ... 27
3.11.3 Development of Capital Investments that Support Aircraft and Operator Requirements ... 27

4 ROADMAPS SHOWING CURRENT CIP PROJECTS AND TRANSITION TO NEXTGEN 27

4.1 Roadmaps to the Future System.. 27
4.1.1 Automation 29
4.1.2 Communications 35
4.1.3 Surveillance.. 38
4.1.4 Navigation.. 42
4.1.5 Weather Systems.. 45
4.1.6 Facilities.. 51
4.1.7 Support Contracts and Automated Management Tools and Processes........ 53

5 CONCLUSION 55

6 APPENDICES TO THE CIP 56

Appendix A Relationship of Projects to Flight Plan Goals………..…....………...A-1
Appendix B Detailed Program Plan Data……………………………...…………...B-1
Appendix C Estimated Expenditures by Budget Line Item...……………...………C-1
Appendix D Acronyms and Abbreviations……………………...……...…....…...D-1

Table of Figures

Figure 1	Strategic Management Process Pathways	4
Figure 2	NextGen Portfolio Relative to the Total Capital Request	7
Figure 3	Air Travel Demand Growth Compared to Growth in GDP	9
Figure 4	Projected Growth in Number of Aircraft Handled by En Route Centers	10
Figure 5	Projected Growth in Instrument Operations at Towers and TRACONs	11
Figure 6	Roadmap Legend	28
Figure 7	Automation Roadmap (1 of 2)	30
Figure 8	Automation Roadmap (2 of 2)	31
Figure 9	Expenditures in the Automation Functional Area	32
Figure 10	Communications Roadmap	36
Figure 11	Expenditures in the Communications Functional Area	37
Figure 12	Surveillance Roadmap	39
Figure 13	Expenditures in the Surveillance Functional Area	40
Figure 14	Navigation Roadmap	43
Figure 15	Expenditures in the Navigation Functional Area	44
Figure 16	Weather Sensor Roadmap (1 of 2)	46
Figure 17	Weather Dissemination, Processing, and Display Roadmap (2 of 2)	48
Figure 18	Expenditures in the Weather Functional Area	49
Figure 19	Expenditures in the Facilities Functional Area	53
Figure 20	Expenditures in the Mission Support Functional Area	54

Federal Aviation Administration National Airspace System Capital Investment Plan for Fiscal Years 2009–2013

1 Introduction

1.1 The Capital Investment Plan

The Federal Aviation Administration (FAA) Capital Investment Plan (CIP) is a 5-year plan that describes the National Airspace System (NAS) modernization projects planned for the next 5 years within anticipated levels of funding. The CIP fulfills our obligations under the Consolidated Appropriations Act, 2008. Division K of that act contains language that requires that we:

> "… 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 2009 through 2013, 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."

The planned project accomplishments shown in the CIP are consistent with the President's FY 2009 budget request and OMB's future year estimates. Funding estimates for budget line items are based on several factors. For the large capital investment projects, the estimated funding is the amount needed for annual contract and project support costs. For infrastructure improvements, the estimated funding is either the cost for specific locations or the annual amounts needed to upgrade existing facilities and equipment based on facility condition surveys. As we move forward with the Next Generation Air Transportation System (NextGen), we are allocating a larger percentage of our planned funding toward implementing the new technology needed to modernize the NAS.

1.2 Strategic Planning and the CIP

FAA's Flight Plan 2008-2012 is our strategic plan. It contains the goals established by FAA management. These goals guide us in improving National Airspace System (NAS) performance and adjusting operations to meet the demands placed on the NAS by future growth. Our strategic goals are supplemented by objectives and supporting initiatives that define the necessary plans and programs to meet them. These objectives and initiatives must have measurable performance targets to assess our progress. We must continually measure our actual performance against the established targets to ensure our initiatives are successful and quickly make adjustments, when they are not producing the expected results.

1.2.1 FAA Strategic Plan

The current FAA strategic plan identifies four specific goal areas:

- **Increased Safety –** Achieve the lowest possible accident rate and constantly improve safety;
- **Greater Capacity –** Work with local governments and airspace users to provide increased capacity in the United States airspace system that reduces congestion and meets projected demand in an environmentally sound manner;
- **International Leadership –** Increase the safety and capacity of the global civil aerospace system in an environmentally sound manner; and
- **Organizational Excellence –** Ensure the success of the FAA's mission through stronger leadership, a better-trained and safer workforce, enhanced cost-control measures, and improved decision-making based on reliable data.

Consistent with the President's Management Agenda, we have linked each CIP project to a Flight Plan goal, objective, and performance target in Appendix A. Although projects may support more than one goal, the link in Appendix A is limited to a single goal to maintain focus on the broader and most important strategies for ensuring safety and improving system performance and capacity. We list several projects under each performance measure for several reasons. Many projects are interdependent, and one project may not be successful in meeting a performance target without completing other supporting projects. Also, in the complex system used for air traffic control, system improvements must address several different operating conditions to reach the overall performance target, and often it takes multiple projects to address all of the variables, which individually contribute to overall system inefficiencies. The complete list of planned initiatives for each performance target helps focus attention on coordinating these efforts to maximize the value of each individual project.

The detailed project information in Appendix B provides more insight into the strategic purpose of projects by including a "Relationship to Flight Plan Goal" section that gives more specific information about how each project helps meet the Flight Plan goal.

1.2.2 The Strategic Management Process

To supplement the broad goals of the FAA Flight Plan, the Air Traffic Organization (ATO) uses the Strategic Management Process (SMP) to identify more detailed actions to improve performance. The SMP objectives, shown in the white ellipses in Figure 1, support five pathways. These pathways identify specific objectives for delivering air traffic services more effectively and efficiently in both the near term and in the future. Each objective will have specific metrics so that we can define and measure planned improvement in system performance and user benefits.

The five SMP pathways are:

- Achieve Operational Excellence;
- Enhance Financial Discipline;
- Increase Capacity Where Needed;
- Ensure Viable Future; and
- Promote Organizational Learning and Growth.

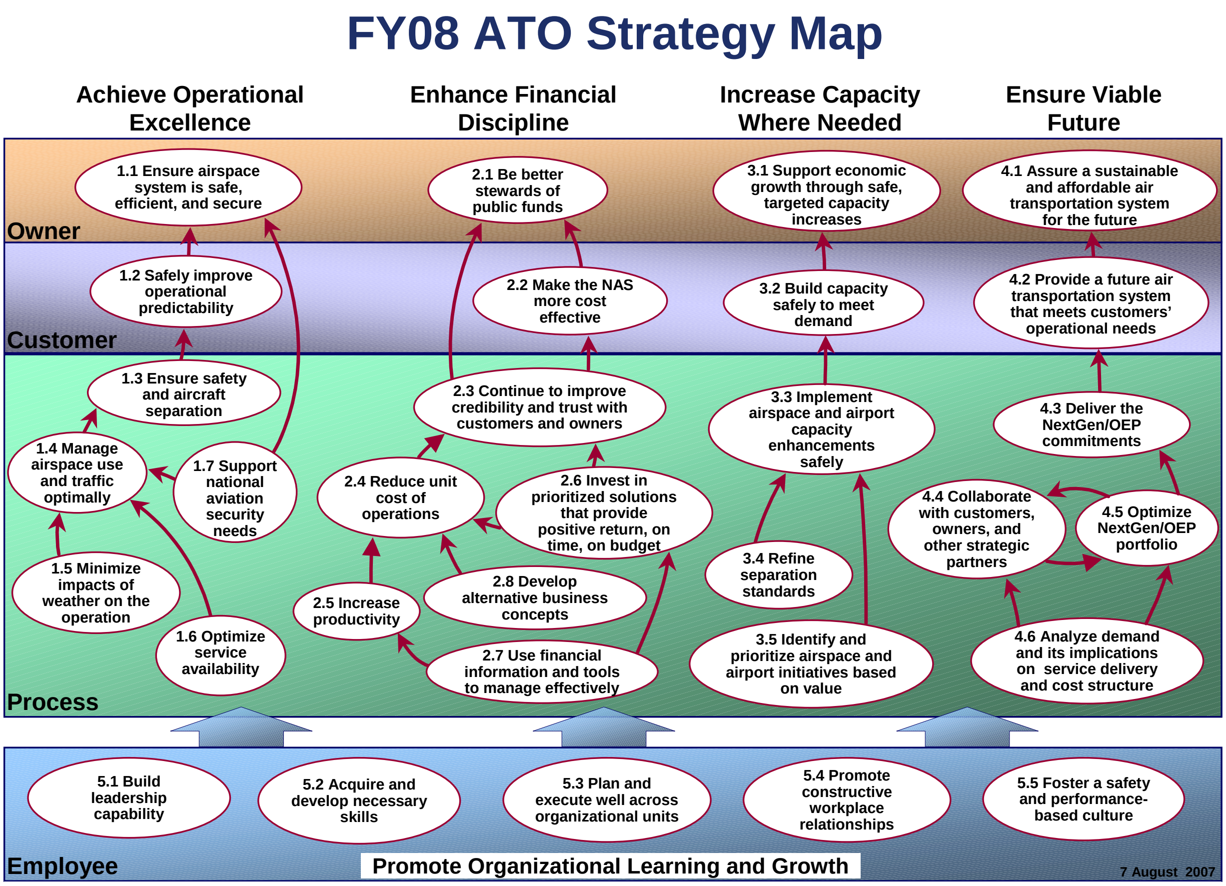

Figure 1 Strategic Management Process Pathways

The first pathway, Achieve Operational Excellence, focuses on maintaining safe and reliable service to all our customers, who want an airspace system that moves aircraft safely, handles the volume of traffic with minimal delays, and is protected from security threats. This pathway requires a large percentage of capital investment resources. The current system must continue to meet the high performance standards set for managing air traffic while we modernize and transform air traffic control to meet the goals of the NextGen.

The second pathway, Enhance Financial Discipline, continues the transition to managing FAA more like a business. It depends on accurately measuring costs, setting benchmarks for efficient performance and improved productivity, and investing to reduce operating costs. Controlling costs is a necessary step in making sure resources are available to meet the challenges of future growth.

The third pathway, Increase Capacity Where Needed, outlines the necessary steps for the ATO to manage the growing demand for air travel. Since several large airports are nearing practical capacity, there is significant pressure to maximize use of existing capacity and support extension of air traffic services to accommodate new runways when they are built.

The fourth pathway, Ensure Viable Future, aims at ensuring that the air transportation system will continue to meet the evolving needs of customers in an affordable way. It extends planning beyond the capabilities of today's systems. As NextGen programs are implemented, we must concurrently explore new procedures and operational improvements to accommodate the projected increase in air travel. The roadmaps appearing in later sections present a detailed transition plan for transforming the air traffic system seamlessly from its present architecture to its future form without inhibiting present operations.

The fifth pathway, Promote Organizational Learning and Growth, focuses on supporting the FAA workforce in adopting best practices to improve management efficiency and customer satisfaction. Good organizations constantly search out and implement these best business practices, so they can continually improve performance.

The ATO Service Units design and implement their respective business plans based on the SMP pathways and objectives. The Service Units align specific projects with the pathways objectives and their associated metrics. They measure their progress against the metrics on a monthly schedule. Progress toward meeting the goals and objectives is reported to ATO leadership monthly.

1.3 Next Generation Air Transportation System (NextGen)

Increasing aviation capacity by implementing NextGen plays a roll in supporting economic growth. U. S. economic growth is supported by our nation's air transportation industry. A recent study by the ATO Operations Planning Service Unit, *The Economic Impact of Civil Aviation on the U.S. Economy,* published in July 2007 estimates that aviation accounted for over $1 trillion in economic activity in 2005, which represents 5.5 percent of the Gross Domestic Product. It created an estimated 10 million aviation-related jobs and flew nearly 30 billion revenue ton-miles of air cargo. A reliable world-wide 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.

1.3.1 Need for NextGen

The projected growth in aviation (see Section 1.4) requires new systems and procedures to accommodate the increased demand for capacity. We must also develop the necessary skills to transition to NextGen, which will transform the existing system into one with advanced capabilities.

1.3.2 Transition to NextGen

The President's FY 2009 budget for NextGen contains a portfolio of investments backed by the commitments of the FAA and Joint Planning and Development Office (JPDO) partner agencies and is based on input from a broad range of stakeholders. The FY 2009 budget sets out a plan to:

- Achieve near-term deployment of mature technologies
- Develop moderately mature concepts for operational viability, and
- Perform research to more fully define long-term capabilities

The fiscal year 2009 budget will be used to deploy foundational technologies and infrastructure such as: Automatic Dependent Surveillance - Broadcast (ADS-B), Data Communications (DataComm), NextGen Network Enabled Weather (NNEW), NAS Voice Switch (NVS) and System Wide Information Management (SWIM). Funds will also be used to more fully develop requirements for the broad range of future NextGen capabilities.

We must invest now to ensure these new capabilities are in place ahead of the forecasted increase of air traffic operations, and we must continue investing well into the future to reach the full potential of these initiatives. Section 3 discusses the NextGen solution sets and budget line items that define a new concept of operations and provide insight into additional steps that take advantage of NextGen's potential to expand capacity.

In the initial years, the line items and funding associated with these NextGen solution sets (e.g. trajectory-based operations, high density arrivals and departures, etc) are groups of activities, which are different from other FAA capital investments. These activities include research and development, planning for capital investments, demonstrations, procedure development, and certification. As the NextGen investments within these capabilities become more developed, they will take the form of traditional capital investments, subject to investment control procedures. Therefore, the out-year funding amounts for the NextGen capabilities are inherently less precise and should be regarded as estimates, subject to refinement, as the work on these capabilities proceeds.

We have begun the transition to NextGen. As the chart below shows (Figure 2), the investment in NextGen increases over the five years of the CIP. We believe we are planning a responsible transformation of the existing air traffic control system to a newer system with far greater capabilities, while maintaining the current system at peak operational performance. As we complete many of the existing CIP programs during this period, increased amounts of funding will be available for development and implementation of NextGen.

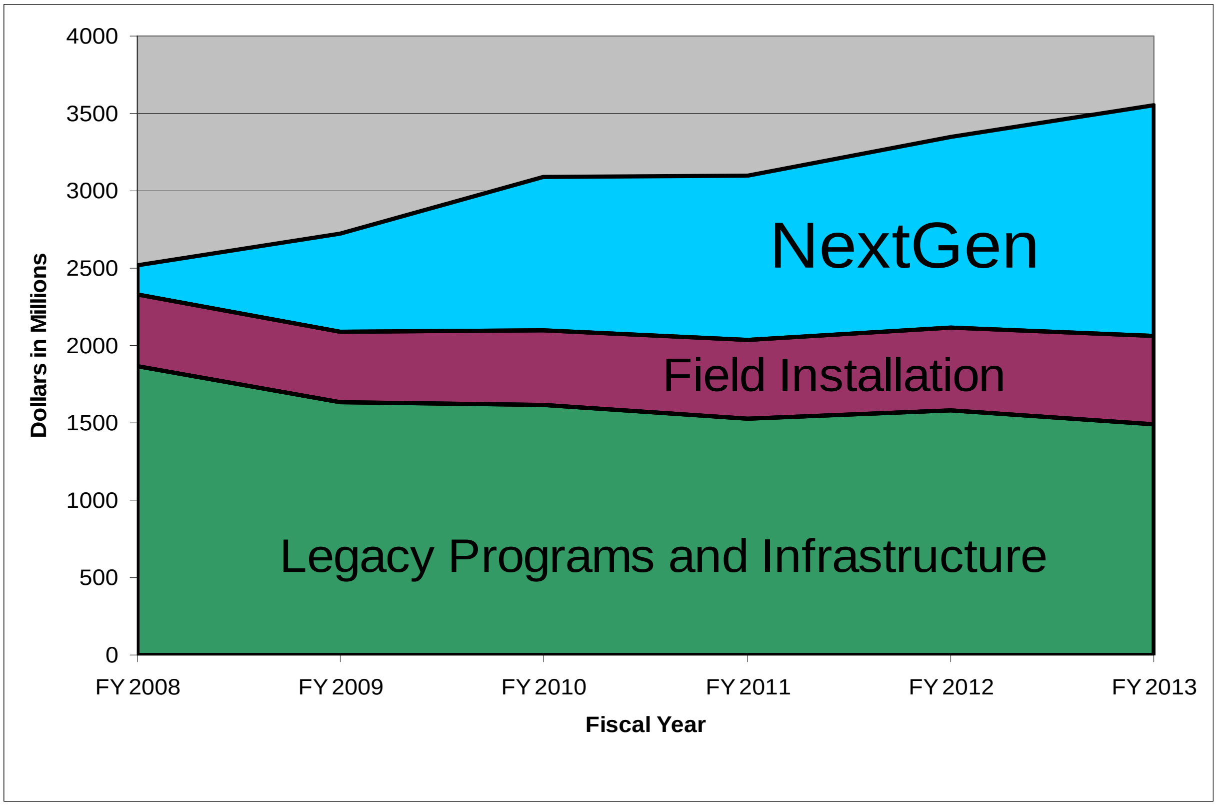

Figure 2 NextGen Portfolio Relative to the Total Capital Request

1.3.4 Operational Evolution Partnership (OEP)

The OEP is the key vehicle for coordination and integration of efforts to introduce NextGen capabilities into the NAS. The coalition of the FAA, the JPDO, and the aviation and aerospace user communities have worked together to define the specific operational capabilities for NextGen and establish a timeline for implementing mid-term capabilities to support our transition to NextGen. Several solution sets have been developed and needed research and system demonstrations have been identified.

In the past, the OEP mainly focused on initiatives to relieve congestion at major airports. The OEP now has a broad scope including strategic research, development, and prototyping, along with specific policy and certification activities for NextGen. The OEP brings together the right FAA and JPDO personnel to assess the benefits of potential initiatives, including program functionality and cost-effectiveness. The OEP will manage integration, ensuring that all new capabilities are aligned and perform as intended. In its role as management integrator, the OEP will establish a strategic timeline that shows exactly what steps are needed, how long each step will take to complete, and who will be responsible for each step.

FAA's OEP Web site is:
http://www.faa.gov/about/office_org/headquarters_offices/ato/publications/oep/

1.4 Important Factors Affecting Planning for the Future

1.4.1 Nature of Capital Investment

Planning for capital investment relies on a long-range forecast. Capital investments normally require extensive planning horizons and often take more than a year to implement before any operational improvements or gains in efficiencies can be realized. This is a normal schedule for large technically sophisticated projects. Thus, project managers must be planning for the operating environment forecast for 4 to 5 years in the future rather than only meeting present needs. To support this planning, the FAA prepares a detailed forecast of future aviation activity every year.

Since most systems, once implemented, will remain in service for up to 20 years, the long-range forecast is a critical tool for assessing near and far term demand. The following section reviews the latest long-term forecast, giving insight into why we are pursuing NextGen solutions to provide the system of the future.

1.4.2 Air Travel Demand

The demand for air travel is closely related to changes in the economy. As Figure 3 shows the growth in revenue passenger miles (RPM) over the last 25 years correlates highly with the growth in Gross Domestic Product (GDP). The chart clearly shows an overall upward trend in growth with some minor deviations in the pattern often caused by abnormal events, such as the terrorist attacks of September 11, 2001. This chart also shows a long-term economic growth trend, which is likely to continue due to population growth and introduction of new technology. If growth continues, it is reasonable to assume that increased demand for air travel will continue. That growth in demand will lead to more aircraft operations, which translates into increased workload for FAA. It also translates into more pressure on the 35 OEP airports to handle additional operations. Significant increases in operations at these airports will increase delays, unless we implement the advanced NextGen capabilities to provide the improved services needed to handle this growth.

