CHAPTER 3
OVERVIEW OF NAS MODERNIZATION INVESTMENTS

This chapter provides a high-level overview of NAS modernization as it is outlined in the NAS Architecture V4.0. It describes the NAS Architecture role in modernization and summarizes NAS operational concepts for enhanced user services, system capabilities needed to fulfill the services, and NAS functions and capital investments needed to make the system capabilities a reality. It also maps NAS capital investments to FAA strategic goals.

NAS Architecture Role in Modernization

NAS modernization supports agency strategic goals and services. The modernized NAS will offer greater flexibility and functionality through systems that are based on up-to-date technology solutions and whose information sharing and common data exchange will continue to evolve over time. The NAS Architecture Version 4.0 is the aviation community's road map for modernizing the NAS. It provides a high-level description of NAS capabilities and services, functions to be performed, dependencies and interactions among functions, and the flow of information among functions. The NAS Architecture V4.0 contains the following information:

- Timing of functional enhancements and operational capabilities
- Sequence of infrastructure improvements
- Projected FAA costs for research, engineering, and development (R,E&D); facilities and equipment (F&E); and operations (OPS) budgets, including safety, security, air traffic control system acquisitions and deployment, personnel, environmental compliance, business operations, and infrastructure sustainment
- User cost estimates and schedules for equipage (air carrier, regional/commuter, general aviation (GA), and military).

The NAS Architecture V4.0 is derived from extensive internal and external coordination with FAA and its customers and stakeholders. After analyzing the NAS Architecture 1997, the NAS Modernization Task Force, appointed by the Administrator, concluded that some of the schedules were too ambitious. The task force recommended implementing specific near-term system capabilities to mitigate development risks and to achieve early user benefits.

The projects for developing these initial capabilities and the development strategy are collectively referred to as Free Flight Phase 1 (FFP1) Core Capabilities Limited Deployment (CCLD). The FAA and the RTCA Select Committee on Free Flight jointly developed the FFP1 Implementation Plan to implement these capabilities. The NAS Architecture V4.0 includes FFP1 CCLD as part of the overall set of the many near-term modernization activities. Figure 3-1 summarizes the steps involved in developing the NAS Architecture V4.0.

The guiding principles outlined in the NAS Architecture V4.0 for modernizing the NAS are:

- Overall NAS safety is enhanced.
- User benefits are introduced early and adapted to user needs.
- Existing services are maintained and enhanced.
- Modernization proceeds in an evolutionary manner.
- Standard components, common systems, and common user interfaces are used wherever possible.
- Adequate security of systems and information is ensured.
- Compatibility across systems is ensured by using accepted systems engineering methodologies.
- Users and service providers are given wide access to NAS information.
- The system is designed to be adaptable and easily extensible as requirements change and traffic grows.

The NAS Architecture V4.0 serves as a planning tool for users and as the principal vehicle for the continuing dialog between the FAA and its user community and other stakeholders. The NAS Architecture V4.0 represents agencywide planning guidance for future agency programs and defines a new paradigm for cooperation among and between agency lines of business (LOB).

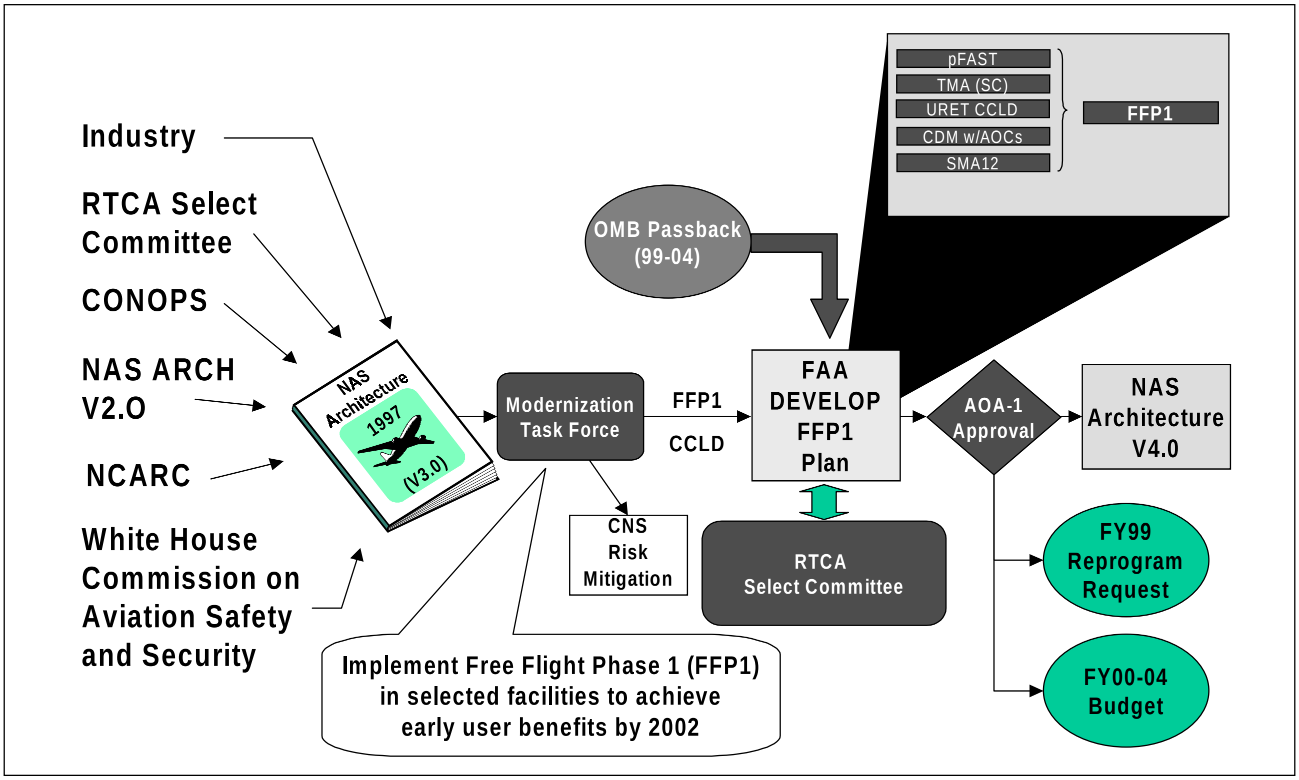

Figure 3-1. NAS Architecture Development

NAS Modernization Operational Concepts and Services

NAS modernization, as outlined in the NAS Architecture V4.0, is based on the FAA and industry joint operational concepts. The operational concepts define improved air traffic control (ATC) and air traffic management (ATM) services for each phase of flight. Additionally, the operational concepts require that related or supporting services be available in a timely manner to ensure NAS modernization success. These operational concepts form the basis for both the FAA and the user community to plan procedural, investment, and architectural decisions that will provide the operational capabilities needed to achieve Free Flight.

The FAA's capital investments, identified in this plan, are based on requirements and timing needed to implement these improved ATC and ATM services and on the guiding principles outlined in the NAS Architecture for modernizing the NAS. A summary of expected operational and service improvements follows:

Flight Planning Operations and Services. Current flight planning services are provided for all phases of flight and during preflight. Flight Services Stations (FSS) provide aviation weather information, aeronautical information, and flight planning assistance to commercial and occasionally military pilots. Currently, most Airline Operating Centers (AOC) electronically file flight plans directly to en route center computers, while some air carriers file bulk-stored flight plans with each en route center. Individual flight plans are also filed through the nearest FSS.

Department of Defense (DOD) Base Operations file military flight plans through the FSS. In some cases, military pilots file directly with FSS personnel. GA pilots interact directly with flight service specialists to acquire preflight briefings, to file visual flight rules (VFR) or instrument flight rules (IFR) flight plans, and to obtain in-flight weather reports. GA pilots can also file via automation rather than through the FSS. Airborne pilots can file or change any segment of their flight plan by contacting ATC or the FSS. Flight service specialists log flight plans into the ATC system via the en route Host computer.

Flight service specialists also coordinate search and rescue activities and provide pilots with information about hazardous condition warnings, airport and airspace capacity constraints, and special use airspace (SUA) schedules. The current process does not allow flight planners to efficiently respond to current and projected conditions in the NAS. Thus, many of these strategic measures are negotiated with the tactical controller after departure. This increases both flight deck and controller workload, and the final product is still not as complete or satisfactory as it would be if an interactive flight planning system based on NAS-wide information were used.