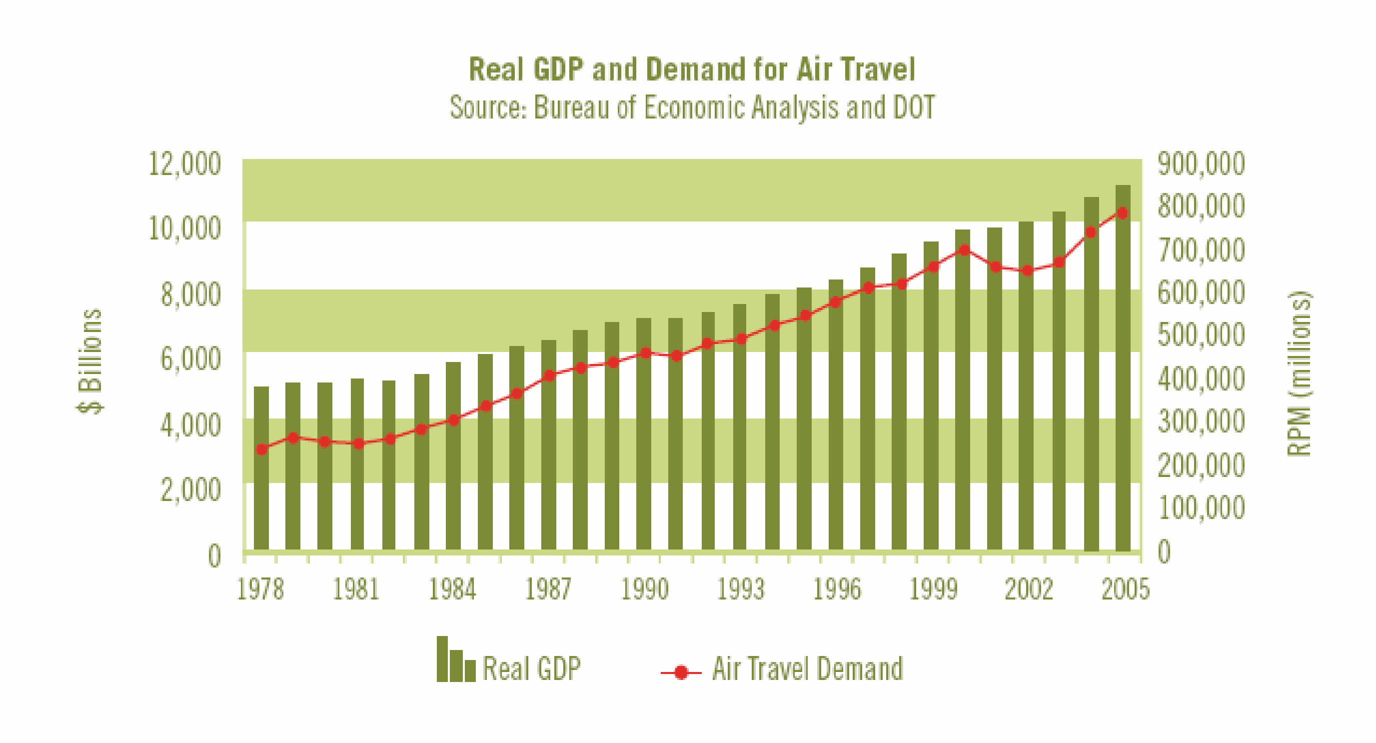

Figure 3 Air Travel Demand Growth Compared to Growth in GDP

The long-range forecast prepared by the FAA Office of Aviation Policy, Planning and Environment shows FAA average annual workload growing about 2.5 percent to accommodate commercial operations into airports through 2030; the forecast also shows that average annual workload for en route centers grows about 3 percent through 2030. The following sections discuss the forecast growth in these two areas and some of the potential changes that may affect that growth in workload. Using forecasts of economic activity from several sources, the FAA prepares a 12-year aviation activity forecast and a long-range aviation forecast to help identify the level of services that the agency must provide in the future.

1.4.3 Growth in En Route Operations

The most significant change in air travel is the increase in use of regional jets. Legacy air carriers have shifted larger aircraft to long haul and international markets. They then offer more frequent service on shorter routes with smaller jets, but that adds to FAA workload growth. That trend has reached the point where regional jets represent 34 percent of the traffic at the 35 busiest airports. Many of these aircraft carry fewer than 100 passengers, and the ratio of operations to passengers carried will continue to grow as they expand their business. Also, a new category of service by very light jets (VLJs) may add to the number of en route and terminal operations.

We understand that much of the new service VLJs offer will be between smaller airports, so they are not expected to affect the large hubs. Regardless of whether they serve small or large airports, their operating characteristics and the market segment they serve makes it likely that they will fly in controlled en route airspace, and this will increase FAA's workload. Over the next 10 years, growth in this segment would create significant pressure on the existing air traffic control system, and that growth would make it more difficult to accommodate the requests for efficient routes and altitudes that reduce operating costs for all commercial operators. The FAA long-term forecast estimates that the workload at FAA en route centers will increase by 82 percent between 2005 and 2025, as Figure 4 shows.

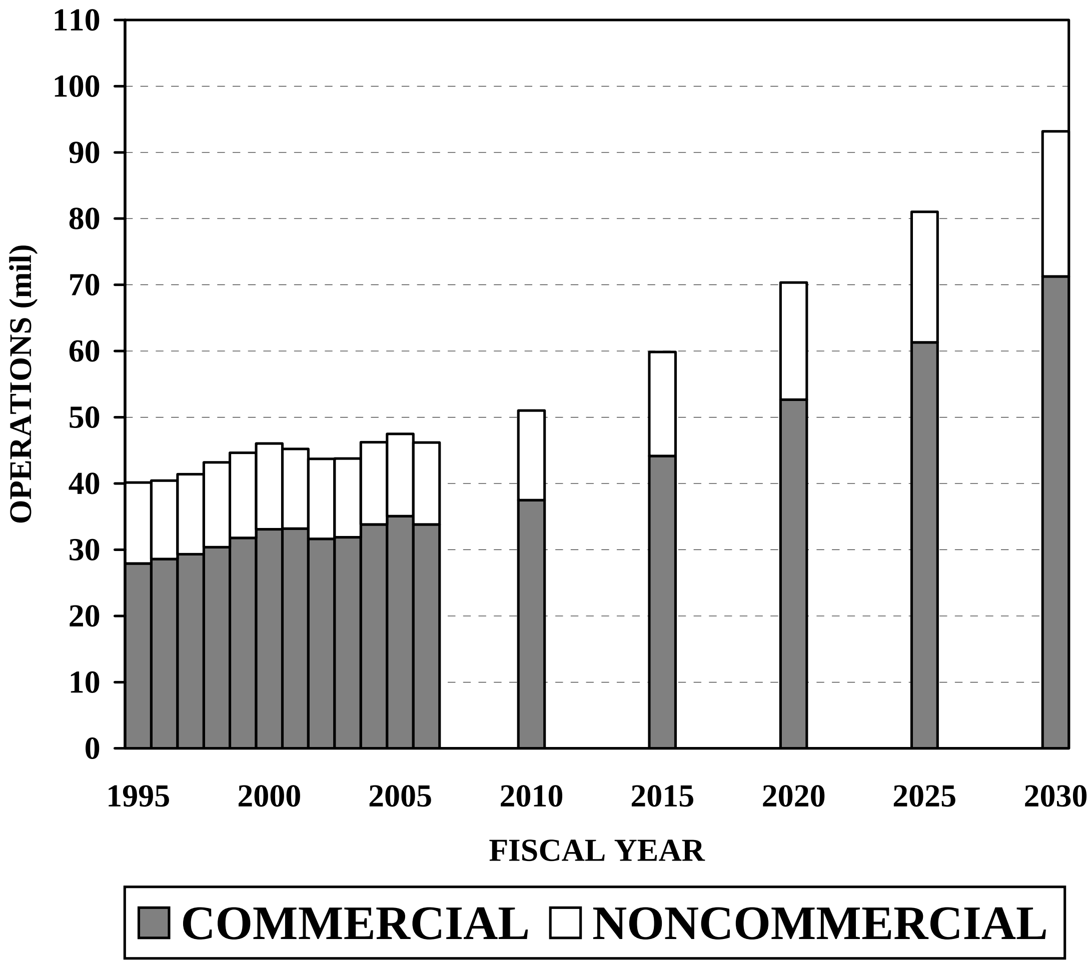

Figure 4 Projected Growth in Number of Aircraft Handled by En Route Centers

1.4.4 Growth in Terminal Operations

Growth in the number of aircraft handled by air traffic control facilities at the major airports has varied during 2007. Some airports serving international flights have seen the largest growth as the legacy carriers have increased international flights in an effort to improve their revenue. System-wide, there have also been more delays due to unfavorable weather near the largest hub airports and increased scheduling at the already constrained major airports. Continued refinement of strategic initiatives to adjust for weather conditions and other operational enhancements will help increase same block time scheduling, but continued growth will require a transformation of air traffic operations to manage the traffic in and out of these airports.

The long-term forecast projects slightly less than 60 percent growth in instrument operations at towers and Terminal Radar Approach Control (TRACON) facilities between 2005 and 2025, as Figure 5 shows. Congestion and delays will increase if FAA does not complete modernization in time to make more efficient use of airspace capacity.

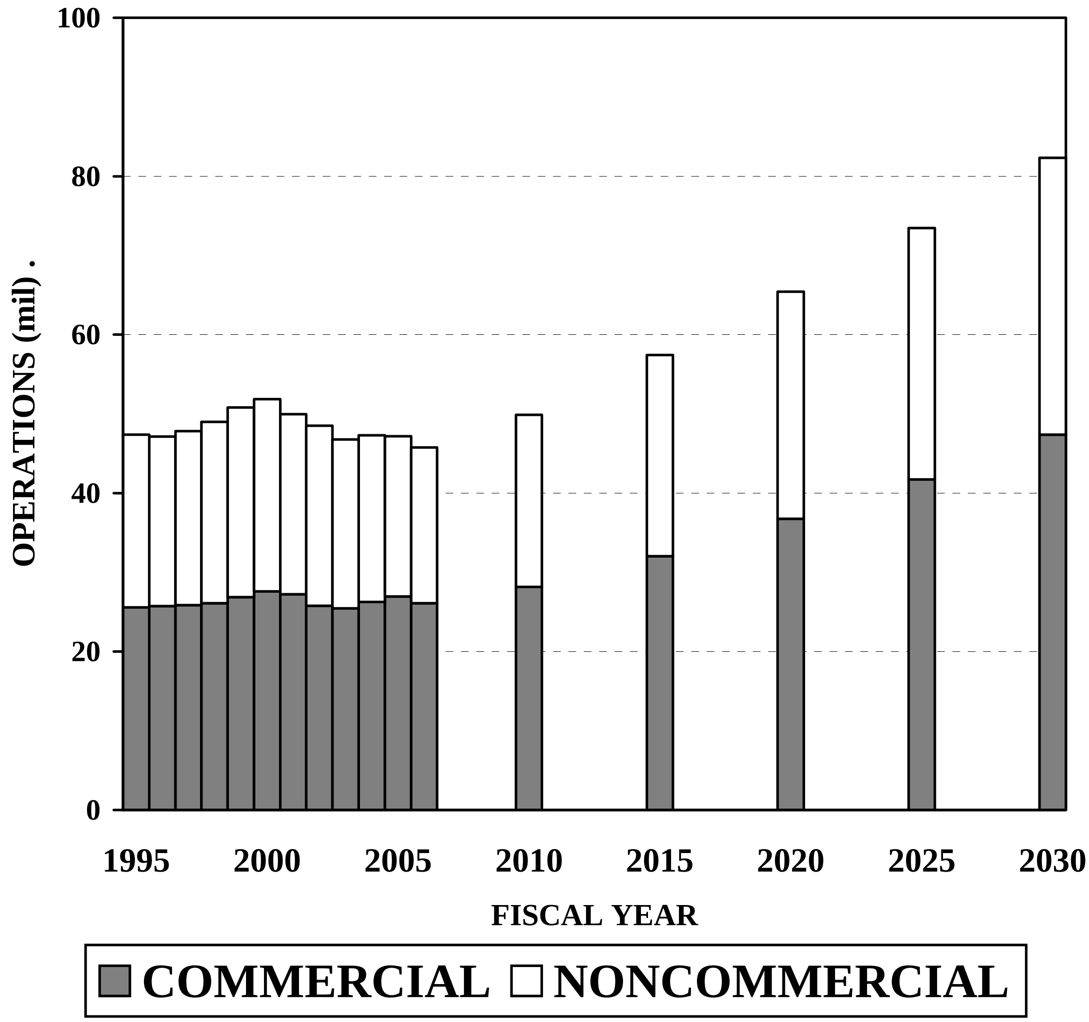

Figure 5 Projected Growth in Instrument Operations at Towers and TRACONs

Accommodating future increases in growth at the busiest airports will be more challenging because several large airports- such as: Newark, LaGuardia, Philadelphia, and Chicago O'Hare - are nearing their respective capacity limits. Since the top 35 airports handle 73 percent of aviation passengers, minor improvements in their capacity will be inadequate to handle the predicted growth in operations.

The FAA continues to actively help large airports increase their capacity. Thirteen new runways have become operational since 2000. The OEP identifies 12 more airfield projects in the planning stages. To encourage building new capacity the FAA's Airport Improvement Program supplements local financing for new airport projects with federal grants.

The FAA also invests its internal capital funding when local airport authorities build new runways. Often, airspace around the airports is reconfigured to accommodate a new runway, and that requires installing new navigational aids and precision landing systems to guide pilots in the approach patterns for the airport. Before precision approach guidance systems become operational, the FAA must develop procedures, install approach lights, and position visibility sensors along the runway so it can be used in the lowest visibility approved for that system. Some airports need new surface surveillance systems to alert pilots to potential runway incursions and to help pilots negotiate complex airport taxiway and runway configurations. Capital investment is also required to expand air traffic control facilities and add additional controller positions to handle the increased complexity of terminal airspace after a new runway is opened. The FAA must allocate capital investment dollars to support these infrastructure investments in the near term, while increasing NextGen investments to achieve the future capacity expansion to handle future increased levels of operations.

2 Safety and Security

Most CIP projects support ATO air traffic control functions, but there are several non-ATO projects in the CIP that support the FAA's safety and security missions. Monitoring and enforcing safety standards are mainly the responsibility of FAA lines of business outside of the ATO. FAA safety projects include upgrading and improving the hardware, software, and communications equipment that support databases of safety information and aircraft design standards. The primary project that has improved safety databases is called the Aviation Safety Analysis System (ASAS), which plays a major role in improving safety and helping safety inspectors allocate their inspection hours to address the most serious problems. The ASAS databases are a readily available source of regulatory data and past FAA actions that safety personnel can access to assist them in carrying out inspections and certifications.

Although most CIP projects support the Increased Capacity goal and are allocated to that goal in Appendix A, they often have some safety benefit as well. These include weather systems that enable controllers to both warn pilots of severe weather problems and select more efficient routes of travel and upgrades for inspection aircraft that check the accuracy of navigational aids and precision-landing systems to allow all weather operations.

Responsibility for airport security programs has shifted to the Department of Homeland Security, but the FAA must maintain and improve internal security. The air traffic control system is part of the nation's critical infrastructure, and we must protect it from damage and disruption. We must ensure both the physical security of structures and equipment and the integrity of information systems and data transfer among them. We must also maintain emergency radio networks to retain operational control when normal systems are unusable.

2.1 Aviation Safety Projects

The following projects are examples of the most important safety capital investments.

2.1.1 Safety Databases

The ASAS and its three follow-on projects—the System Approach for Safety Oversight, the Aviation System Knowledge Management Environment, and Regulation and Certification Infrastructure System Safety —buy hardware, software, and information-sharing technology to support aviation safety databases. These databases contain records of safety infractions by pilots and air carriers; safety regulations governing how to operate, manufacture, and repair aircraft; and directives and compliance records for commercial operators. Having this information readily available ensures that the FAA safety inspectors are aware of the past safety compliance of the people and organizations they are reviewing. It also increases the effectiveness of these inspectors and ensures that they have the latest information about FAA regulations and Advisory Circulars readily available when they conduct inspections.

2.1.2 Runway Incursion Reduction Program

The Runway Incursion Reduction Program (RIRP) will continue research, development, and operational evaluation of technologies to increase runway safety. Consistent with National Transportation Safety Board recommendations and initiatives identified in the FAA Flight Plan and the Runway Safety Blueprint, research emphasis will remain on technologies that provide direct safety warnings to pilots and aircrews as well as those that can be applied cost effectively at small to medium airports. Initiatives include operational evaluation of Runway Intersection Lights, Low Cost Ground Surveillance, and Final Approach Runway Occupancy Signal awareness tools. The program will also develop upgraded capabilities for the Runway Status Lights. As appropriate, solutions will be prototyped and tested in an operational setting to validate their technical performance and operational effectiveness.

2.1.3 Airport Surface Surveillance

A more detailed discussion of the Airport Surface Detection Equipment (ASDE), which helps to prevent runway incursions, appears in section 4.1.3. The ASDE Model 3 (ASDE-3) is a radar-based system that displays the location of aircraft on or near the runway and ground vehicles that could pose a hazard to aircraft. This enables controllers to issue warnings to prevent a runway or taxiway incident. ASDE Model X (ASDE-X) uses a variety of technologies to better display the location of aircraft and ground vehicles near the runways and taxiways.

2.1.4 Weather Systems

Although we discuss these systems in section 4.1.5, we also mention them here because many weather sensors improve the safety of flight. The Terminal Doppler Weather Radar (TDWR), Weather Systems Processor (WSP), and the Low Level Wind Shear Alerting System (LLWAS) provide warnings of dangerous wind shear conditions. This helps pilots avoid flying into hazardous weather as they approach and land at an airport. The TDWR operates at the larger airports; the WSP is at medium-sized airports; and the LLWAS is used both at airports without radar coverage and to supplement radar information at airports with weather radar using ground-based wind sensors. Visibility sensors measure the distance pilots can see on a runway so they know whether visibility is above or below the minimums needed for a safe landing. Information from the weather sensing and reporting systems is often integrated to produce weather forecasts so controllers can make more informed decisions in routing flights around severe weather and avoiding turbulence and thunderstorm risks.

2.1.5 Traffic Alert and Collision Avoidance System (TCAS)

TCAS provides pilots with warnings and resolution advisories to avoid colliding with another aircraft. This project will support efforts to develop improved software for these systems.

2.1.6 Aeronautical Information Management (AIM)

The program will improve aeronautical information services by adopting modern information technology and improvements in business processes and aeronautical information policies. Target capabilities in AIM include:

- Centralize and standardize Notices-to-Airmen (NOTAMs);
- Migrate to fully digital NOTAM, weather and flight plan services;
- Streamline and automate processes for generating status changes such as airspace reservations/activations and NOTAMs;
- Centralize and standardize definition and scheduling of military airspace;
- Improve quality and value of pilot briefing and flight planning services by integrating digital weather and digital NOTAMs into briefing and analysis services; and
- Integrate Aeronautical Information services into SWIM and other NextGen capabilities.