NAS modernization will expand user support and streamline the flight planning process for all users. It will provide the following service enhancements:

- Users will be able to file user-preferred routes.
- The flight planner will have an improved awareness of conditions along the route.
- Collaborative interaction among users and service providers will be possible.
- Improved information security will be available.
- Interactive flight planning will be available for properly equipped aircraft
- A real-time NAS-wide information service will be available throughout the flight.

Airport Surface Operations and Services. The Airport Traffic Control Tower (ATCT) separates aircraft at the airport. The ATCT ensures safe and efficient surface movement between runways and gates and separates aircraft that are landing on and departing from the runways. Other responsibilities include relaying IFR clearances, providing taxi instructions, and assisting airborne aircraft within the immediate vicinity of the airport.

Today's airport surface operations are often characterized by long delays. During low-visibility weather conditions, airport operations may be dramatically slowed or come to a complete standstill. Also, communications are conducted via analog radio, and frequency congestion can increase the possibility of missed instructions or confusing directions.

NAS modernization will enable improved, low-visibility surface operations, improved overall situational awareness, and automated conflict detection. Users will have more efficient and safer surface operations moving to and from runways and terminal gates.

Terminal Area Operations and Services. Terminal radar approach control (TRACON) facilities ensure that aircraft are safely separated and sequenced within the airspace immediately surrounding one or more airports. Current TRACON operations are often constrained because of inflexible standard departure and arrival routes.

To ensure safety when being sequenced onto runways, arriving aircraft often begin descent well before the terminal area, reduce speed, and are routed over longer distances. This consumes extra fuel and increases time to the gate. Departing aircraft are often vectored off course and given climb restrictions as they are sequenced out of the terminal area until they can safely resume navigation along their filed route.

NAS modernization will support more flexible use of terminal airspace. It will increase the number of available runways for IFR operations, allowing more flexible routing and user-preferred trajectories to and from airport runways. Automated data exchange between aircraft and terminal decision support systems will monitor conformance with arrival or departure trajectories. A seamless digital communication network will facilitate coordination among tower, departure/arrival, and en route service providers.

En Route (Cruise) Operations and Services. Current domestic en route centers provide en route ATC services through a ground-based network of radars, communications, and ATC automation systems with limited decision support tools. The existing hardware platforms are not based on an open systems architecture.

NAS modernization will provide improved technology in the en route domain. Evolving system and avionics technology will dramatically change the way en route air traffic is controlled in the future. Pilot situational awareness will be increased through improved cockpit avionics.

These avionics will display critical flight safety information such as weather, nearby traffic, terrain features, SUA status, notices to airmen, and significant weather advisories. Display of real-time weather information in the cockpit will help alleviate some of the hazards encountered during en route flight. Digital maps of exact location and altitudes of heavy rain, lightning, and other thunderstorm activity will also be displayed in the cockpit, greatly assisting pilots in avoiding hazardous conditions and increasing flight safety.

The NAS-wide information service will provide more real-time information to both service providers and users. The increased information flow will enhance movement toward Free Flight. User benefits, such as reduced operating costs, increased safety, and preferred routing, will incrementally increase as more and more users and service providers gain access to the NAS-wide information service.

Oceanic Operations and Services. Today's oceanic capacity is limited by lack of direct radar surveillance, indirect communications through a third-party, high frequency (HF) operator, and very basic controller automation tools. Oceanic service providers use "time and distance" separation procedures and rely on periodic aircraft position reports relayed by a commercial service provider to oceanic ATC facilities. Some specially equipped aircraft fly flexible tracks in the Central Pacific and North Atlantic and are allowed limited user-preferred routes that reduce air miles, flight times, and fuel consumption. Because oceanic airspace lacks a surveillance system and real-time communication exchange between users and service providers, separation standards tend to be large, and navigation errors can be undetected.

As the NAS is modernized, the oceanic phase of flight will transition to Free Flight in conjunction with the rest of the NAS. As technology improves, users will transition away from tracks toward preferred trajectories in oceanic airspace, allowing airspace configuration to change dynamically, based on weather, demand, and user preferences.

Although control procedures and separation standards vary between domestic en route and oceanic sectors, future en route centers will capitalize on a common open systems hardware architecture, which will enable common standards to be established for both domestic and oceanic environments. New advancements in ATC technology will facilitate merging the historically separate domestic en route and oceanic control methods. Alternative acquisition strategies are being examined for meeting the long-term oceanic architecture goals.