2.2 Security

Several projects protect FAA facilities and equipment and prevent injury to employees and damage to and disruption of air traffic control systems.

2.2.1 Facility Security Risk Management

The FAA established the Facility Risk Management Program to respond to Presidential Decision Directive 63, which requires Federal agencies to develop programs to protect critical infrastructure. That directive has been superseded by Homeland Security Presidential Directive (HSPD) 7, which addresses identifying, prioritizing, and protecting critical infrastructure. The program takes an integrated approach to security by improving access control, surveillance, and intrusion detection. The program also includes perimeter hardening and adding blast resistant film to windows at NAS critical facilities. Security upgrades will continue at 180 smaller facilities between 2009 and 2013.

2.2.2 Information Security

The FAA must protect the NAS from both external and internal cyber threats. The number of incidents has been reasonably small, but the critical nature of FAA's infrastructure requires elaborate security precautions to prevent intrusions. As part of our existing information technology security program, we are working to strengthen the firewalls that prevent intrusion and to upgrade anti-virus software and other safeguards.

The FAA Cyber Security program is a partnership between the FAA Chief Information Officer and FAA lines of business and staff offices that focuses on protecting our information technology (IT) infrastructure. The program includes computer security incident response; IT and Information Systems Security (ISS) awareness and training; IT research and development; policy, standards, and requirements development; program evaluations; and system certification and compliance. This comprehensive Cyber Security effort offers information system security awareness training for the agency's key ISS personnel, protection of FAA's information systems, and appropriate responses to computer security incidents.

2.2.3 Emergency Communications

In case of natural disasters or human-caused service disruptions, the FAA must maintain communications among its facilities. The NAS Recovery Communications (RCOM) project provides an emergency communications network using high frequency and very high frequency radios and satellite communications. RCOM also provides secure communications equipment for voice and facsimile messages and mobile communications devices for short-range communications. We are continually upgrading and testing these systems so that they will work when they are needed.

2.2.4 Automated Detection and Processing Terminal (ADAPT)

The FAA will use ADAPT to validate the identity and legitimacy of aircraft operating within or entering the NAS. ADAPT is a highly integrated set of database systems provided by FAA, Department of Commerce, Department of Homeland Security, and the Transportation Security Administration.

3 Next Generation Air Transportation System

Over the last 20 years, the FAA has significantly modernized the existing air traffic control system. By both improving equipment and adding a robust strategic planning capability at the Air Traffic Control System Command Center, the agency has markedly improved its ability to handle the flow of air traffic. However, we anticipate reaching the limits of improving the current system in the near future. With continued aviation growth on the horizon, the FAA must implement new ways of managing the predicted air traffic volume. The Next Generation Air Transportation System (NextGen) replaces and expands the current system's capabilities. This section discusses the key elements contained in the NextGen solution sets and budget line items that identify the operational improvements that we must implement to create a system to handle future demand.

3.1 Demonstrations and Infrastructure Development

This project supports major field demonstrations of key NextGen capabilities. These demonstrations include stakeholder participation to ensure user evaluation of new concepts in an operational environment. The purpose is to validate the benefits of NextGen and encourage stakeholder adoption of the capabilities. There are four NextGen demonstrations.

International Air Traffic Interoperability: This effort, which includes the Atlantic Interoperability Initiative to Reduce Emissions (AIIRE), will obtain data from commercial aircraft along oceanic routes to demonstrate and accelerate Airline and Air Navigation Service Providers (ANSP) efficiency and improvements using existing systems and technologies. The flight trials development stage will include system architecture, design, hardware and software development (where applicable), procedures development, simulations, component and subsystem testing and certification, and system checkout. This international interoperability air traffic demonstration and development initiative will also assist the international communities and the FAA in validating 4D Trajectory Based Operations (TBO) and Performance-based Air Traffic Management (PATM) alternatives.

High Density Airport (HDA) Capacity and Efficiency Improvement Project: Trajectory Based Management (TBM) will be accomplished using fully defined 3D paths to ensure aircraft sequencing and spacing (path stretching using dog-legs or offsets). The 3D paths permit more orderly and predictable traffic patterns and use path clearances rather than the conventional speed, altitude, and heading clearances to manage aircraft spacing. This technique has the potential to reduce controller workload and allow the airplane to precisely follow a continuous path using the accuracy of Required Navigation Performance (RNP) operations.

Unmanned Aircraft Systems (UAS) 4D Trajectory Based Demonstration: The first objective will utilize the advanced capabilities of the UAS community to serve as a testbed for exploring future 4D trajectory based concepts. The second objective is to examine potential concepts for the wide-spread integration of UAS into the future NextGen environment.

Virtual Tower (Staffed and Autonomous): The Virtual Tower (VT) program will demonstrate and validate the potential of emerging alternative approaches to performing local and ground air traffic control from facilities other than the current Airport Traffic Control Tower (ATCT).

3.2 System Development

This project focuses on four areas of research and development – safety, capacity, human factors, and environment. The safety research includes expanding information sharing and data analysis to identify and mitigate risks before they lead to accidents. The capacity research develops requirements for new air traffic management systems to support NextGen; measures NextGen concepts to determine if they achieve the capacity targets for 2025; and develops flexible airspace categories to increase throughput. The human factors research investigates higher efficiency levels in air traffic control and identifies the new role for controllers as more responsibility shifts to the flight crew. The environmental research provides new procedures, technologies, and fuels to reduce emissions, fuel burn, and noise; and includes demonstrations, methods to adapt the current infrastructure, and estimates of costs and benefits.

Controller Efficiency: This subproject examines human factors related to increasing controller efficiency to meet rising demand. A key performance target of NextGen is to satisfy growth in demand up to three times current levels. Automation and technology must work in concert with the humans in the system to meet the targeted efficiency levels. Human factors aspects, e.g. cognitive load, or verbal communications in existing air traffic control systems are a limiting factor for traffic loads. Projected traffic loads will exceed the capability of our current mode of air traffic control when traffic levels exceed 130 percent of 2004 levels (baseline).

Air/Ground Integration: This subproject examines human factors when systems on aircraft and at ground locations are integrated and the roles of humans shift. Achieving the capacity targets of NextGen and achieving allocation of tasks to flight crews/aircraft such as self-separation between aircraft requires significant changes in the roles and responsibilities of pilots and controllers, and there interaction with automation. Integration of air and ground capabilities poses significant challenges for the air traffic service provider and the flight crew. A core human factors issue is to ensure that safety is maintained. Information on intent as well as positive information on delegation of authority must be clear and unambiguous; and new types of human error modes are required to manage safety risk in the changing environment.

Advanced Noise and Emission Reduction: This subproject examines the impact of operational changes that might result from the introduction of new airframes and engines and how to reduce the environmental impact of aircraft. Achieving the NextGen target of three times current levels of capacity could cause aircraft noise and emissions to increase threefold. The potential for environmental damage could restrict capacity growth and prevent full realization of NextGen. The problem is to reduce the environmental impact of aviation in absolute terms through new operational procedures, technologies, and fuels to allow the desired increase in capacity.

Emissions Validation Modeling: There must be a thorough understanding of the economic and operational impacts of the system alternatives for reducing noise and emissions with respect to the system alternatives for increasing capacity. As the system solutions to increase capacity develop, there must be validation that proposed solutions to reduce noise and emission are sufficient to prevent environmental restrictions that might limit the required capacity increases.

New ATM Requirement: This subproject identifies, defines and validates system requirements established by the NextGen mid-term concept elements. Achieving NextGen will require a full-scale transformation of the air traffic control system, because our current system simply is not scalable to handle the required changes. The new system must demonstrate higher capacity levels at faster speeds than today. A system transformation of this magnitude requires air traffic control to change from tracking aircraft to managing trajectories.

NextGen Operations Concept Validation: This subproject defines, and validates detailed concepts to be achieved by NextGen operational capabilities. As proposed system alternatives for NextGen develop, there must be an understanding of the economic and operational impact of the solutions. This requires a thorough understanding of how the aerospace system operates, the impact of change on system performance and risk, and how the system impacts the nation. There must be methods, metrics, and models that demonstrate whether or not the proposed solution contributes to increased capacity, reduced transit time, or increased on time arrivals; and if so, how much the solution contributes.

System Safety Management Transformation: Safety is the top priority of FAA. Transforming the system will require a thorough understanding of the operational impact (with respect to safety) of system alternatives. While pursuing three times current levels of capacity, FAA will continue to pursue reduced fatality rates. This will require: data analysis capabilities to predict, identify, and mitigate safety risks before they become accidents; safety guidelines to help stakeholders develop their own safety management systems; and modeling to help measure progress toward achieving FAA goals.

Wake Turbulence Recategorization: Achieving the NextGen targets requires improved airspace access for a changing fleet mix and updated separation standards that increase capacity to allow efficient use of congested airspace while at the same time maintaining safe operations. Current wake separation standards are set-up to protect the smallest aircraft in one category from the largest aircraft in the next category. Establishing categories which are adapted to the aircraft's operational profile, .e.g. partially loaded or flying continuous descent profile, could increase flexibility and throughput.

3.3 Initiate Trajectory Based Operations

This project primarily supports improvements in en route operations, but it does affect efficiency in all other phases of flight. It requires a shift from a clearance-based Air Traffic Control (ATC) system to a trajectory-based one. The rationale for a trajectory-based system is that aircraft will receive approval to fly with assurance that their flight path (trajectory) is free of near- and mid-term conflicts. Aircraft will be able to fly the most efficient flight path with specified times to pass pre-identified waypoints, and air traffic control intervention will not be necessary, except when atmospheric or off-nominal conditions do not allow the aircraft to fly the planned route at the planned times.

3.3.1 Background

Currently, controllers are responsible for separation of aircraft; and they assess the airspace in their sector to assign altitudes and routes of flight. With increasing diversity and volume of aircraft using the en route airspace, controllers find it more difficult to accommodate optimal routes and altitudes. The combination of different airspeeds and turbulence behind large aircraft requires larger separations. Also, as more aircraft fly in any one sector, the amount and the relative simplicity of voice communication limits controllers' ability to maintain flight efficiency and minimum separation distances. This, in effect, reduces the capacity of a given amount of airspace.

3.3.2 Operational Capability Description

A key aspect of trajectory-based operations (TBO) is integrating trajectory planning with strategic planning to minimize the tactical decision making for overall airspace management. The flexible management of aggregate trajectories enabled by TBO allows maximum access for all air traffic with more efficiency for those aircraft with advanced capabilities that support the air traffic management concept enabled by TBO.

3.3.3 Development of Capital Investments that Support Trajectory Based Operations

FAA is planning several new technologies that support TBO. Later releases of software enhancements to ERAM will allow assessment of whether requested trajectories are available and will reserve that airspace for flight well in advance. Just before flight time, weather information can be integrated into the approval process for trajectories, so the assigned trajectory can be changed if the original trajectory is unavailable due to severe weather. The enhanced surveillance with ADS-B and communication, which results from the DataComm program, will minimize the voice communication between pilots and controllers and enable them to have more complex interactions than voice alone cannot support. Strategic planning will also be more precise, due to improved weather forecasting and more timely sharing of weather information made possible by the NextGen Weather Processor.

3.4 Reduce Weather Impact

Weather can impact aviation in a number of ways. Over 70 percent of aviation delays are weather related. However, the most dangerous impact is from thunderstorms. These powerful storms can damage aircraft with lightning strikes and severe turbulence, and deteriorate performance if there is ice accumulation on the wings. Due to the risk related to encounters with severe weather, pilots plan routes that let them avoid flying close to thunderstorms. Fog and low clouds can obscure visibility for aircraft approaching airport runways. Only the most well equipped aircraft can land when visibility is severely restricted. Airports will often be closed when visibilities are below established minimums. Rain and snow can also result in airport closures because heavy precipitation can seriously reduce visibility or braking effectiveness on the runway. Winds also affect flight schedules. Stronger than expected head winds can increase en route flight times and create such issues as overlapping arrivals because arrivals from the west are earlier than expected and arrivals from the east are later than expected. Access to accurate weather information is essential for planning a flight and avoiding problems while in flight. To adequately reduce weather impact, the FAA must continue to effectively integrate weather information into operational systems and decision-making.

3.4.1 Background

Weather information used in aviation today is not in the formats or resolution needed to provide the degree of predictability necessary for flight planning and ATM. Current systems need improvements, but it is especially important to upgrade weather systems to cope with the increases in air traffic predicted for the future. Unpredicted changes in the weather cause significant disruptions in the NAS, and the current system is unable to respond well to changes stemming from unpredicted weather. The goal is to make weather information more user friendly by creating better access and more frequently updated information so decisions can be made faster and better. Integrated weather information, along with probabilistic forecasts, will minimize the effects of weather on NextGen operations. Accurate preflight planning has as much potential to reduce delays as trying to mitigate impacts after the aircraft is airborne.

3.4.2 Operational Capability Description

The FAA can improve NAS performance by reducing the operational impact of weather. Integrating consistent and accurate weather into ATM, flight operations centers, and flight decks will improve safety and reduce delays. Improvements are needed in weather sensors, forecast technology, and techniques for providing universal user access to weather information. Decision support systems need to directly incorporate weather data so expected weather is matched to specific route planning. This will maximize use of airspace and minimize delays.

3.4.3 Development of Capital Investments that Reduce Weather Impact

There will be investments in both sensing and dissemination systems. The FAA will continue to upgrade the group of weather sensors described generically as automated weather observing systems to better detect ceilings, precipitation type and freezing rain. We will upgrade the weather channel of terminal radars and carry out service life extension programs (SLEP) on other existing systems such as the Terminal Doppler Weather Radar and the Weather and Radar Processor (WARP). We will decide in the future whether to replace WARP with the NextGen Net-enabled Weather (NNEW) system.

A key component of the NNEW is the NextGen 4D Weather Cube. It is a distributed “virtual” database that will receive weather data directly from sensors and other weather sources and either automatically or by request send data to FAA facilities. The 4D weather cube allows observations and forecasts to be more widely and consistently distributed to a broad set of users via network enabled operations.

There will also be investments in supporting systems. We can use the ADS-B transmitters to send weather data to the cockpit. The consolidated automation systems will incorporate weather data into their decision software.

3.5 Increase Arrivals/Departures at High Density Airports

The 35 OEP airports serve about 73 percent of airline passengers. Many of these airports are operating near capacity during peak hours of travel demand. Although building new runways can accommodate increased operations at these airports, expansion of airside capacity is not an option if developable land is unavailable and environmental issues restrict new construction. Thus, the FAA must develop better technology to maximize use of available capacity. This solution set addresses opportunities to increase runway throughput.

3.5.1 Background

Making full use of available runway capacity is challenging. First, aircraft have different landing speeds and that affects the amount of required separation between aircraft. Second, large wide-body aircraft generate significant wake turbulence, which is a hazard to smaller narrow-body aircraft. As a result, it is rare to achieve the theoretical maximum runway acceptance rate. Automation programs, improved approach procedures, and trajectory-based operations could potentially increase the number of aircraft handled on each runway.

Another inefficiency in terminal control at large airports is the need to vector aircraft into a line to approach the runway end. Since aircraft can enter terminal airspace from any one of several directions, controllers typically require that they fly an indirect route to the airport to position them in the line for the runway. This increases efficient use of the runway, but it also increases flight time and fuel burn. If trajectory-based management is able to bring aircraft more directly to the line at a precise time, it could save airline direct operating costs.

3.5.2 Operational Capability Description

High-density corridors will provide more efficient transition to and from trajectory-based en route airspace. The corridors will seamlessly integrate surface operations through transition altitudes to and from en route airspace. Arriving aircraft will receive specific 4D trajectory profiles via data communications as early as possible. As routes converge, automation will establish airborne spacing and merging procedures that reduce spacing and save flight time. Required Navigation Performance/Area Navigation (RNP/RNAV) routes will be prevalent, allowing for closer route spacing than is available today. Also, aircraft approaching closely spaced parallel runways may conduct parallel runway procedures, thereby removing another restriction on runway capacity.

Time savings will also be provided on the airport surface. Onboard displays of the data communications provided taxi route, coupled with display of surface traffic and other hazards, will enable aircraft to safely taxi at or near normal speeds in low visibility conditions. This has the added benefit of reducing runway incursions and other taxi errors. Cockpit and ground automation will allow aircraft to plan for crossing active runways without tower intervention. Near real time updates for airport surface maps will be provided via data communications.

3.5.3 Development of Capital Investments that Support Increased Arrivals/Departures at High Density Airports

Improving runway utilization will depend on enhanced automation. The ERAM and modernized terminal automation will be upgraded to merge en route and terminal routes. Matching terminal routes and en route flight paths end-to-end will reduce flight time and maximize use of runway capacity. Improving surface operations will rely on enhanced surveillance of the airport surface combined with automation in the Surface Management System. Transferring information to the cockpit will require implementing the new Data Communications System. Increasing RNP/RNAV approaches may require installing more DME locations.

3.6 Improved Collaborative Air Traffic Management (CATM)

Significant service improvements are possible by collaborating with aircraft operators regarding how to deal with severe weather conditions and with air traffic and airport congestion, both in terminal areas and en route. By sharing information and letting customers identify their priorities, better decisions can be made regarding how to handle re-routes and potential delays. Adjustments are shared equitably among all the aircraft using the affected airspace, but users can decide which of their own flights to hold back and which flights need to move to prevent further downstream delays. The quality of the decisions depends heavily on the quality of the information being used. Sharing all available information in near real-time requires a sophisticated network such as SWIM. It also depends on the accuracy of software that forecasts future conditions and the available capacity of affected airports.

3.6.1 Background

The FAA has been collaborating with users for several years. Existing software predicts the demand at specific airports and the available capacity. When demand exceeds capacity, there are several ways to control demand to reduce delays that would occur if traffic flows were not adjusted. Either aircraft can be held on the ground at their departure airport until there is balance between demand and capacity, or aircraft at the congested airport can be held so runways can accommodate more approaching aircraft. Either of these decisions has gradations between full holds and normal operations, so judgments have to be made regarding how stringent a holding order has to be. An additional complication is the impact of weather. If capacity is restricted because of weather, a forecast of when the weather pattern will change becomes a key factor in deciding whether to hold aircraft. An inaccurate forecast can result in more delays than necessary or it can increase delays because aircraft cannot land at an airport that was forecasted to be clear of the weather, but it is still affected.

Weather also is important in the en route domain. Airlines try to avoid moderate to heavy turbulence and thunderstorms to avoid damage to the aircraft and injuries to passengers and crew. Choosing a different route to avoid severe weather normally involves a time and distance penalty. To strategically manage weather and en route congestion, the FAA is implementing the Airspace Flow Program to match demand with the expected capacity of the target airspace. The FAA coordinates with air carriers to choose the most efficient alternative routes for those aircraft that can’t be assigned to the flow-constrained area. It also judges when diversion is no longer necessary and future flights can fly their planned routes.

3.6.2 Operational Capability Description

When the FAA fully implements NextGen, all airspace users will be able to collaborate on Air Traffic Management (ATM) decisions. The system will accommodate everything from large airline operations centers to the single pilot with a personal computer. Authorized users will have access to information relevant to their level of operations, and that information will be more timely and comprehensive when NextGen improvements are implemented.

Collaborative Air Traffic Management is the means for balancing operator objectives and constraints with overall NAS performance objectives. To ensure that locally developed solutions do not conflict with overall goals or other implemented strategies, decision makers follow NAS-wide objectives and pre-developed "play books" to ensure that delays are minimized throughout the system rather than at a few selected airports. In NextGen systems, flight planning will be iterative and interactive, and automation systems will store trajectory and other information. As the departure time draws closer, operators will be notified of any changes necessitated by weather or other factors so adjustments can be made to the trajectory. For sophisticated NextGen users, a preferred trajectory and alternate trajectories may be filed in advance so selection of an alternative, when needed, will be automatic depending on the forecast weather.

3.6.3 Development of Capital Investments that Support Improved Collaborative Air Traffic Management

Investment will continue in modernizing the ATM System and upgrading the software that calculates capacity and demand for major airports. The automation upgrades for ERAM and terminal automation systems will enhance the information feeds to the ATM platforms. SWIM will allow data sharing among all the airspace users. Upgrades to the weather dissemination systems will improve the timeliness and forecast accuracies used to strategically mange air traffic. This, plus improvements in defining and managing aeronautical information, will provide the basis for the NextGen Automation Platforms to have access to complete and consolidated information, which improves the efficiency of comparing, displaying and managing traffic conditions.

3.7 Increase Flexibility in the Terminal Environment

This solution set gives airports that support both high-density and lower density operations the flexibility to serve all types of aircraft that want to land at the airport. It seeks to provide a core NextGen functionality to both high- and medium-level airports. This is important since medium level airports are expected to have faster growth rates than high-density airports, which often operate near capacity several hours of the day. At airports where traffic demand is lower, operations requiring lesser aircraft capabilities can be offered; this allows access to a wider range of users while retaining some of the throughput and efficiencies of the high-density airports.

3.7.1 Background

Since we expect higher growth rates at the medium-density airports, we need to focus on ensuring that their capacity grows to meet that demand.

3.7.2 Operational Capability Description

Aircraft equipped for airborne spacing and merging procedures at large airports will be handled during periods of peak operations. The smaller, more flexible air traffic control facilities will be able to more easily accommodate aircraft transiting their airspace or landing at a satellite airport with fewer requirements than those needed for super density operations. These airports can allow satellite navigation based approaches, limited use of continuous descent approaches, and other efficient procedures for aircraft with less equipment than larger aircraft.

3.7.3 Development of Capital Investments that Support Increased Flexibility in the Terminal Environment

Investment to support this type of operation includes the Wide Area Augmentation System and Local Area Augmentation System to allow approaches during limited visibility. The Tower Data Link System can be used to provide departure and simple, coded taxi route clearances. Aircraft that are properly equipped can also use RNP/RNAV approach procedures. The Traffic Information System (TIS-B), which broadcasts over ADS-B transmitters, can provide expanded traffic advisory services. Reduced separations can be safely used when technology-based wake turbulence separation decision support tools have been implemented.

3.8 Increase Safety, Security, and Environmental Performance

Safety is the FAA's primary goal. As we continue to develop new techniques and technologies for air traffic control, we will ensure that they are as safe or safer than current systems. Increasingly, we are seeking to discover safety issues before work begins on new initiatives, and improve design safety for new systems and procedures. Security also deserves special attention. The air traffic control system is part of the critical infrastructure of the United States and needs to be protected from terrorist threats as well as natural disasters. Many of the facilities were designed in the middle of the last century and need to be upgraded to more current standards.

We must also address environmental concerns for every project. Anticipated increases in air transportation demand will place significant environmental pressures on various segments of the NAS. The primary environmental constraints on the capacity and flexibility of NextGen will likely be community noise, local air quality, global climate impacts, water quality, and energy production and consumption. Our NextGen environmental challenge is to manage aviation's environmental concerns in a manner that reduces or limits the impact of these challenges to allow aviation growth.

3.8.1 Background

The FAA is examining the optimal configuration for its air traffic facilities. The outcome is very likely to involve new construction. Designing security and environmental improvements into new facilities is much more economic than adding them to existing facilities.

The FAA has adopted the Safety Management System, which the International Civil Aviation Organization (ICAO) recommended. We must analyze programs during their earliest stages and throughout their life cycle to uncover safety risks or hazards. This action allows the designers to incorporate safety into a program before we have spent significant sums building it, and it ensures that planned improvements do not result in any new risks.

3.8.2 Operational Capability Description

The potential for significant growth and increased complexity in the air transportation system requires a fundamental change in the way we manage safety. Future safety programs will evolve from reactive data analysis to integrated historic and prognostic evaluation and management of safety risks so that we can prevent future accidents and incidents. This means that we must require program offices to analyze safety issues as they develop new capabilities and procedures and incorporate safety risk management when they are implemented.

3.8.3 Development of Capital Investments that Support Increased Safety, Security and Environmental Performance

For the FAA, the Security Integrated Tool Set (SITS) embeds security requirements for flights and airspace into daily operations so that it becomes an efficient, normal part of the task. Monitoring aircraft and airspace for security is equally important as other operational considerations regarding weather, congested airspace, and Special Use Airspace. This requires incorporating security characteristics into the operational toolset and developing a supporting security infrastructure. Including security into NextGen improvements should improve controller efficiency.

3.9 Networked Facilities

The Networked facilities solution set includes all initiatives that are focused primarily on improvements in NAS resource management. This effort includes allocating staff and facilities optimally, using more cost-effective and flexible systems for information sharing and facility backup, and improvements in managing and training employees. It involves all activities related to the establishing and removing facilities, and changing the size and number of control facilities as well as thinning or eliminating other facilities such as navigation aids.

3.9.1 Background

Handling increased traffic in the future while managing costs and improving services is a key goal of this solution set. The current system has built in limitations in flexibility, cost of service delivery, and continuity of operations. Redesigning facilities can overcome some of these limitations. In addition, some smaller airports have limited service and future growth may qualify them for more service. We must explore how to provide expanded services at a lower cost.

3.9.2 Operational Capability Descriptions

Flexible ground-ground and air-ground communications networks do not require that air traffic facilities be in close proximity to air traffic being managed. Facilities can be sited in locations that enhance infrastructure security, allow service continuity and optimize workforce deployment. New information systems planned for NextGen improve monitoring of infrastructure health and system performance to maintain service availability. Transforming FAA’s delivery of ground, air-ground, and other services will enable the flexibility needed to respond to demand in an affordable and timely manner. Flexible infrastructure can scale service delivery up and down as needs change.

3.9.3 Development of Capital Investments that Support Transform Facilities

Initial investments will focus on analyzing how service will be delivered under the NextGen system and design of the facilities that can provide those services. It will include examining the requirements for creating virtual towers and determining how best to create facilities that more optimally allocate and balance current workload while taking advantage of new and expanded capabilities.

3.10 Airport Development

One of the most effective ways to increase capacity and decrease delays is to build more runways. The FAA has promoted new construction wherever possible, but expanding airports in major urban areas is difficult. It is impressive that since 2000, 13 new runways have opened at the 35 major airports referred to as the OEP airports. These new runways will support 1.6 million additional operations. There are 10 additional airfield projects underway at the OEP airports, which will add even more capacity in future years. Local airport authorities build new runways, and FAA airport grants partially finance many projects; however, additional FAA investment is necessary to make full use of the increased capacity.

3.10.1 Background

The 35 OEP airports serve 73 percent of airline passengers. These airports are most likely to have significant delays due to the heavy demand for air travel and the limitations on capacity expansion. The FAA encourages building new runways and other capacity projects, whenever possible. A new runway can support a large number of new operations during visual flight conditions, but that runway needs supporting equipment to increase the airport's capacity to handle additional flights during limited visibility conditions. If NextGen is going to succeed, the FAA must be prepared to invest in equipment that will allow new runways to increase capacity in adverse weather, when delays are most likely to occur.

3.10.2 Operational Capability Description

There are 10 projects underway at eight OEP airports – Philadelphia, Los Angeles, Washington Dulles, Chicago, Charlotte, Atlanta, and Dallas-Ft. Worth. Six are new runways, and the others are runway extensions or taxiway improvements that allow the airport to handle more operations. There are 11 more projects in the planning stages, and it is likely that there will be a continuing effort through 2025 to construct new capacity to accommodate growing demand.

3.10.3 Development of Capital Investments that Support Airport Development

There are several infrastructure investments required to support new airport and new runway construction. To achieve the maximum benefit, a new runway at an OEP airport must have precision approach guidance. Current policy is that the Instrument Landing System (ILS) will be required at OEP airports. Installation of an ILS also requires runway visual range and approach lights. Communication lines and automation systems must be installed or modified to accommodate the new equipment.

3.11 Aircraft and Operator Requirements

Many of the NextGen investments will not result in the expected benefits if aircraft and commercial operators do not equip their aircraft with next-generation equipment. The Automatic Dependent Surveillance–Broadcast ground stations will rely on transmissions from aircraft that send information on their location and operating parameters. DataComm will require that aircraft have the appropriate communications equipment to support data link. Efforts will continue to ensure that aircraft equip at a rate compatible with development of new capabilities.

3.11.1 Background

Demonstration projects have shown that there are potential efficiencies in managing air traffic if FAA and users share the responsibility for separation of aircraft. For this to happen, mechanisms must exist to share information, and aircraft must install equipment that will be compatible with the FAA ground installations.

3.11.2 Operational Capability Description

NextGen operational improvements depend on introducing new technology. This requires investment by both FAA and aircraft operators. Improved surveillance will depend on aircraft equipping to transmit accurate position information to the ADS-B ground stations. Improved communication requires an update for aircraft radios, which incorporates the ability to receive and display data link transmissions. Taking advantage of terminal approach procedures that allow lesser separation requires more precise navigation equipment.

3.11.3 Development of Capital Investments that Support Aircraft and Operator Requirements

The capital investment to support this solution set will be the responsibility of aircraft owners and operators. FAA has been working to make the appropriate investments to bring their systems on line in the predicted timeframe, so users are confident their investment will bring them benefits.

4 Roadmaps Showing Current CIP Projects and Transition to NextGen

4.1 Roadmaps to the Future System

The detailed roadmaps appearing in the following sections are an integral part of the NAS Enterprise Architecture. The roadmaps show progression from the present system to NextGen. The roadmaps extend planning beyond the 5-year financial horizon covered in the CIP, to ensure an orderly transition to NextGen. Modernization will occur in incremental steps, and we must clearly show the planned pathway to reach NextGen. Current CIP projects that are foundational technologies for NextGen are funded over the next 5 years to begin the transition.

We update the Roadmaps frequently to reflect the results of studies, demonstration projects, and economic analysis related to projects. The CIP text does not explain every detail in the roadmaps, because final decisions on some elements will depend on study results and associated demonstration projects. For more detailed information, view the Enterprise Architecture and Roadmaps at http://www.nas-architecture.faa.gov.

Figure 6 defines the symbols used in the roadmaps. The diamonds indicate decisions regarding whether or not to proceed with a planned improvement. Since the introduction gives only a general overview of the planned changes, the reader should view the NAS architecture Web site for a more complete description of all decisions involved in upgrading NAS capabilities.

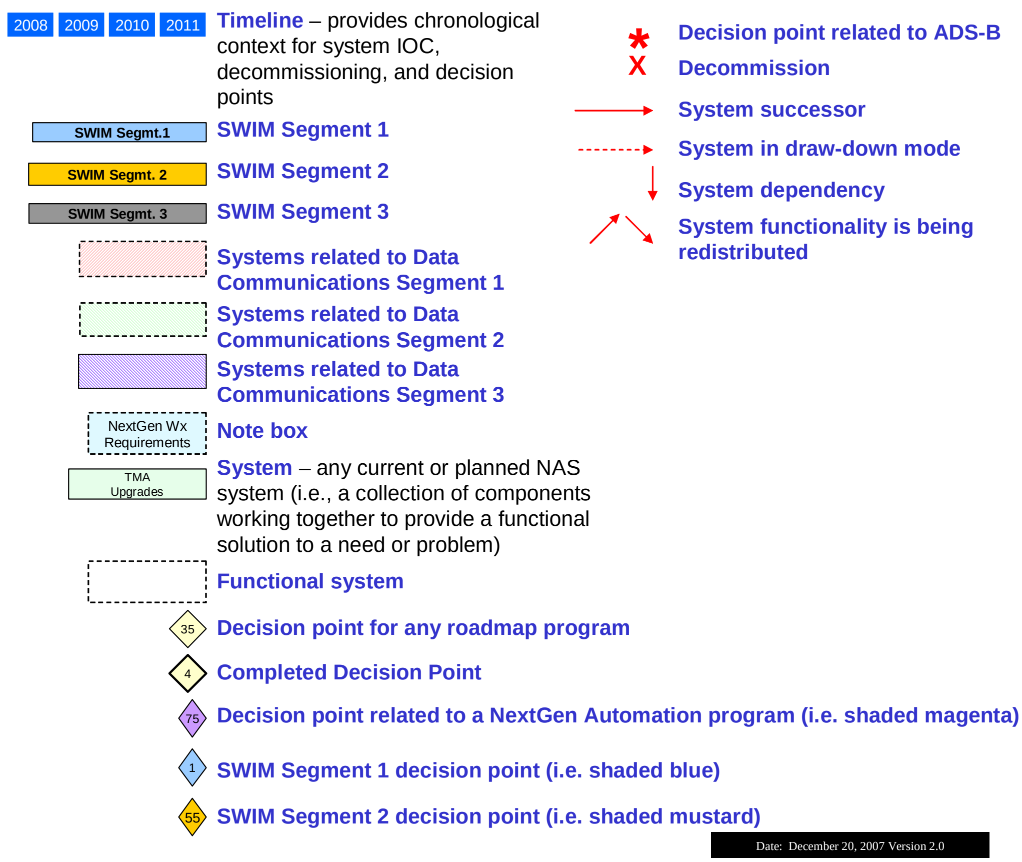

Figure 6 Roadmap Legend

4.1.1 Automation

Automation is a core element of the air traffic control system. For controllers to keep over 50,000 flights safely separated every day they require a real-time depiction of aircraft location and information about operating characteristics such as speed and altitude. Automation gives controllers continuously updated displays of aircraft position, identification, speed, altitude and 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 using that information to project its future position.

Other important features of automation:

- It generates visual displays of information on routes, restricted areas, and several other fixed features of the controller's sector.
- It uses software that further enhances safety by providing automated alerts to controllers of potential aircraft conflicts and warnings that aircraft may be approaching a terrain hazard.
- It supports many functions that are essential to controlling air traffic, such as showing the data from weather sensors, giving the status of runway lights and navigational aids, and providing flight plan information on aircraft being monitored.

The automation roadmaps in Figures 7 and 8 depict current systems and progression to more capable NextGen systems over an extended planning period. One of the important changes that will occur during the roadmap timeframe is that we will be consolidating functions in larger shared systems. These systems will be able to offer more sophisticated services, such as early approval of direct routes, and they will allow better allocation of workload among facilities. New systems will have quicker access to more data and will have the processing power to determine whether the best routes are available or if pilots must use alternate routes to avoid severe weather.

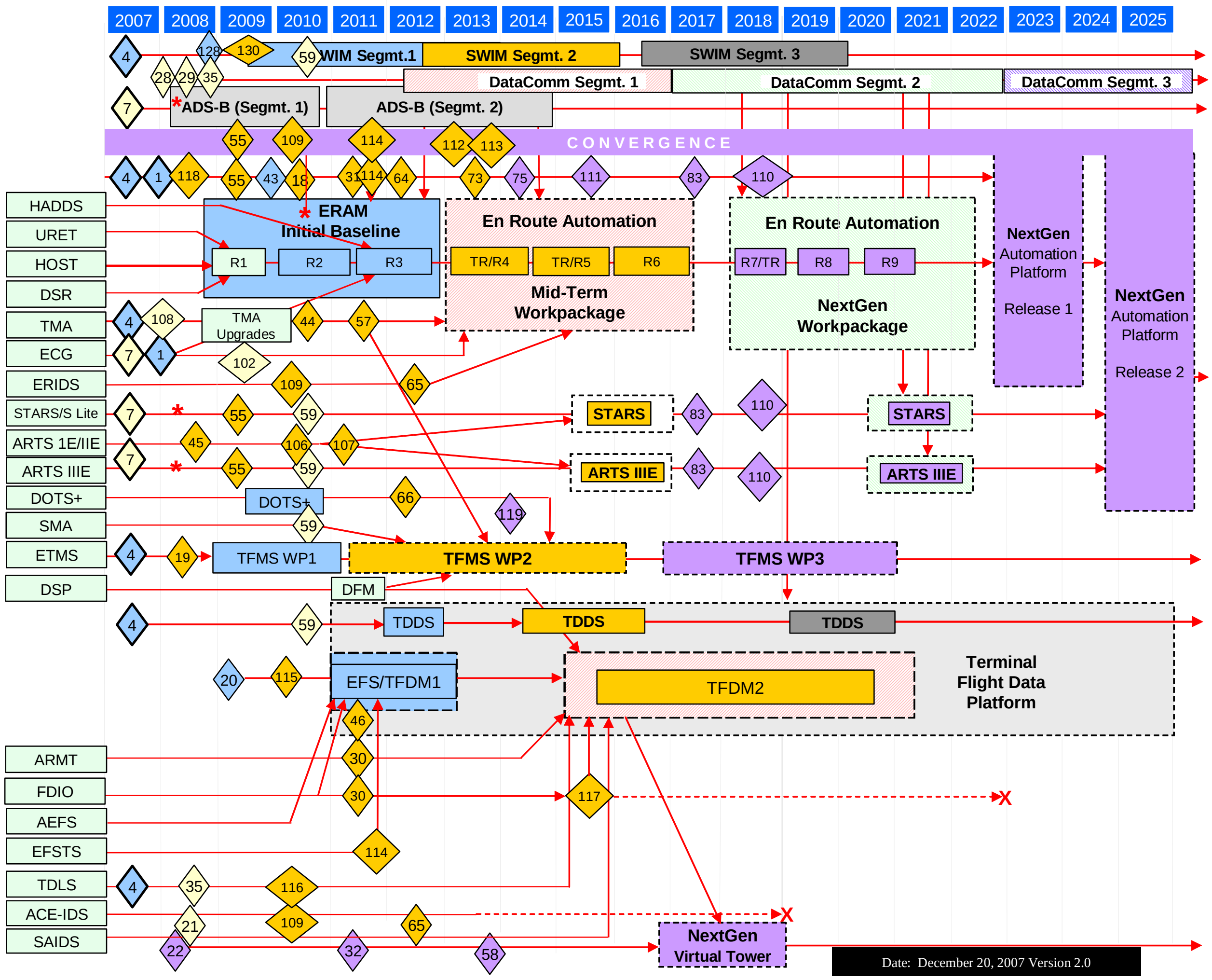

Figure 7 Automation Roadmap (1 of 2)