Traffic Flow Management (TFM) Operations and Services. The TFM system organizes traffic nationally and locally to balance capacity and demand throughout the NAS. At airports, TFM determines and manages airport acceptance rates while taking into account conditions such as winds, severe weather, runway configuration, operations factors, and equipment outage.

In the future, TFM, in collaboration with users, will employ both ground delays and airborne flight metering to manage traffic to meet the airport/sector acceptance rate. Airport capacity will be allocated by arrival time, rather than the current controlled departure time slots. Users will determine what departure time is needed to meet that slot. Instead of being assigned arrival slots at specific times for each flight, each user will be allocated a block number of arrivals within an arrival window. Users will then determine which flights should depart to meet the arrival window.

TFM will designate airspace to be avoided in severe weather conditions, when traffic is very dense, or when SUA areas are active. It will designate routings into and out of major terminal areas where traffic or weather conditions complicate Free Flight profiles, and it will monitor all airspace to ensure that airspace will be available for general use when not reserved for military operations. Dynamic allocation of airspace to both civilian and military users will optimize use of this shared resource with minimum constraints. This requires strategic and tactical airspace management using information on planned and actual movements of aircraft in real time.

The TFM system will store and update data—such as user-preferred trajectories, weather information, dynamic density, airline schedules, and status of NAS systems—based on real-time input. It will provide NAS users and service providers with common situational awareness of weather and other information and an understanding of the availability of NAS resources.

The data will be integrated and disseminated to various automation tools and facilities. These automation tools will be used to create traffic management strategies to facilitate user-preferred trajectories and to accommodate other user needs and priorities. TFM decisions will be made at the most appropriate level—national, regional, or local—increasing efficiency across the NAS, independent of airspace boundaries.

Infrastructure Management Operations and Services. The performance of NAS systems need to be maintained to preserve NAS integrity and avoid air traffic delays or disruptions. NAS infrastructure management assures NAS performance by managing NAS equipment, facilities, systems, and the services they provide. The existing maintenance concept provides limited automation and requires annual increases in personnel resources to maintain the current level of services as the NAS increases in size and complexity.

NAS modernization will consolidate infrastructure management activities and provide services based on a national perspective rather than individual elements of the NAS infrastructure. It will increase the use of remote monitoring and control and facilitate collaboration between service providers and users by providing infrastructure status to the NAS-wide information network. This will allow users to participate in prioritizing scheduled and unscheduled repairs to essential NAS equipment.

Internal Agency Operations and Services. Many internal agency and related functions support, and need to evolve in conjunction with, NAS modernization. Regulation and certification processes must be reviewed to identify the timing of changes needed to support modernization. The acquisition process needs to be able to allow new technologies to be introduced rapidly.

Other processes critical to the success of NAS modernization include identifying and resolving human factors issues, providing proper training, certifying evolving avionics technologies, developing new procedures, implementing needed airspace changes, integrating airport and commercial space requirements, applying sound engineering principles, and applying sound business management principles.

Evolution of NAS Capabilities

NAS modernization, as previously described, will provide the capabilities to support enhanced user services. It is driven by safety issues, security management concerns, user benefits, and new technology. Modernization will help the FAA operate more efficiently and respond to user requests while controlling growth in staffing and maintenance activities. Both NAS users and the FAA will benefit from modernization. The modernization plan takes an aggressive approach to implementing new technology, which requires a time-phased approach and establishing new requirements and standards.

Several significant technological developments support the transition to Free Flight, as outlined in the NAS Architecture V4.0. The increase in automation in the cockpit and automated ATC decision support tools, coupled with data link communications, permit greater operational collaboration between NAS users and service providers. Augmented global positioning system (GPS) for navigation and the accuracy of position and time reporting for automatic dependent surveillance broadcast (ADS-B) support ground and air/air surveillance as the basis for the transition to Free Flight.

Key NAS Capabilities. Listed below are 17 key capabilities, which are summarized in the NAS Architecture, to support improved ATC and ATM operations and services. ATC capabilities include:

- Increased navigation and landing position accuracy and site availability
- Increased exchange of common weather data
- Improved aircraft positional accuracy reporting to service providers
- Increased self-separation by properly equipped aircraft
- Increased surveillance area coverage
- Increased digital voice and data communications among service providers and pilots
- Improved flight plan negotiations
- Improved arrival/departure sequencing and spacing for tactical traffic flow
- Increased flexibility in flying user-preferred routes
- Increased oceanic airspace capacity
- Improved surface traffic management
- Increased low-altitude direct routes
- Increased availability of aeronautical information to service providers and NAS users.

ATM capabilities include the following:

- Increased availability of aeronautical information to service providers and NAS users
- Improved collaborative decisionmaking (CDM) between service providers and NAS users for strategic planning
- Increased ability to support search and rescue activities
- Improved infrastructure maintenance management.

Risk Management. Because of numerous program changes and complex program interdependencies, it is important to monitor risks in NAS modernization. Two new programs, FFP1 and Safe Flight 21, are being implemented to help manage risks in developing and implementing improved NAS capabilities. FFP1 addresses risks for the ATM Decision Support Systems (DSS). This program is discussed under the topic “System Efficiency—Free Flight Phase 1 Investments.” Safe Flight 21 addresses risk management for the communications, navigation, and surveillance (CNS) systems (CIP programs M36 and S10).

NAS Modernization Phases. NAS modernization will be implemented in phases that will take into account both user benefits and safety factors. The FAA’s primary considerations are safety and security risk management; therefore, capability changes to the ATC system will be phased in. FAA considerations

Phase 1 (1998-2002)	Phase 2 (2003-2007)	Phase 3 (2008-2015)
Continue NAS modernization and implement limited Free Flight prototypes. Complete ATC DSS infrastructure sustainment and begin "opening" of systems such as Host, STARS, and TFM. Collaboration between AOC's and ATCSCC is underway. Begin Installing new infrastructure to support more precise position reporting and less structured routes. FFP1 CCLD deployed and procedural changes made to enhance operations.	**Continue NAS modernization and begin transition to Free Flight.** New "open" DSS systems are installed, and new CNS infrastructure being deployed. Free Flight concepts are implemented as procedural changes are made to take advantage of more collaboration with users.	**Achieve Free Flight operations.** New integrated ATC and TFM DSS tools allow greater sharing of 4-D flight profiles throughout the NAS, enabling greater flexibility and planning with users. Capacity is increased as more accurate position reports are incorporated onto DSS tools. Installation of CNS completed.
Key Technologies •CPDLC •WAAS/GPS •URET CCLD •ADS-B A/A •Passive FAST •STARS	Key Technologies •Limited NEXCOM •WAAS/LAAS •ADS-B Ground Stations •ITWS •STARS P³I •CP	Key Technologies •Full NEXCOM •Full CP •Next-Generation En Route Automation •A-FAST/WV •NAS Info System
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Figure 3-2. NAS Modernization Phases

also include the time necessary to develop, test, and evaluate evolving technologies before they can be implemented, as well as the economic life cycles of existing systems and the large, diverse fleets of domestic and international aircraft.

Phased evolution will allow technology and capabilities to be implemented such that during one phase a platform is provided for the next phase. Figure 3-2 identifies the three modernization phases, which are characterized as follows:

Phase 1: 1998 to 2002. Continue NAS modernization and implement limited Free Flight prototypes.

In this phase, current systems and services will be maintained while advanced services and upgraded systems are introduced. New technologies, such as the GPS Wide Area Augmentation System (WAAS), user request evaluation tool core capability limited development (URET CCLD), ADS-B, and Center TRACON Automation System (CTAS)—consisting of passive final approach spacing tool (pFAST) and traffic management advisor single center (TMA SC)—will be integrated through a logical series of changes.

Data link use will be expanded to include operational communications between pilots and controllers in en route airspace; however, voice communications will remain the primary method of information exchange during this period.

TFM will focus on building CDM support services that will allow the FAA to interact with airlines in real time to resolve traffic congestion. CDM capabilities will be enhanced by ration-by-schedule and control-by-time-of-arrival capabilities, which will augment current ground delay procedures. Additionally, AOC automation will be directly linked to FAA TFM to support real-time decisionmaking between airlines and the FAA.

Phase 2: 2003 to 2007. Continue NAS modernization and begin transition to Free Flight.

Phase 2 enhancements include updating and expanding CTAS, STARS preplanned product development (P^3I), and en route automation upgrades. STARS P^3I includes the capability to improve arrival traffic sequencing using time-based separation techniques. Factors such as maximum runway utilization rates, aircraft performance characteristics, and departure traffic schedules are taken into consideration to produce a constant and efficient flow of arriving traffic to the runway.