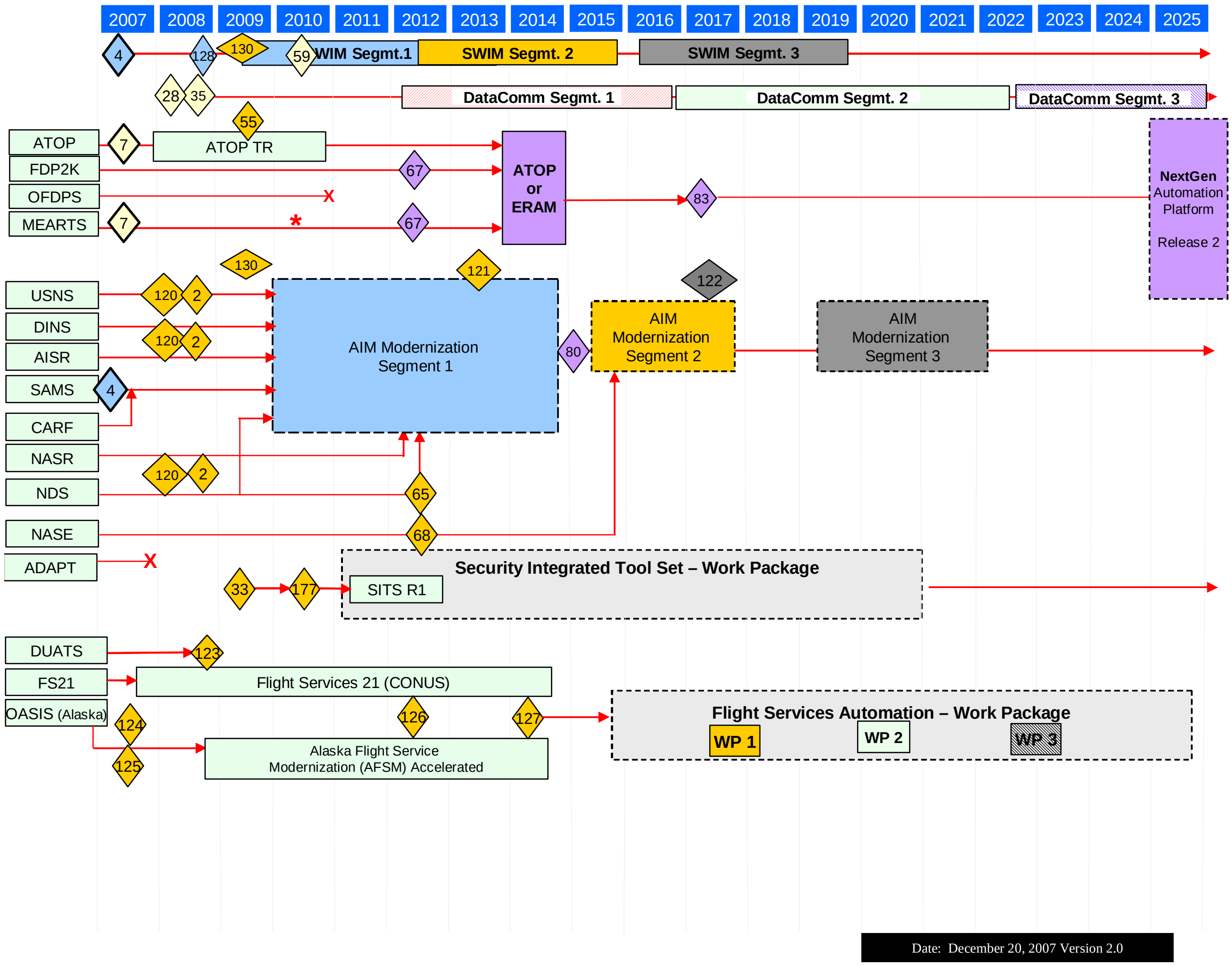

Figure 8 Automation Roadmap (2 of 2)

Figure 9 shows projected CIP expenditures on automation roadmap projects.

BLI Number	Program Name	FY 2009 Budget	FY 2010	FY 2011	FY 2012	FY 2013
	Automation Functional Area	**$664.1**	**$950.9**	**$914.8**	**$897.8**	**$1,034.0**
1A02	Traffic Management Advisor (TMA)	$3.7	$0.0	$0.0	$0.0	$0.0
1A08	Next Generation Air Transportation System (NextGen) - Demonstrations and Infrastructure Development	$28.0	$30.0	$30.0	$30.0	$30.0
1A09	Next Generation Air Transportation System (NextGen) - System Development	$41.4	$102.9	$104.0	$105.3	$108.3
1A10	Next Generation Air Transportation System (NextGen) - Trajectory Based Operations	$39.5	$90.1	$90.8	$87.0	$67.8
1A12	Next Generation Air Transportation System (NextGen) - Arrivals/Departures at High Density Airports	$18.2	$74.2	$85.3	$110.0	$316.1
1A13	Next Generation Air Transportation System (NextGen) - Collaborative Air Traffic Management (CATM)	$27.7	$111.4	$103.9	$84.3	$87.8
1A14	Next Generation Air Transportation System (NextGen) - Flexible Terminal Environment	$37.1	$102.0	$106.9	$45.8	$30.8
2A01	En Route Automation Modernization (ERAM)	$203.1	$170.9	$131.5	$183.2	$171.1
2A02	En Route Communications Gateway (ECG)	$7.4	$12.6	$16.3	$19.8	$18.5
2A06	Air Traffic Management (ATM)	$90.2	$31.6	$15.2	$8.5	$13.4
2A11	Oceanic Automation System	$20.7	$12.7	$20.8	$10.0	$7.1
2A15	System-Wide Information Management (SWIM)	$41.0	$54.3	$38.2	$22.5	$8.0
2A17X	Automated Detection & Processing Terminal (ADAPT)	$0.0	$6.0	$0.0	$0.0	$0.0
2B03	Standard Terminal Automation Replacement System (STARS) (TAMR Phase 1)	$28.2	$47.0	$47.0	$47.8	$57.0
2B04	Terminal Automation Modernization/ Replacement Program (TAMR Phase 3)	$3.0	$50.0	$50.0	$80.0	$90.0
2B05	Terminal Automation Program	$4.3	$2.4	$2.4	$2.5	$2.5
2B19	Integrated Display System (IDS)	$7.0	$3.0	$4.0	$0.0	$0.0
2B22X	Terminal Automation Modernization/ Replacement Program (TAMR Phase 2)	$0.0	$1.7	$1.1	$2.4	$3.0
2D08	Instrument Flight Procedures Automation (IFPA)	$10.9	$7.9	$0.5	$0.0	$0.0
4A10	Aeronautical Information Management (AIM)	$11.6	$10.0	$10.0	$8.0	$8.0

Figure 9 Expenditures in the Automation Functional Area[1]

One can more easily understand these automation roadmaps when they are segmented into nine major elements. At the top of Figure 7 are the three systems that appear in several other functional roadmaps (System Wide Information Management (SWIM), Data Communications (DataComm) and Automatic Dependent Surveillance-Broadcast system (ADS-B)). These systems are central to collecting and sharing information used throughout the NAS. They transmit and receive critical information to support air traffic control in both the en route and terminal environments.

The far left column of Figure 7 shows the first seven components of the en route automation system (HADDS, URET, Host, DSR, TMA, ECG, and ERIDS, all are defined below). The roadmap shows their eventual incorporation into the En Route Automation Modernization (ERAM) program. The next three systems (STARS/S Lite, ARTS 1E/IIE, and ARTS IIIE, also defined below) are different terminal automation models that will be sustained as separate systems until they are eventually consolidated into the NextGen Automation Platform (NAP). The four following systems (DOTS+, SMA, ETMS, and DSP) are part of the automation used for Traffic Flow Management (TFM). TFM is used to strategically manage air traffic, and it will be upgraded as a separate system throughout the period shown in the roadmaps. The bottom seven blocks are information and display systems that feed data to terminal control facilities. We will consolidate their functions in the Terminal Flight Data Platform.

[1] Out-year funding amounts are estimates that assume enactment of the Administration's reauthorization proposal to reform FAA's financing system by adopting cost-based user fees and fuel taxes for the costs of air traffic services.

The far left column of Figure 8 shows four systems (ATOP, FDP2K, OFDPS, and MEARTS), which are used to control aircraft flying over the oceans. A decision is pending on whether oceanic automation will remain stand-alone or be incorporated into ERAM upgrades. The next eight systems (USNS, DINS, AISR, SAMS, CARF, NASR, NDS, and NASE) provide status information on airports, airspace, and navigation facilities. A modernized and consolidated Aeronautical Information Management (AIM) system will replace these individual systems. The ADAPT is a security system that validates the identity and legitimacy of aircraft within or entering the NAS; it will be incorporated into the more capable Security Integrated Tool Set (SITS) beginning in 2010. The final three systems (DUATS, FS21, and OASIS) provide flight services to pilots.

The SWIM program is developing the network architecture that will allow distribution of information relevant to air traffic control to those who need it when they need it. Sharing real-time information on weather and traffic conditions will allow FAA collaboration with users to minimize delays and improve operational efficiency. The DataComm program is developing data link equipment to allow critical data to be shared more efficiently with cockpit crews and to reduce the amount of voice communication. The ADS-B program will transform the way air traffic control facilities receive information on aircraft position, speed, altitude, mode of flight, and identification. An aircraft, using its on-board navigation and flight management system, will broadcast information from these systems to ground receivers.

The FAA is currently installing ERAM hardware and software in en route air traffic control facilities. We are integrating existing en route components into the overall ERAM program. The components include:

- Host Air Traffic Management Data Distribution System (HADDS),
- User Request Evaluation Tool (URET), which allows controllers to select direct routes for aircraft,
- Host Computer,
- Display Replacement System (DSR),
- En route Communications Gateway (ECG), and
- Traffic Management Advisor (TMA).

ERAM replaces both the hardware used for en route automation and translates the software into a modern programming language. The existing software language is obsolete, and modern computers cannot use it. ERAM will expand the capacity of en route centers to handle aircraft, and it will be capable of providing four-dimensional (4D) trajectory management. By adding the fourth dimension, which sets the time aircraft need to arrive at specific waypoints for air traffic control purposes, fewer deviations from direct routes will be necessary, and more aircraft will be able to use their most efficient flight paths. ERAM will remain in service until at least 2022, then, it will be replaced by NAP. During its lifespan, ERAM will be continually upgraded by technical refresh (TR) of hardware components and new software releases to further extend its capabilities. These releases appear on the roadmap with an R and the associated release number.

The En Route Information Display System (ERIDS) distributes important information electronically to controllers to improve productivity and efficiency. The information includes

Notices to Airmen, Pilot Reports, aeronautical charts and airport information, instrument approach and departure procedures, letters of agreement, and local procedures.

The existing terminal automation systems – Automated Radar Terminal System (ARTS) and the Standard Terminal Automation Replacement System (STARS) – will receive technical refresh and upgrades under the Terminal Automation Modernization Replacement (TAMR) program and remain in service until Release 2 of the NAP replaces them. Terminal automation systems assist controllers in handling traffic departing and arriving at airports. These systems will be modified to use the technology introduced by SWIM, Data Comm, and SBS programs. Modernizing terminal automation systems in conjunction with introducing new procedures will allow more direct routes to runway ends, reduce aircraft separation standards, and decrease delays at busy airports.

Traffic Flow Management Systems (TFMS) improve efficiency by collecting information on the use of busy routes and airports. This information is displayed at the Air Traffic Control System Command Center and all affected facilities so they can make decisions on route selection and synchronize traffic approaching airports. This reduces the amount of maneuvering near airports and reduces delays. The FAA has significant investments in TFM and is continually upgrading its capabilities: Dynamic Ocean Track System (DOTS) used for oceanic flights adjusts over water routes to take advantage of favorable winds; the Surface Management Advisor (SMA) reduces taxi time; and the Departure Spacing Program (DSP) assists controllers in sequencing takeoffs. These capabilities will all be incorporated in the TFMS upgrades. The roadmap shows that TFMS will remain a separate system through 2025.

Tower and TRACON controllers must constantly update themselves on conditions around the airport and planned routes of travel for arriving aircraft. They use several separate systems to provide this information. The roadmap shows:

- ARMT – Airport Resource Management Tool,
- FDIO – Flight Data Input Output,
- AEFS – Advanced Electronic Flight Strip System (contains information on the planned route of flight for each aircraft using their airspace),
- ACE-IDS – Automated Surface Observing System Controller Equipment Information Display System, and
- SAIDS – Systems Atlanta Information Display System.

The FAA will integrate the functional capabilities of all these information systems into the Terminal Flight Data Platform to enable controllers to minimize the number of displays they need to monitor.

The FAA has upgraded the suite of systems used for oceanic control, and the Advanced Technologies and Oceanic Procedures (ATOP) system is operational at the three centers that control oceanic air traffic. At those centers, it replaces the Offshore Data Processing System (OFDPS). We will either incorporate the functions of the Flight Data Processor upgraded in 2000 (FDP2K) and the Microprocessor En Route Automated Radar Tracking System (MEARTS) installed at Anchorage into an upgraded ATOP system by 2013 or we will transfer these functions to ERAM once we decide which alternative is more efficient. Automation of oceanic air traffic control, accompanied by improved position reporting and communications to air traffic facilities, allows reduced separation between aircraft and significant fuel savings because aircraft flying internationally can use more optimal routes.

There are several systems that are used to inform pilots and controllers of temporary changes to airspace use, availability of navigational aids or airport status (such as a closed runway). Both pilots and controllers regularly review this information, which the following systems provide:

- USNS – United States NOTAM (Notice to Airmen) System,
- DINS – Defense Internet NOTAM Service,
- AISR – Aeronautical Information System Replacement,
- SAMS – Special Airspace Management System,
- CARF – Central Altitude Reservation Facility,
- NASR – National Airspace System Resources,
- NDS – NOTAM Distribution System, and
- NASE – NAS Adaptation Services Environment.

NOTAMs are notices of temporary changes such as temporary flight restrictions and runway closures for construction. SAMS and CARF inform controllers when airspace ordinarily reserved for military use is available for civilian use. The other systems contain more detailed information about FAA air traffic control equipment or less frequently changed information such as charts and airspace regulations. The AIM program will establish a standard format and a user-friendly interface for finding the information needed for a specific route of flight.

The bottom three systems on the left side of Figure 8 provide flight services. The FAA has contracted for flight services in the lower 48 states, and the contractor is responsible for upgrading equipment, such as flight service specialist workstations. The Direct User Access Terminals (DUATS) currently allow pilots to file flight plans and obtain weather information for their planned routes from flight service stations, and we plan to decide during 2008 whether to continue this service. Flight Service Automation Systems (FS-21 and OASIS (Operational and Supportability Implementation System)) are used by flight service specialists to record flight plans and provide weather briefings to pilots. The Alaska Flight Service Modernization (AFSM) project will replace the existing automation system used there because it is a leased system and the lease expires in 2010. We will also request funding to upgrade the buildings and supporting equipment for Alaska's flight service stations.

4.1.2 Communications

Radio, ground telecommunications lines, and satellite links connect pilots with controllers and provide communications within and among facilities. Voice switches in air traffic facilities enable controllers to select the channels they need to communicate with one another and with pilots. Controllers are able to use radios located either in their facilities or at remote locations to communicate verbally with pilots. The remote radios extend the range of pilot-controller communication beyond the geographic limits of direct radio transmission and transmit voice communications from their location to the air traffic facility through telecommunication lines.

Backup systems provide communications when the primary systems fail. Figure 10 is the roadmap for the modernization of these systems.

A limited band of frequencies has been reserved for air traffic communications. As the volume of air traffic increases, the fixed number of available frequencies within that band limits our flexibility to add control sectors. There are several solutions to expanding the number of communication channels. FAA is working proactively with international standards committees and industry to identify the most suitable technology for handling future growth and the expanding levels of information exchange needed to maintain efficient operations.

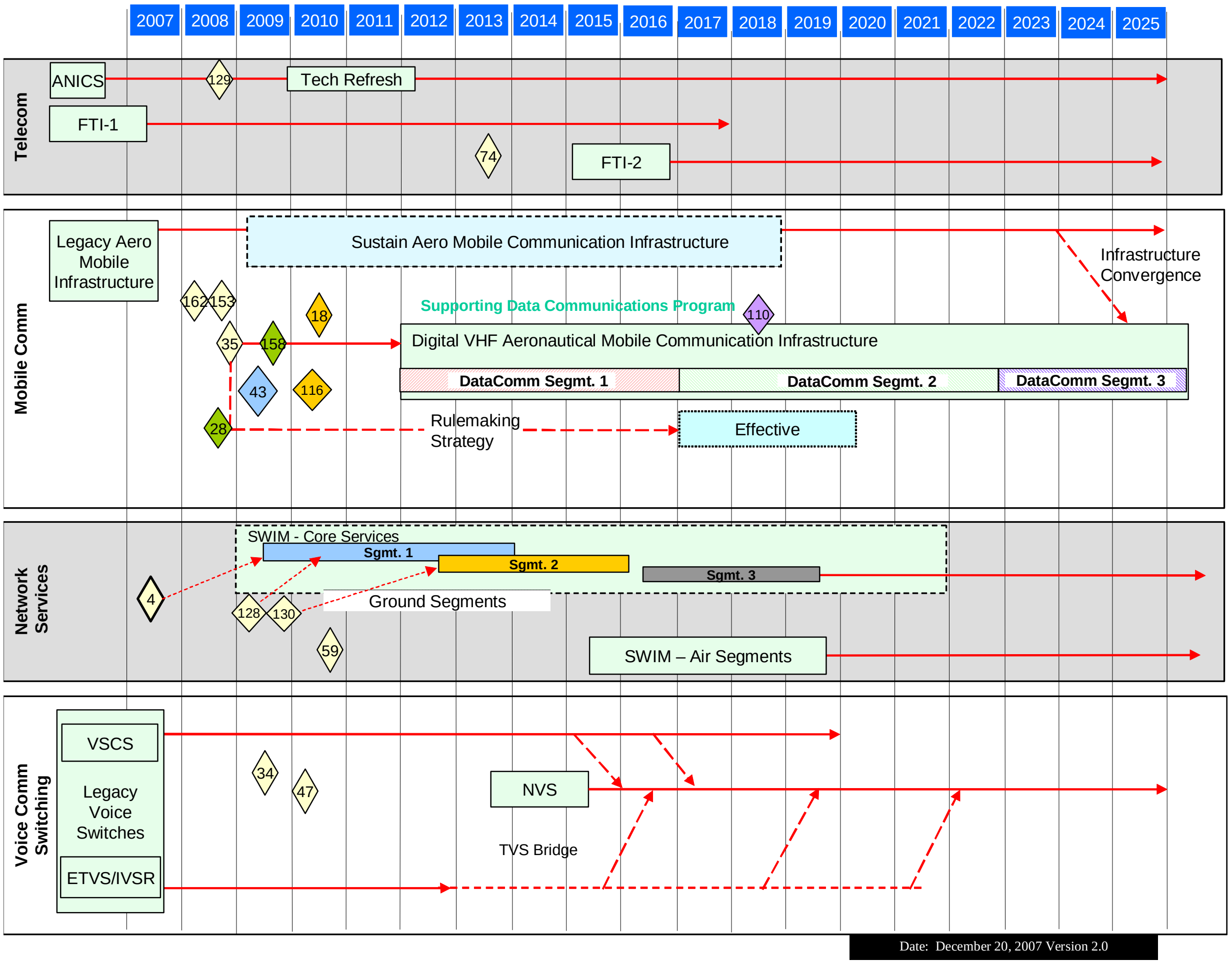

Figure 10 Communications Roadmap

Figure 11 shows the projected CIP spending for replacing communications systems and improving and modernizing communications channels.