DSS's will determine the most advantageous descent point from cruise altitude, so each aircraft can fly the optimum descent profile for fuel efficiency. Airport, weather, TFM, and ATC system performance data will be available to aircraft via data link. FAA digital radios will provide increased data link capacity, introduced during this phase. This will permit the expansion of ATC data link services to accommodate the entire aircraft fleet.

Phase 3: 2008 to 2015. Achieve Free Flight operations.

Automation during this phase will fully integrate all technologies into the ATM system. This phase will introduce full implementation of digital communications and air traffic planning tools that incorporate weather prediction and advisories. The oceanic and en route domains will employ similar procedures and separation methods. A new, NAS-wide 4-dimensional flight profile will provide maximum flexibility and planning for users and service providers.

As the phase-in of new technology reaches completion, remaining obsolescent navigation systems will be retired. Increased capabilities of the modernized NAS will eventually allow increased capacity and VFR-like flight operations in IFR conditions.

NAS Modernization Investments and Strategic Goals Mapping

The remainder of this chapter focuses on linking capital investments with strategic goals.

NAS modernization supports the FAA mission and strategic goals. The modernization plan outlined in the NAS Architecture V4.0 includes comprehensive estimates for R,E&D; F&E; and OPS budgets for all agency personnel and programs through 2015. Therefore, costs have been estimated for all LOB and staff activities.

The NAS Architecture also includes some user cost estimates for avionics equipment. Cost estimates for the Airport Improvement Program (AIP) have not been included, although the AIP also contributes to FAA strategic goals. Also, other airport costs from state or local agencies have not been estimated. The NPIAS contains airport cost estimates. The FAA will work with all users and stakeholders to help identify NAS modernization impacts.

The current CIP includes program descriptions for F&E programs only. Table 3-1 maps CIP/Architecture programs to the FAA strategic goals that they support. The following discussions link the Architecture/CIP programs to the strategic focus areas.

Table 3-1. Relationship of NAS Architecture/CIP to FAA Strategic Goals

New CIP Number	Old CIP Number	Title	Safety	Security	System Efficiency	Environment	Global Leadership	FAA Reform	FAA Work Environment
A01		En Route Automation Program	X		X				X
A02		Tower Automation Program							
A03		Automated Radar Terminal System (ARTS) Improvements	X		X				X
A04		Standard Terminal Automation Replacement System (STARS)	X	X	X				X
A05		Air Traffic Management Program	X		X				X
A06	41-21	En Route Software Development (ERSDS)	X		X				
A07	23-01	Operational and Supportability Implementation System (OASIS) for Flight Service Automation System (FSAS)	X	X	X				
A08	43-21	Operational Data Management System (ODMS)	X		X				X
A10	61-23	Oceanic Automation Program (OAP)	X		X		X		
A13	32-16	Digital Bright Radar Indicator Tower Equipment (DBRITE)	X		X				
A14	56-23	Instrument Approach Procedures Automation (IAPA)	X		X		X		X
A15	56-24	Civil Aviation Registry Modernization	X						X
A17	56-51	Aviation Safety Analysis System (ASAS)	X	X					X
A18	56-68	Safety Performance Analysis Subsystem (SPAS)	X						X
A19	56-72	Portable Performance Support System (PPSS)	X						X
A20	66-21	Integrated Flight Quality Assurance (IFQA)	X						
A21		Conflict Probe	X		X				X
A22		Free Flight Phase 1 (FFP1) Integration	X		X				
A23		NAS-Wide Information Services	X	X	X				X
C01		Voice Switching and Control System (VSCS)			X				
C04	25-08	Radio Control Equipment (RCE)			X				
C05		Voice Switches			X				
C06		Communications Facilities Enhancement			X				
C09	44-05	Sustaining Backup Emergency Communications (BUEC)	X		X				
C10	44-07	Emergency Transceiver Replacement	X						
C11	45-02	Data Multiplexing Network (DMN) Continuation	X		X				
C12	45-05	Expansion/Reconfiguration of LDRCL	X		X				

Table 3-1. Relationship of NAS Architecture/CIP to FAA Strategic Goals (Continued)

New CIP Number	Old CIP Number	Title	Safety	Security	System Efficiency	Environment	Global Leadership	FAA Reform	FAA Work Environment
C14	45-20	Critical Telecommunications Support	X		X				
C15	45-21	FAA Telecommunications Satellite (FAATSAT)	X		X				
C17	45-24	Establish Alaskan NAS Interfacility Communication System Satellite Network	X		X				
C18	46-28	NAS Recovery Communication (RCOM)		X					X
C20	63-05	Aeronautical Data Link	X		X		X		
C21	64-01	Next Generation Air/Ground Communications System (NEXCOM)	X		X		X		
C22	64-17	Gulf of Mexico	X		X		X		
C23	62-11	Voice Recorder Replacement Program (VRRP)	X		X			X	
C24		FAA Skylinks	X		X				
C25		Automated Flight Service Stations Voice Switches (AFSSVS)			X				
F01		ATCT/TRACON Establishment/Sustainment/Replacement	X		X				X
F02		Large TRACON's	X		X				
F03	32-25	Austin-Bergstrom International Airport Program	X		X				
F04	32-27	DOD/FAA Air traffic Control Facility Transfer/Modernization	X		X				
F05	33-20	Flight Service Station Modernization		X		X			X
F06	46-09	ARTCC Plant Modernization/Expansion		X		X			X
F08	42-22	Sustain San Juan Facilities		X	X	X			
F10	46-05	Airport Cable Loop Systems Sustained Support		X	X				
F11	46-07	Power Systems Sustained Support	X			X			
F12	46-08	Modernize and Improve FAA Buildings and Equipment Sustained Support		X		X			
F13		NAS Facilities Occupational Safety and Health (OSH) and Environmental Compliance	X			X			X
F14	56-17	System Support Laboratory Sustained Support	X	X	X	X			
F15	56-18	General Support Laboratory Sustained Support	X	X	X	X			
F16	56-19	William J. Hughes Technical Center Building and Plant Support			X	X			
F17	56-70	Computer Aided Engineering Graphics Modernization			X	X			X
F18	56-30	Aeronautical Center Support Facilities	X			X			X
F19	56-33	Aeronautical Center Leases				X			
F20	56-54	Provide FAA Housing						X	X
F22	56-62	Child Care Centers						X	X
F23	46-09	Relocate Honolulu CERAP		X		X			X
F24		Facility Security Risk Management	X	X					
M02	26-19	Technical Support Services	X		X	X			
M03	36-13	Capital Investment Plan System Engineering	X	X	X	X	X	X	X
M04	36-23	NAS In-Plant Contract Support Services (NAS/IPCSS)			X				X
M05	36-24	NAS Regional/Center Logistics Support Services			X				X
M07		NAS Infrastructure Management System (NIMS)		X	X	X			X
M08	46-16	Continued General Support	X	X	X			X	X
M10	56-02	Distance Learning	X		X			X	X
M11	56-11	Aircraft Fleet Modernization	X		X		X		
M12	56-12	Aircraft-Related Equipment Program	X		X		X		
M13	56-16	Precision Automated Tracking System (PATS)			X				
M15	56-15	NAS Spectrum Engineering Management	X	X	X	X			
M17	56-27	Test Equipment Modernization and Replacement	X		X				

Table 3-1. Relationship of NAS Architecture/CIP to FAA Strategic Goals (Continued)