BLI Number	Program Name	FY 2009 Budget	FY 2010	FY 2011	FY 2012	FY 2013
	Communication Functional Area	**$150.2**	**$207.5**	**$201.7**	**$199.8**	**$189.7**
1A07	Data Communication in support of Next Generation Air Transportation System	$28.8	$28.6	$36.7	$38.1	$25.0
2A07	Air/Ground Communications Infrastructure	$7.5	$4.8	$4.9	$5.3	$4.5
2A10	Voice Switching Control System (VSCS)	$23.3	$17.0	$15.9	$0.0	$0.0
2A14	Next Generation VHF Air/Ground Communications System (NEXCOM)	$46.4	$79.9	$70.6	$92.4	$97.2
2B08	Terminal Voice Switch Replacement (TVSR)	$8.4	$10.3	$0.0	$0.0	$0.0
2B15	National Airspace System Voice Switch (NVS)	$10.0	$40.0	$50.0	$50.0	$50.0
2B17	Voice Recorder Replacement Program (VRRP)	$10.8	$11.9	$9.6	$0.0	$0.0
2E07	Alaskan NAS Interfacility Communications System (ANICS)	$5.0	$3.0	$2.0	$2.0	$1.0
3A04	National Airspace System (NAS) Recovery Communications (RCOM)	$10.0	$12.0	$12.0	$12.0	$12.0

Figure 11 Expenditures in the Communications Functional Area[2]

Figure 10 shows the planned modernization of communications systems that FAA uses. The first box, Telecom, at the top of the page, shows two backbone systems that carry FAA messages. 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. Because there are far fewer ground telecommunications connections in Alaska, this system is needed to ensure that important air traffic information is reliably transmitted between smaller and larger facilities. Previously used commercial satellite service did not meet FAA standards for reliability and availability. ANICS will continue to operate for the entire period shown in the roadmap with technical refresh and renovation as required due to the extreme weather conditions in Alaska. The FAA Telecommunications Infrastructure (FTI) program leases communication infrastructure to connect its facilities in the lower 48 states. The single contract awarded in 2002 consolidates services to reduce costs, upgrade security, and increase accountability for internal users of telecommunications services.

The second box, Mobile Comm, shows the radio systems that are used to communicate with pilots. The FAA uses frequencies in the Very High Frequency (VHF) band to communicate with civil aircraft, and it uses frequencies in the Ultra High Frequency (UHF) band to communicate with military aircraft. The FAA is currently replacing the VHF radios with the Next Generation Air/Ground Communications (NEXCOM) multimode digital radios, and it is also replacing UHF radios. Starting in 2009, the FAA will be developing digital communications with data link capability (DataComm) for pilot-controller communications.

The third box, Network Services, contains the System Wide Information Management (SWIM) program, which will establish information management and data sharing for the NextGen. SWIM will develop policies and standards to support data management, along with the core services to enter data into NAS systems, retrieve it, secure its integrity, and control its access and use. SWIM is being developed incrementally. Segment 1, the initial phase of SWIM includes capabilities that were selected based upon the needs of various users (both government and private sector), the maturity of design standards for concepts of use, and the ability of existing

[2] Out-year funding amounts are estimates that assume enactment of the Administration's reauthorization proposal to reform FAA's financing system by adopting cost-based user fees and fuel taxes for the costs of air traffic services.

programs to integrate these SWIM capabilities into their program plans. Future segments will be based on positive test results for initial steps and are planned to include the additional capabilities that move the FAA toward the data sharing required for NextGen programs.

SWIM will reduce the number and types of interfaces between information systems, reduce unnecessary redundancy of information systems, improve predictability and operational decision-making, and reduce cost of service. The improved coordination that SWIM will provide will enable transition from tactical conflict management of air traffic to strategic trajectory-based operations.

The fourth block, Voice Comm Switching, shows the voice switching systems used in FAA facilities. The Voice Switching and Control System (VSCS) is used at en route centers to connect controllers with the appropriate telecommunications line to speak to pilots, controllers in other facilities, and controllers within their own facility. The voice messages to the facility are carried on telecommunications lines that feed into the VSCS, and the controllers can select the channel they need to speak to the appropriate person. The Interim Voice Switch Replacement (IVSR) contract fills the same function in airport towers and Terminal Radar Approach Control (TRACON) facilities.

The FAA is upgrading the VSCS with a technical refresh to replace components that have a high failure rate. We are replacing terminal voice switches at the rate of about 10 per year, and about 380 switches out of 420 have been replaced to date. The terminal voice switch program also installs a new voice switch when an airport traffic control tower is constructed at a new location.

The FAA has begun developing requirements for the NAS Voice Switch (NVS), a single scalable design that would replace both center and terminal voice switches. It would have a modular configuration, so it could be sized for the facility where it was installed. The value of using a single type of voice switch is that it reduces the number of training courses for maintenance technicians and the inventory of spare parts needed to maintain it. It also enables operation of planned NextGen facilities. Installation of the NVS is currently scheduled to begin in 2013 and, by 2023, all the voice switches will be NVS.

4.1.3 Surveillance

To provide separation services to aircraft, air traffic controllers must have an accurate display of all aircraft under their control. Controller displays use radar and transponder information to show location of aircraft and to portray flight data. En route facilities use the Air Route Surveillance Radar (ARSR), and terminal facilities use several models of the Airport Surveillance Radar (ASR) as primary radars. The ARSR and ASR radars are primary because they do not require a cooperative transmission from an aircraft to detect and track its location. The controller displays in both en route and terminal facilities use primary radar only as a back up to the returns from secondary radars called the Air Traffic Control Beacon Interrogators (ATCBI) and Mode Select (Mode S). Secondary radar sends a signal to aircraft equipped with a transponder. The transponder sends a reply, which gives the aircraft call sign, altitude, and speed and allows the beacon interrogator to determine its position. Using ATCBI or Mode S enhances the controller's ability to separate traffic because the transponder reply provides flight and altitude information that can also be shown beside the aircraft's symbol.

We use two systems on the airport surface. The ASDE-3 is a 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 incursions. The ASDE-X uses several technologies to improve detection of aircraft and provide a clear display of the positions of aircraft and vehicles on taxiways and runways.

Figure 12 is the roadmap for surveillance systems.

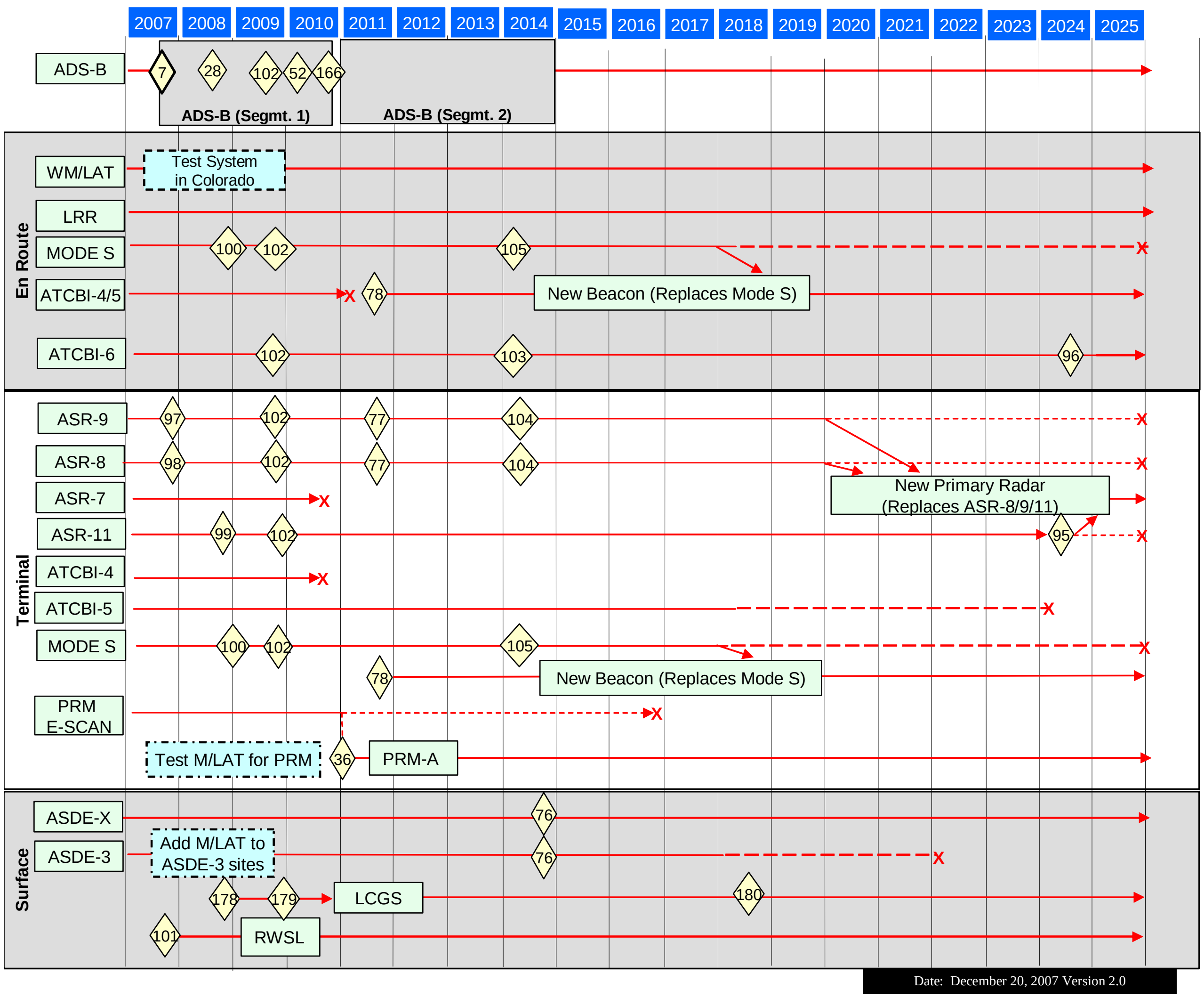

Figure 12 Surveillance Roadmap

Figure 13 shows the CIP costs associated with upgrading the surveillance units.

BLI Number	Program Name	FY 2009 Budget	FY 2010	FY 2011	FY 2012	FY 2013
	Surveillance Functional Area	**$409.9**	**$252.4**	**$206.6**	**$331.8**	**$308.2**
2A08	ATC Beacon Interrogator (ATCBI) - Replacement	$13.0	$5.2	$0.0	$0.0	$0.0
2A09	Air Traffic Control En Route Radar Facilities Improvements	$5.3	$5.3	$5.6	$5.8	$5.9
2A16	Automatic Dependant Surveillance-Broadcast (ADS-B) NAS-Wide	$300.0	$200.4	$175.2	$284.2	$270.7
2B01	Airport Surface Detection Equipment - Model X (ASDE-X)	$32.7	$11.1	$0.0	$8.4	$11.0
2B10	Airport Surveillance Radar (ASR-9)	$8.8	$2.2	$0.0	$0.0	$0.0
2B11	Terminal Digital Radar (ASR-11)	$17.1	$12.6	$4.4	$4.4	$4.4
2B13	Precision Runway Monitors	$1.0	$0.0	$0.0	$0.0	$0.0
2B14	Runway Status Lights (RWSL)	$27.0	$11.8	$18.2	$24.2	$11.8
2B20	ASR-8 Service Life Extension Program	$3.0	$0.0	$0.0	$0.0	$0.0
2C03	Weather Camera Program	$2.0	$3.8	$3.2	$4.8	$4.4

Figure 13 Expenditures in the Surveillance Functional Area[3]

The Automatic Dependent Surveillance-Broadcast (ADS-B) line at the top of the roadmap indicates a planned shift toward a different technology for providing surveillance data to controllers. The nationwide implementation of ADS-B will enable a once-per-second transmission of location and other flight information from the aircraft to replace or supplement the transponder response or passive reflected energy from radars. The advantage of ADS-B is that it has a faster update rate (1 second versus 5 seconds for a radar), and the accuracy remains constant regardless of the distance from the aircraft to the receiving site, unlike radar technology where accuracy declines with distance.

The major systems shown in the block for en route are the Long Range Radar (LRR – a generic term for the various ARSR models), the Air Traffic Control Beacon Interrogator (ATCBI), and the Mode S. The LRR has a range exceeding 200 miles, and it provides back up aircraft location information to the en route centers. It is a "skin-paint" radar that sends out electrical pulses and determines aircraft location by combining information on the angle of elevation of the beam and the time it takes the reflected energy to return to the radar antenna. The ATCBI or Mode S transmits a beacon signal to aircraft, which triggers a transponder in the aircraft.

We will maintain the LRR throughout the roadmap timeframe because of national and homeland security concerns. The FAA and the Department of Defense will jointly fund the maintenance required to keep the existing systems operational. We are replacing the ATCBI 4s, slated for a 2011 decommissioning, with the ATCBI-6s. The ATCBI 5 and Mode S may start being phased out in 2017, and a decision will be made in 2011 whether a New Beacon system is needed to support NextGen or whether the ADS-B is robust enough to support terminal surveillance displays.

The Wide Area Multilateration (WM/LAT) system is experimental and is being tested in Colorado. It uses triangulation to determine the location of an aircraft that cannot be detected by radar. In mountainous terrain the line-of-sight transmission from a radar can be blocked by an intervening mountain between the radar and the aircraft. The WM/LAT system overcomes this

[3] Out-year funding amounts are estimates that assume enactment of the Administration's reauthorization proposal to reform FAA's financing system by adopting cost-based user fees and fuel taxes for the costs of air traffic services.

problem, and it is being locally financed and may be implemented in other mountain regions if it proves to be successful.

There are four models of terminal radars currently in use. The Airport Surveillance Radar Model 11 (ASR-11) is the newest, and it is replacing some of the older radars that were not replaced by the ASR-9 program. As shown in the roadmap, FAA will replace all the existing ASR-7s by 2011. The ASR-8 and the ASR-9 will have Service Life Extension Programs (SLEP) to update and modernize their components, and a decision will be made in 2011 whether to continue to update these systems or to design a replacement. Current planning calls for keeping these skin paint radars operational to address safety and weather requirements.

The Precision Radar Monitor (PRM) is installed at six airports, and can be used to allow simultaneous approaches to closely spaced parallel runways. It is a rapid update radar that provides the precision that controllers need to ensure two aircraft approaching side by side maintain safe clearance from each other. The sixth system will become operational at Detroit in 2009. The 2009 funding will be used to determine if PRM systems can be modified to use multilateration to provide precision separation information to controllers.

Controllers use two systems to maintain aircraft separation on the airport surface. Some airports have ASDE-3, which uses radar and a display in the tower to depict the location of aircraft on or approaching the taxiways and runways. These displays show aircraft location when buildings, weather or darkness obscure the view of the airport surface. The ASDE-X uses several technologies to perform the same function. We plan to upgrade 21 of the existing ASDE-3 radars with the multilateration technology to enhance their effectiveness, and ASDE-X will replace 4 existing ASDE-3 radars. We plan to also install ASDE-X at 10 new locations. We are accelerating installations so that all systems will be installed by 2010 and the final system will become operational in 2011.

The surface surveillance section of the roadmap shows that FAA is testing a new system, the Low Cost Ground Surveillance (LCGS) system, and it may be deployed in 2010. After testing competing designs for the LCGS, we will decide during 2009 which of the competing technologies has the best performance and whether to deploy the technology as a production system. LCGS would be used at small to medium-sized airports, and it would cost less than the ASDE-X or ASDE-3 with multilateration. Deploying LCGS would increase the number of airports that use sophisticated detection system to show the location of aircraft and other vehicles near the runways and taxiways on tower displays, which would enhance our efforts to reduce runway incursions.

A third system to warn pilots about potential runway incursions is the Runway Status Lights (RWSL). These systems use lights embedded in the runway to inform a pilot when it is unsafe to cross a runway; they then change color when it is safe to proceed. These lights have been tested at Dallas/Ft. Worth. The FAA has requested funding in FY 2009 to implement these systems at additional airports as part of the agency’s goal to reduce runway incursions.

4.1.4 Navigation

There are two major types of navigational aids: those used for en route navigation and those used for precision approach and landing guidance. Radio navigation aids form the established routes normally used for flying across the U.S. Pilots use these en route navigation aids to follow their planned routes accurately under all visibility conditions. Precision landing guidance systems, and the associated equipment on the ground provide radio signals and approach lights that pilots use to safely land in limited visibility.

The ground-based system commonly used for en route navigation is the Very High Frequency Omnidirectional Range with Distance Measuring Equipment (VOR and DME). There are over 1,000 VORs spread across the United States. These navigational aids allow pilots to determine an accurate position and also help define the airways, which are routes based on the straight lines from VOR to VOR. Airways have the added value of providing predictability for air traffic control. Using airways can simplify route planning and reduce the length of the clearances to fly from departure to destination. The precision landing aids, called Instrument Landing Systems (ILS), guide pilots to runway ends in very limited visibility. There are over 1,000 ILSs installed in the United States. They are essential to airlines for maintaining schedule reliability during poor weather.

Figure 14 shows the roadmap for navigation aids.

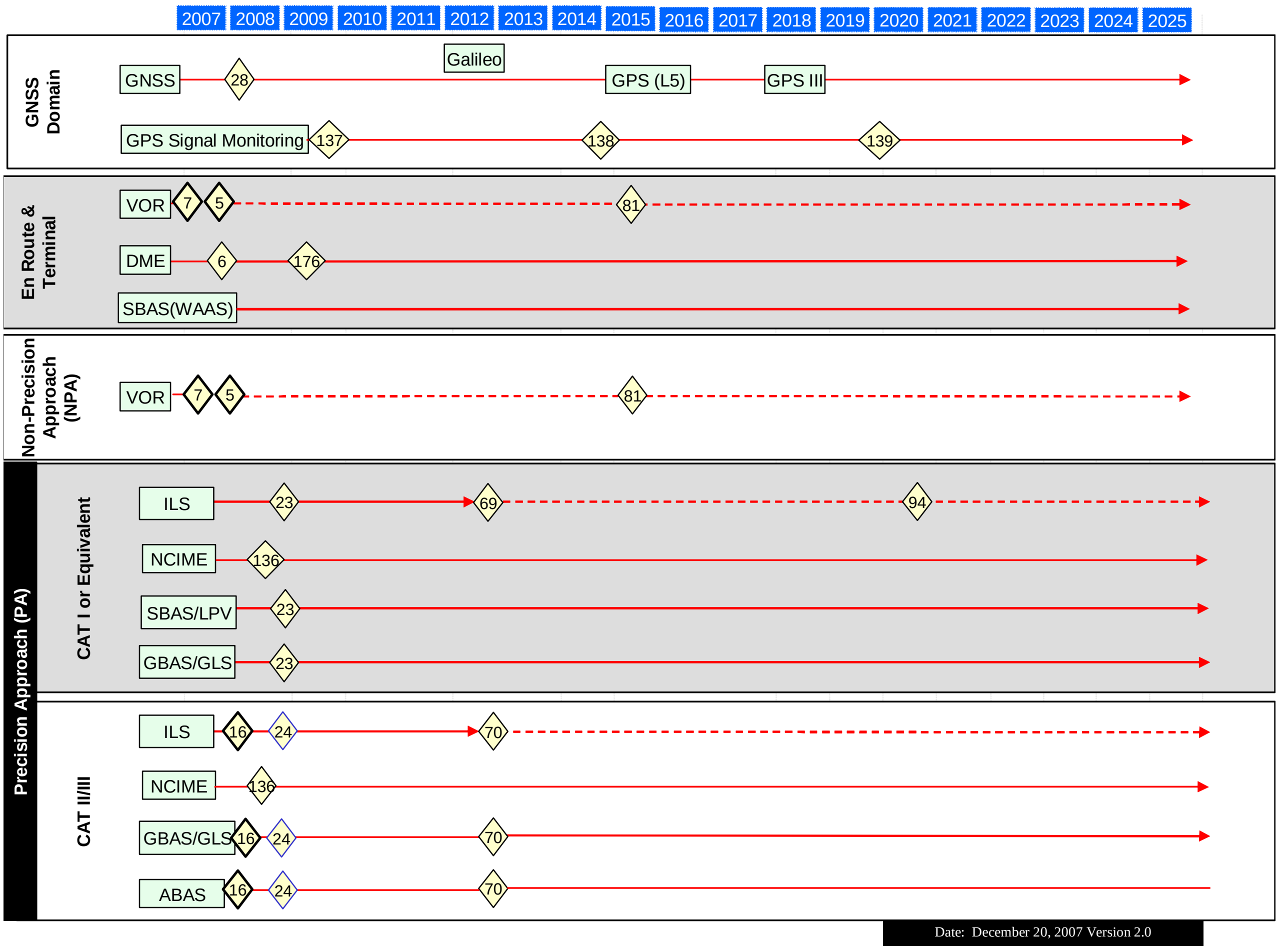

Figure 14 Navigation Roadmap

Figure 15 shows the future capital investments for navigation systems included in the CIP.

BLI Number	Program Name	FY 2009 Budget	FY 2010	FY 2011	FY 2012	FY 2013
	Navigation Functional Area	**$162.4**	**$166.9**	**$146.1**	**$141.9**	**$139.8**
2D01	VHF Omnidirectional Radio Range (VOR) with Distance Measuring Equipment	$7.5	$5.0	$5.0	$5.0	$2.5
2D02	Instrument Landing Systems (ILS) - Establish	$7.5	$21.8	$7.8	$5.0	$7.0
2D03	Wide Area Augmentation System (WAAS) for GPS	$99.0	$100.9	$101.1	$100.5	$100.3
2D04	Runway Visual Range (RVR)	$5.0	$5.0	$5.0	$5.0	$4.0
2D05	Approach Lighting System Improvement Program (ALSIP)	$10.0	$10.0	$5.0	$5.0	$3.0
2D06	Distance Measuring Equipment (DME)	$6.0	$8.0	$6.0	$5.0	$5.0
2D07	Visual Navaids - Establish/Expand	$1.7	$3.2	$3.2	$3.4	$5.0
2D09	Navigation and Landing Aids - Service Life Extension Program (SLEP)	$1.0	$6.0	$6.0	$6.0	$8.0
2D10	VASI Replacement - Replace with Precision Approach Path Indicator	$4.0	$7.0	$7.0	$7.0	$5.0
2D11	GPS Civil Requirements	$20.7	$0.0	$0.0	$0.0	$0.0

Figure 15 Expenditures in the Navigation Functional Area[4]

The major component of the Global Navigation Satellite Services (GNSS) domain is the satellite constellation called the Global Positioning System (GPS) operated by the Department of Defense. There are 24 active satellites in orbit, and an aircraft's position can be determined by interpreting the data transmitted by all the satellites in view (4 or more is ideal). Two GPS upgrades are expected in future years. The next generation of satellites will have a second frequency for civilian use. A properly equipped aircraft receiver that receives both signals can calculate corrections to account for atmospheric distortion. The GPS III family of satellites will be upgraded with more transmitting power.

The GNSS also includes non-U.S. satellites. A European system called Galileo is being developed, and satellites launched in this program would increase the navigation information available to determine aircraft position. Launch of these additional satellites is expected to begin in about 2014.

GPS III civil-side requirements development (identified as GPS Civil Requirements in the FY09 Budget) will be another enhancement to the GPS constellation. This program will finance the development of techniques to determine whether any of the GPS satellites are operating outside acceptable tolerances. If the civil frequencies being added to GPS satellites are out of tolerance, a message will be up-linked to the GPS satellites so navigation receivers are notified which satellites are not usable for their position calculation.

The en route and terminal domains rely primarily on the system of VORs, Distance Measuring Equipment (DME), and Space Based Augmentation System (SBAS) for navigation. The approximately 1,000 operational VORs are the predominant system for en route. The DME is used for both en route and terminal navigation. The VOR gives the direction to the station, and the DME gives the distance. In the terminal area, one or more DMEs can be used for Required Navigation Performance/Area Navigation (RNP/RNAV) approaches to an airport. These approaches improve an aircraft's precision in following the designated approach path, which increases the number of airplanes that can land at an airport within any given time period. The

[4] Out-year funding amounts are estimates that assume enactment of the Administration's reauthorization proposal to reform FAA's financing system by adopting cost-based user fees and fuel taxes for the costs of air traffic services.

SBAS, which is the WAAS (Wide Area Augmentation System), is another alternative for en route navigation. The WAAS provides corrections and satellite reliability information to GPS receivers properly equipped, and the augmented signal can be translated into a precise geographic position. As the transition to SBAS navigation occurs, FAA will decide during 2008 whether half the VORs can be decommissioned and during 2015 whether virtually all VORs could be decommissioned.

Non-precision approaches provide guidance to pilots preparing to land on a runway when there is limited visibility, but, as the term implies, these approaches are not accurate enough to allow descent to the minimum altitudes possible with a precision approach. Many of the non-precision approaches are supported by VORs. If a decision is made to decommission VORs, another navigation aid will have to be used for these approaches. SBAS provides more accurate guidance than the VORs. The FAA is developing procedures to use the SBAS guidance to replace the VOR approaches.

There are three categories of precision approach. Category I is the most common. The Category I approach guides the pilot to the runway end, but it 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 more than a half mile. The Category II and III approaches have lower minimums (i.e., less vertical and horizontal visibility is required). Currently only the ILS is accurate enough for precision approaches. Category II and III ILS have the redundancy and reliability that justify lower minimums. Alternatives for precision approach guidance are the SBAS/LPV (Localizer Performance with Vertical guidance) and Ground Based Augmentation Systems/ Global Navigation Satellite System (GNSS) Landing System (GBAS/GLS). When these alternatives become operational, a number of ILSs can be decommissioned, but a number will remain operational to provide back-up capability at the OEP airports.

Another alternative for precision approaches is the Aircraft Based Augmentation System (ABAS), which will be feasible when the GPS constellation is upgraded with a second civil frequency. The ABAS does not rely on ground based augmentation systems. It uses the GPS receiver carried in the aircraft to monitor signals from several satellites to ensure the satellite information is accurate enough to be used for a precision approach.

4.1.5 Weather Systems

Weather information is essential to aviation. Pilots need to know the effect winds aloft will have on their speed and whether there will be sufficient visibility for them to land at their destination airport. Pilots also use weather information to determine if they need to fly a different route to avoid severe weather, like thunderstorms and turbulence that can damage aircraft and potentially injure passengers. The FAA has a significant role in collecting and distributing weather data. The FAA distributes weather hazard information from its own systems and from the National Weather Service to air traffic control facilities, pilots, airline operations centers, and other aviation-related facilities. Because of its impact on an aircraft’s speed, weather data is essential for computing the 4D trajectories used in the NextGen systems.

There are two major categories of weather information systems. The first is the weather sensors that measure several atmospheric parameters, including temperature, wind speed and direction, relative humidity and cloud heights. Sensors provide real-time information to air traffic facilities and to centralized weather forecasting systems. The second category is weather processing and display systems, which integrate data from the sensors, forecast weather patterns, and create weather graphics for air traffic displays. An advanced feature enables some systems to project the future movement of weather affecting operations. The first weather roadmap (Figure 16) shows the current and planned status of weather sensors.

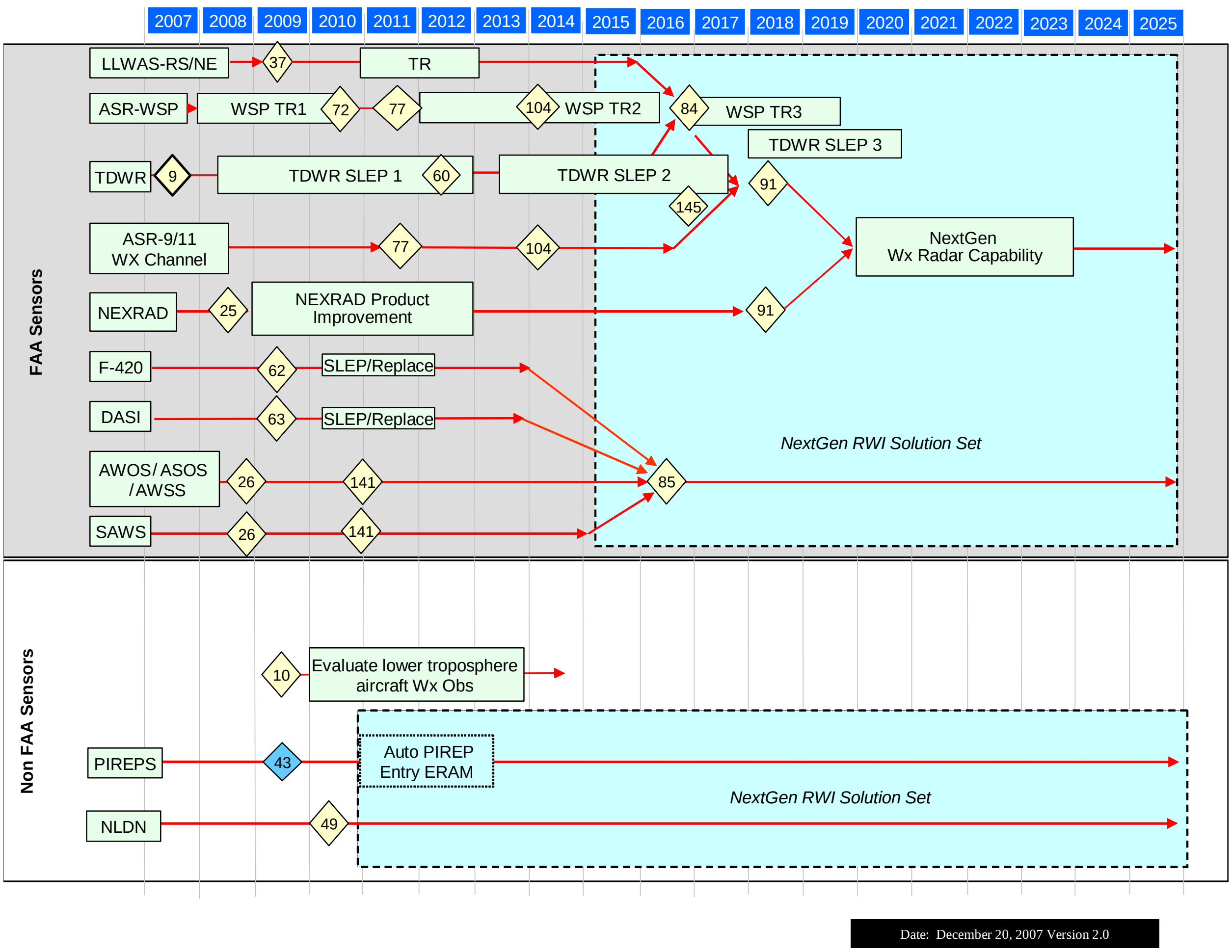

Figure 16 Weather Sensor Roadmap (1 of 2)

FAA sensors shown in the roadmap include the Low Level Wind Shear Alert System (LLWAS); the Airport Surveillance Radar - Weather System Processor (ASR-WSP); and the Terminal Doppler Weather Radar (TDWR), which all detect wind conditions near the surface of the airport to warn pilots of gust fronts and wind shear. The ASR-9/11 Weather (Wx) Channel and the Next Generation Weather Radar (NEXRAD) detect precipitation, wind and thunderstorms that affect aircraft in flight. The F-420 and the Digital Altimeter Setting Indicator (DASI) are located in FAA facilities and display the current wind and barometric pressure for controllers. The

Automated Weather Observing Systems (AWOS/ASOS/SAWS) measure weather parameters on the surface to report conditions to air traffic facilities and pilots and also assist in weather forecasting.

Of the three different sensors that can detect wind shear, the most sophisticated is the TDWR. There are 47 of these radars, and most are located within 10 miles of a runway end. Using Doppler technology, the radars can detect the rapid changes in wind speed and direction that indicate wind shear hazards for an aircraft approaching a runway. For medium-sized airports that don't qualify for a TDWR, a lower cost alternative is the Weather System Processor (WSP), which interprets data from the terminal surveillance radar to identify wind shear. To supplement these radar systems, LLWAS wind sensors located at 6 to 10 points around the runways measure surface wind direction and velocity. The LLWAS wind sensors and the associated computer systems determine whether significant changes in the wind at different locations near the airport present a wind shear hazard to aircraft. LLWASs serve locations that do not have a TDWR or WSP as well as locations where they supplement the radars with point-specific wind measurements to verify the presence and location of wind shears. The roadmap shows that we will perform a service life extension on the TDWR and technical refresh on the LLWAS and ASR-WSP and decide in the 2018 timeframe whether to replace all of them with a NextGen weather radar system.

Replacing the ASR-9/11 weather channel will be necessary only if the ASR-9/11 do not remain in operation. The FAA plans to decide by 2018 whether to incorporate these functions into the NextGen terminal weather radar. The NEXRAD was developed under a joint DOC National Weather Service, Department of Defense (DoD), and FAA program. These systems are Doppler weather radars that collect atmospheric weather conditions over a broad area and are essential for forecasting future weather. In the short term we are installing upgrades such as Dual Polarization (Dual Pol) and software improvements. Working with our partner agencies we will also decide by 2018 whether to incorporate NEXRAD into the NextGen terminal weather system.

The Automated Surface Observing Systems (ASOS) and other variants - such as the Automated Weather Observing System (AWOS) and the Stand Alone Weather Sensing (SAWS) system - have up to 14 sensors that measure weather data. 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 problems. The Digital Altimeter Setting Indicator (DASI) displays current altimeter settings in the tower. The F-420 is a wind sensor that measures the wind near the runway, so that pilots know which direction to land on a runway. These sensors will require updating, and we plan to work with our partner agencies and decide how their functions are incorporated into the NextGen Reduce Weather Impact solution set.

Pilot reports (PIREPS) of weather conditions can be transmitted by voice or automated systems to FAA facilities. We are studying whether these reports can be transmitted directly to air traffic automation systems in the future. The National Lightning Detection Network (NLDN) reports on the location of lightning strikes. The existing system or a modernized system will continue operating through 2025.

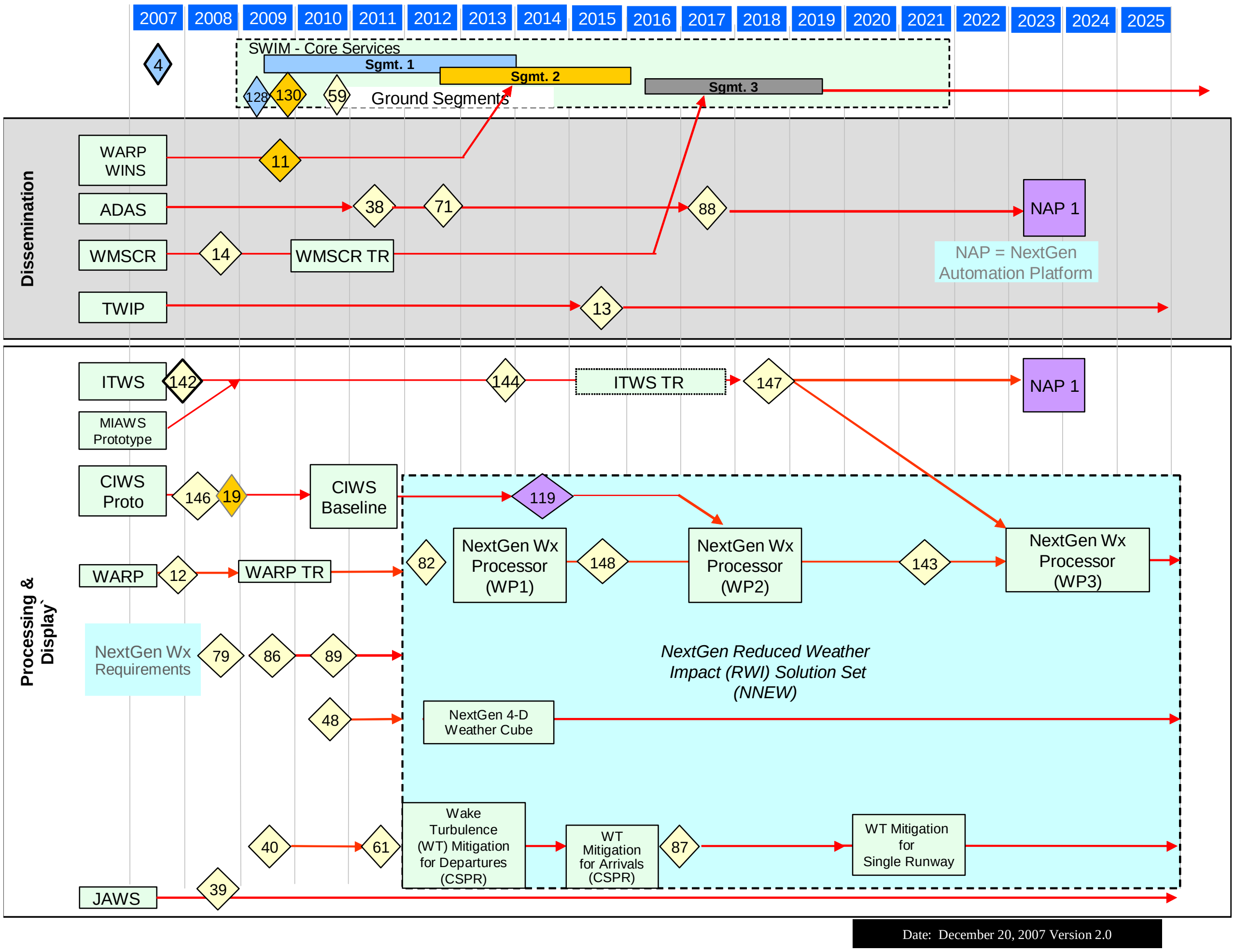

Figure 17 Weather Dissemination, Processing, and Display Roadmap (2 of 2)

Figure 18 shows the planned expenditures included in the CIP for weather sensors and weather dissemination and processing systems.

BLI Number	Program Name	FY 2009 Budget	FY 2010	FY 2011	FY 2012	FY 2013
	Weather Functional Area	**$63.1**	**$119.7**	**$125.0**	**$123.8**	**$131.8**
1A06	NextGen Network Enabled Weather (NNEW)	$20.0	$25.0	$25.0	$25.0	$25.0
1A12	Next Generation Air Transportation System (NextGen)-Reduced Weather	$14.4	$62.0	$62.0	$64.1	$100.7
2A03	Next Generation Weather Radar (NEXRAD)	$3.0	$3.0	$3.0	$3.0	$0.0
2A12	Corridor Integrated Weather System (CIWS)	$5.9	$8.4	$17.4	$22.7	$4.0
2B02	Terminal Doppler Weather Radar (TDWR) - Provide	$6.1	$9.9	$8.6	$7.7	$2.1
2B16	Weather System Processor (WSP)	$0.7	$0.3	$0.0	$0.0	$0.0
2B21	Integrated Terminal Weather Systems (ITWS)	$4.5	$4.4	$2.3	$0.0	$0.0
2C01	Automated Surface Observing System (ASOS)	$8.5	$6.7	$6.7	$1.3	$0.0

Figure 18 Expenditures in the Weather Functional Area[5]

The FAA plans to consolidate weather processing, display and dissemination systems into the NextGen systems that capture and process weather data and then integrate that data into the decision software for advanced automation capabilities.

The Weather and Radar Processor (WARP) used in en route control facilities receives information from Next Generation Weather Radars (NEXRAD), from automated weather sensors located at airports, and from other sources such as weather satellites. It compiles the information for interpretation by the Center Weather Service Unit forecasting stations. WARP also feeds data to controllers' displays. The Automated Weather Observation Data Acquisition System (ADAS) is a radio link that transmits AWOS/ASOS/SAWS data to air traffic facilities. The Weather Information Network Server (WINS) stores NEXRAD data, which will be distributed by SWIM once it is operational. The Weather Message Switching Center Replacement (WMSCR), operated by the FAA, is a network with terminal nodes in Salt Lake City and Atlanta that collects and distributes weather information. The Terminal Weather Information for Pilots (TWIP) system transfers weather information to FAA facilities and the airline's communication provider for use in analyzing weather conditions. Current planning shows that the first four systems shown on the roadmap will become part of the SWIM network to distribute weather data during Segment 2. The TWIP may stay a separate system, but the FAA will decide during 2015 whether to integrate the system into the SWIM Air Segment.

The Integrated Terminal Weather System (ITWS) consolidates weather information from automated sensors and surrounding radars to provide real-time weather information for terminal control facilities. The system also projects movement of severe weather systems up to 20 minutes into the future. 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 excessive maneuvering to accommodate a runway change as aircraft approach an airport. The ITWS has been installed at 22 airports, and it will receive technical refresh in the near term. The ITWS weather inputs and processing power will become part of the NextGen Automation Platform by 2022.

[5] Out-year funding amounts are estimates that assume enactment of the Administration's reauthorization proposal to reform FAA's financing system by adopting cost-based user fees and fuel taxes for the costs of air traffic services.

The Medium Intensity Airport Weather System (MIAWS) prototype uses weather information from the airport surveillance radars to fulfill some of the same functions as the ITWS at smaller airports where it is not economical to install an ITWS. Its functions will be integrated with the ITWS program.

The Corridor Integrated Weather System (CIWS) gathers weather information occurring along the busiest air traffic corridors to help controllers select the most efficient routes when they must divert traffic to avoid severe weather conditions. The CIWS prototype tested a predictive capability to refine the decisions on when normal routes will be available. This system will become part of the NextGen Weather Processor and support the Traffic Flow Management automation software.

The NextGen Weather Processor will incorporate the functionality of the existing Weather and Radar Processing (WARP) system. Work Package 2 (WP 2) will enhance the display of weather information by using new algorithms to portray icing conditions, turbulence, and other hazards. The ITWS functions will be incorporated as part of WP 3. Further upgrades of weather-predicting algorithms will also be added in WP 3 to include Wind Shear/Microburst and Wake Vortex Detection and prediction advisories.

The NextGen 4D Weather Cube is a distributed "virtual" database that will receive weather data directly from sensors and other sources, and either automatically, or by request, send data to FAA facilities so that observations and forecasts can be more widely and consistently distributed to a broad set of users via network enabled operations. The 4D Weather Cube will be part of the NextGen Networked Enabled Weather program and supports the Reduce Weather Impact solution set.

The Wake Turbulence program is developing technology-based solutions to safely reduce the present aircraft separation applied to mitigate wake vortex impacts. Currently controllers must maintain a set distance between aircraft to ensure a low likelihood that the following aircraft could encounter wake turbulence. The technology solutions focus on using knowledge of how wakes move laterally with crosswinds. The first product, Wake Turbulence for Departures (WTMD), is a controller decision support tool for use with departure operations on closely spaced parallel runways (CSPR). When there is a persistent crosswind, the WTMD will indicate that it is safe to allow a departure after a heavy aircraft departs on an adjacent CSPR. As shown in Figure 17 (Weather Dissemination, Processing and Display Roadmap) the next expected product will be a crosswind decision support tool that will be used for approaches to CSPR. In future years, the FAA will develop equipment that addresses a potential reduction in separation standards for single and multiple runway operations during both approaches and departures.

The Juneau Airport Weather System (JAWS) uses wind sensors to detect and transmit turbulence and dangerous wind alerts to air traffic facilities near the Juneau airport. The approach and departure routes for Juneau follow a narrow channel between two mountain ranges. Detecting and transmitting information on the wind conditions along these routes help ensure safe operations for aircraft arriving and departing this airport.

4.1.6 Facilities

The ATO has thousands of manned and unmanned operational facilities, which we must regularly upgrade and modernize. The largest facilities are the 20 en route centers, which house hundreds of employees and the equipment needed to control aircraft flying in the en route airspace. The other operational facilities with significant staffing are the over 500 tower and 178 TRACON facilities that control traffic departing and arriving at airports.

There are also more than 16,000 unmanned facilities—many in very remote locations—supporting communications, navigation, and surveillance equipment and weather sensors. Much of this equipment is housed in shelters and buildings that have exceeded their service lives and need renovation. Many have deteriorating steel towers and foundations. Some newer unmanned buildings and structures frequently need renovation because they are in remote and/or hostile locations near the ocean or on mountain tops. Replacing roofing, power, heating/cooling, and structural and security components of these structures is essential to the successful operation of the NAS.

The William J. Hughes Technical Center (WJHTC) in Atlantic City, New Jersey, and the Mike Monroney Aeronautical Center (MMAC) and FAA Depot in Oklahoma City have many buildings. Each year these complexes receive funds to both sustain 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 Trust, and funds are requested to pay the annual lease costs. The WJHTC supports research programs and testing of new equipment that will be installed in the NAS. In 2009 funding is requested to upgrade electrical and water supply systems and improve roadways. In addition funding is provided to reconfigure the research laboratories to accommodate acceptance testing for new equipment and to test modifications to existing equipment. The MMAC receives infrastructure funding for building renovation, a hanger fire suppression system, sewer upgrades, and an updated telecommunications infrastructure.

The FAA operates 3 Center Radar Approach (CERAP) facilities located at San Juan, Puerto Rico; Guam; and Honolulu, Hawaii that operate as both a center and a Terminal Radar Approach Control (TRACON) facility. They control a limited amount of airspace surrounding their islands and also guide aircraft to airport runways. The San Juan facility needs renovations and an analysis is underway regarding how to proceed.

There are two large budget line items for tower and TRACON investments. The first is the Terminal Air Traffic Control Facilities – Replace program, which includes funding for both airport traffic control towers (ATCT) and TRACON facilities. This line item funds replacement of existing towers and construction of towers for new airports. In most years there are between 10 and 20 projects to replace towers that are too small to handle the traffic growth that has occurred since they were built or have inadequate sight lines due to construction of new runways or new hangers. These types of projects will continue, and over the next 2 years FAA will conduct studies to determine whether efficiencies are possible by controlling airport surface movements from a remote facility rather than using a tower on the airport. The second line item is the Terminal Air Traffic Control Facilities – Modernize program which replaces specific exterior or interior components of existing towers such as: elevators; heating ventilation and cooling equipment; roofs; or other infrastructure that FAA must upgrade to keep towers functioning.

The FAA invests about $50 million a year to upgrade and improve Air Route Traffic Control Center (ARTCC) facilities. Projects include expanding the size of the facility, replacing heating and cooling systems, and upgrading electrical power distribution systems.

In 2009, funding is requested to modernize flight service stations (FSS) and automated flight service stations (AFSS) in Alaska including updating the automation system.

Over the next 2 years, the FAA will be evaluating the design and potential location of NextGen facilities, including the amount of airspace they would have to control to reap the benefits of the NextGen architecture. There are several issues associated with changing the number and location of en route centers. We cannot upgrade many of the current centers to meet new security guidelines. Some control rooms have limited expansion space. Another consideration will be the scope of changes needed in ARTCC communications systems. The potential benefits include the ability to control larger expanses of airspace over more than one time zone and improve productivity. If the studies show that benefits will exceed costs, the FAA may begin building these new facilities starting in 2014. Studies will also look at the possibility of incorporating some terminal services into the NextGen control facilities. By efficient use of airspace, these new facilities may be able to minimize delays and safely increase throughput at the busiest airports.

Figure 19 shows the planned expenditures for facilities projects that contribute to modernizing the air traffic control system.

BLI Number	Program Name	FY 2009 Budget	FY 2010	FY 2011	FY 2012	FY 2013
	Facilities Functional Area	**$465.5**	**$528.4**	**$628.6**	**$774.3**	**$836.6**
1A04	William J. Hughes Technical Center Facilities	$12.0	$12.0	$12.0	$12.0	$12.0
1A05	William J. Hughes Technical Center Infrastructure Sustainment	$5.4	$5.5	$5.6	$5.7	$5.9
1A16	Next Generation Air Transportation System (NextGen) - Networked Facilities	$17.0	$38.6	$115.2	$281.2	$374.0
2A04	Air Traffic Control System Command Center (ATCSCC) Relocation	$28.6	$10.3	$2.1	$2.1	$0.0
2A05	ARTCC Building Improvements/Plant Improvements	$56.5	$56.5	$57.0	$62.0	$62.4
2A13	San Juan Radar Approach Control (CERAP)	$6.0	$0.0	$0.0	$0.0	$0.0
2B06	Terminal Air Traffic Control Facilities - Replace	$134.3	$150.0	$160.0	$165.0	$165.0
2B07	ATCT/Terminal Radar Approach Control (TRACON) Facilities - Improve	$37.9	$42.6	$48.0	$53.3	$52.7
2B12	DOD/FAA Facilities Transfer	$1.4	$1.4	$1.4	$1.5	$1.5
2B18	Houston Area Air Traffic System (HAATS)	$3.6	$2.0	$0.0	$0.0	$0.0
2C02	Flight Service Station (FSS) Modernization	$14.6	$20.3	$22.3	$16.5	$8.5
2E01	Fuel Storage Tank Replacement and Monitoring	$6.1	$6.2	$6.3	$6.4	$6.6
2E02	Unstaffed Infrastructure Sustainment (formerly FAA Buildings and Equipment)	$15.3	$14.5	$15.0	$15.7	$16.3
2E03	Air Navigational Aids and ATC Facilities (Local Projects)	$1.5	$2.5	$2.6	$2.6	$2.7
2E05	Airport Cable Loop Systems - Sustained Support	$7.0	$5.0	$5.0	$5.0	$5.0
2E07	Facility Disposition	$5.0	$5.0	$5.0	$5.0	$5.0
2E08	Electrical Power Systems - Sustain/Support	$51.0	$70.0	$70.0	$70.0	$70.0
3A01	Hazardous Materials Management	$18.0	$20.0	$20.0	$20.0	$20.0
3A05	Facility Security Risk Management	$15.0	$40.0	$54.4	$23.0	$1.0
3B01	Aeronautical Center Infrastructure Modernization	$13.5	$9.8	$10.1	$10.3	$10.5
4A04	Mike Monroney Aeronautical Center Leases	$15.8	$16.2	$16.6	$17.0	$17.5

Figure 19 Expenditures in the Facilities Functional Area[6]

4.1.7 Support Contracts and Automated Management Tools and Processes

The FAA has several support contracts and automated management tools that help our employees plan and manage modernization of existing systems; develop detailed transition plans to install new equipment; and oversee installing that equipment. The System Engineering and Technical Assistance contract and the Center for Advanced Aviation System Development contract help us plan overall modernization and simulate the impact on air traffic of implementing new concepts and new equipment. The Technical Services Support program provides field engineers who oversee site preparation and installation of new equipment. These engineers and technicians help the FAA keep installation on schedule for the many projects with equipment deliveries. The National Implementation Support Contract helps plan our transition to new equipment. Since air traffic control functions must continue while we install new equipment, we must prepare detailed plans before we begin installation to minimize any disruption. The Computer Assisted Engineering Graphics and Web-based Configuration Management programs give engineers the tools to effectively plan, manage, and document NAS improvements.

Another category of support contracts covers leasing, modifying, or modernizing buildings to house engineering and training. The FAA also leases or purchases computer automation to support these engineering functions. Examples include the lease for the Mike Monroney Aeronautical Center and licensing fees for software used for the WJHTC. In addition, there are

[6] Out-year funding amounts are estimates that assume enactment of the Administration's reauthorization proposal to reform FAA's financing system by adopting cost-based user fees and fuel taxes for the costs of air traffic services.

support contracts to provide spectrum engineering to allocate radio frequencies for new installations and to prevent outside interference with existing frequencies. We also have support contracts for environmental projects to remove asbestos, improve fire/life safety, prevent fuel tanks from leaking and clean up environmental pollution.

BLI Number	Program Name	FY 2009 Budget	FY 2010	FY 2011	FY 2012	FY 2013
	Mission Support Functional Area	**$347.9**	**$373.7**	**$357.3**	**$334.2**	**$344.9**
1A01	Advanced Technology Development and Prototyping (ATDP)	$41.4	$36.9	$37.2	$35.2	$32.4
1A03	NAS Improvement of System Support Laboratory	$1.0	$1.0	$1.0	$1.0	$1.0
1A15	Next Generation Air Transportation System (NextGen) - Safety, Security, and Environment	$8.0	$27.0	$33.0	$0.0	$0.0
2B09	NAS Facilities OSHA and Environmental Standards Compliance	$26.0	$26.0	$26.0	$26.0	$26.0
2E04	Aircraft Related Equipment Program	$7.8	$10.0	$9.0	$13.0	$9.0
2E09	Aircraft Fleet Modernization	$3.0	$15.0	$0.0	$0.0	$0.0
2E10	Aircraft Fleet Modernization - International Aircraft	$24.9	$0.0	$0.0	$0.0	$0.0
2E11X	Independent Operational Test/Evaluation - Outyear request	$0.0	$3.5	$5.0	$5.2	$5.3
3A03	Logistics Support Systems and Facilities (LSSF)	$9.3	$9.3	$0.0	$0.0	$0.0
3A06	Information Security	$12.0	$12.0	$12.0	$12.0	$12.0
3A09	Logical Access Control	$0.0	$15.1	$10.2	$9.0	$10.0
3B02	National Airspace System (NAS) Training Facilities	$1.4	$0.0	$0.0	$0.0	$0.0
3B03	Distance Learning	$1.5	$1.5	$1.0	$1.0	$1.0
3B04	National Airspace System (NAS) Training - Simulator	$12.0	$4.3	$0.0	$0.0	$0.0
4A01	System Engineering and Development Support	$32.0	$32.7	$32.3	$32.9	$33.5
4A02	Program Support Leases	$43.5	$47.6	$49.1	$50.5	$52.1
4A03	Logistics Support Services (LSS)	$7.9	$8.0	$8.5	$8.5	$8.5
4A05	Transition Engineering Support	$10.7	$15.0	$15.0	$15.0	$15.0
4A06	Frequency and Spectrum Engineering	$3.5	$2.5	$2.0	$0.0	$0.0
4A07	Technical Support Services Contract (TSSC)	$22.0	$22.0	$22.0	$22.0	$30.0
4A08	Resource Tracking Program (RTP)	$4.0	$4.0	$4.0	$4.0	$4.0
4A09	Center for Advanced Aviation System Development (CAASD)	$76.0	$80.3	$90.0	$98.9	$105.1

Figure 20 Expenditures in the Mission Support Functional Area[7]

Figure 20 shows the planned expenditures for the specific mission support projects that will help us modernize the air traffic control system.

[7] Out-year funding amounts are estimates that assume enactment of the Administration's reauthorization proposal to reform FAA's financing system by adopting cost-based user fees and fuel taxes for the costs of air traffic services.

5 Conclusion

Economic growth continued in 2007, but decreased to less than 1% during the final quarter. This slowing of economic growth does not appear to have a significant impact on aviation growth. The number of passengers and the 2007 increase in air traffic operations indicate that long-term travel demand continues to increase. The most significant growth has been in international travel, but demand for domestic travel also appears to be growing.

Many carriers have shifted their emphasis to longer routes, which increases the number of revenue passenger miles with fewer operations. Offsetting this decrease in operations is the use of regional jets for routes formerly flown by larger aircraft. These aircraft hold fewer passengers, but they can provide more frequent service. A significant concern for the future is whether higher fuel prices will affect profitability. We believe that there will be some adjustments in the industry in the near term, but growth in the number of passengers and aircraft operations will continue.

Growth will put the most pressure on the capacity at large airports, and both new runways and more sophisticated management of air traffic activity will be needed. We will need new and better equipment and procedures to accommodate the anticipated growth. We have already begun preparing for the future by starting NextGen projects that transition our existing system to the system of the future. These projects must begin now to be ready for the increase in demand predicted by the Joint Planning and Development Office. We must have the tools to allocate airspace more efficiently for the expected volume of flights and to reduce congestion and delays caused by severe weather. Timely and accurate information must be shared with users to optimize the airspace use and allow efficient operations for our customers.

One of the great challenges in preparing for the future is deciding how to balance spending between building significant system improvements and maintaining reliability and availability of the current system while reducing costs. We need additional capacity, but we must also reduce operating costs. In the short term, reducing costs depends on a consistent program of modernizing existing facilities and equipment.

As the roadmaps show, we are developing a long-term, coordinated effort to build a system that can handle future air travel demand and prevent increases in delays. We have begun work on some of the initiatives, but several important steps follow. Continuing to enhance the collaborative air traffic management technology program will improve interaction between commercial carriers and the FAA and help reduce delays. The SWIM program will help us share information so decisions will be more informed with real-time information on system status. Introducing Automatic Dependent Surveillance and data link communication will improve efficiency and reduce workload. Improving automation and weather display systems will increase the data available and allow us to share it more effectively to support decision making for more efficient use of airspace. It will take these initial efforts and a continuing commitment to modernization to achieve the goal of building a system that can handle future growth.

6 Appendices to the CIP

The CIP contains four appendices:

Appendix A

- Lists FAA strategic goals, objectives and performance targets
- Associates CIP projects with strategic objectives and performance targets

Appendix B

- Provides CIP project descriptions and the relationship of projects to strategic goals
- Provides the Strategic Management Plan (SMP) pathway and objective supported by projects
- Lists FY 2009–2013 — performance output goals
- Shows system implementation schedules

Appendix C

- Provides estimated expenditures 2009–2013 by Budget Line Item (BLI)

Appendix D

- Defines acronyms and abbreviations