New CIP Number	Old CIP Number	Title	Safety	Security	System Efficiency	Environment	Global Leadership	FAA Reform	FAA Work Environment
M18	56-28	Computer Resources Nucleus (CORN) — Replaced by ICE-MAN			X				X
M20	56-35	NAS Training Modernization	X			X	X	X	X
M21		Asset Supply Chain Management	X		X			X	X
M22	56-47	NAS Implementation Support			X	X			
M24	56-52	National Aviation Safety Data Analysis Center (NASDAC)	X					X	X
M25	56-55	Independent Operational Test and Evaluation	X		X			X	
M26	56-56	NAS Management Automation Program (NASMAP)						X	X
M27	56-58	National Airspace Integrated Logistics Support (NAILS)						X	
M28	56-61	FAA Corporate Systems Architecture	X	X				X	X
M29	45-25	ATOMS Local Area Network/Wide Area Network			X			X	X
M31		NAS Information Security System (NISS)	X	X					
M33		Advanced Airport Security Systems	X	X	X				
M34		Airport Technology	X						
M35		General Aviation and Vertical Flight Technology	X						
M36		Alaska Capstone Initiative/Safe Flight 21	X						
M37		Cockpit Technology	X						
N03	34-06	Instrument Landing System (ILS)	X		X				
N04	34-09	Visual Navaids	X		X				
N05	44-12	Low-Power TACAN Antennas			X	X			
N06	44-14	VORTAC	X		X				
N08		Runway Visual Range (RVR)	X		X				
N09	44-30	Sustain Distance Measuring Equipment (DME)	X		X				
N10	44-32	Sustain Nondirectional Beacon (NDB)	X		X				
N11	44-35	Loran-C Monitors and Transmitter Enhancements	X						
N12		Augmentations for the Global Positioning System (GPS)	X		X	X	X		
N13		Transponder Landing System (TLS)	X						
S01		Airport Surface Detection Equipment (ASDE) and Airport Movement Area Safety System (AMASS)	X		X		X		
S02		Secondary Surveillance	X		X				
S03		Terminal Radar Program	X		X				
S04		Long-Range Radar Program	X	X	X				
S05	44-42	Long-Range Radar Radome Replacement			X				
S08	64-27	Precision Runway Monitor	X		X				
S09		Runway Incursion Reduction Program (RIRP)	X		X				
S10		Automatic Dependent Surveillance Broadcast (ADS-B)	X						
W01		Aviation Surface Weather Observation Network (ASWON)	X		X		X	X	
W02		Weather Radar Program	X		X				
W03	24-18	Terminal Doppler Weather Radar (TDWR) System	X		X				
W04		Weather and Radar Processor (WARP)	X		X			X	
W05		Low-Level Windshear Alert System (LLWAS)	X		X				
W06	43-13	Digital Altimeter Setting Indicator Replacement			X				
W07	63-21	Integrated Terminal Weather System (ITWS)	X		X			X	
W09	64-13	ASR Weather Systems Processor (ASR-WSP)	X		X				

Safety Functions and Investments

Aviation safety is the top priority of NAS modernization, which enhances safety through more effective risk management in critical areas of the aviation system. Recently, the FAA's focused safety agenda, "Safer Skies," identified high-priority safety concerns; its safety objective is to reduce accidents fivefold over the next decade. The NAS Architecture V4.0 identifies how safety risk management strengthens several of these high-priority areas by reducing the potential for controlled flight into terrain and runway incursions, improving flow control of approach and landing operations, and providing better weather information. Also, systematically integrating human factors engineering activities into every phase of NAS modernization will enhance safety.

Strategic focus areas for the FAA Strategic Plan safety mission goal include streamlining regulation and certification activities; enhancing safety information collection, sharing, and analysis; supporting surveillance and inspection activities; and providing information to aid in accident prevention.

CIP programs that support the safety mission area include the Aircraft Fleet Modernization program; Aircraft Related Equipment program; and automated safety information systems, including the NAS Data Analysis Center (NASDAC), Aviation Safety Analysis System (ASAS), Safety Performance Analysis System (SPAS), Portable Performance Support System (PPSS), Integrated Flight Quality Assurance (IFQA) tools, and the Instrument Approach Procedures Automation (IAPA) program.

The FAA Corporate System Architecture (CSA) program supports certification of software for air and ground systems. The proposed Runway Incursion Reduction Program (RIRP), and the airport surface detection equipment (ASDE) Radar/Airport Movement Area Safety System (AMASS) program will provide information to NAS service providers and users to enhance the reduction of incidents and accidents attributable to runway incursions.

In addition, several CIP programs discussed under "System Efficiency—NAS Modernization Functions and Investments" support the safety goal.

Security Functions and Investments

Strategic focus areas for the security goal include information security, facility security, and development of a domestic aviation security baseline. CIP projects support all security strategic focus areas.

Information Security. The President's Commission on Critical Infrastructure Protection (PCCIP) report of October 1997 lists transportation first among the eight national infrastructures. The PCCIP describes these national infrastructures as collectively dependent on fragile computer and communications systems confronted by an array of dangerous threats to their availability and integrity. Presidential Decision Directive (PDD-63), signed by the president on May 22, 1998, assigns Federal agency responsibilities for responding to the security findings of the PCCIP. PDD-63 specifically directs the FAA to develop and implement a comprehensive information systems security (INFOSEC) program to protect the NAS.

The FAA is defining a NAS information security architecture that will be an integral part of NAS modernization. The NAS Information Security System program has been established to support this effort. The information security architecture will specify the framework, policies, operational concepts, and security engineering methodologies to minimize the vulnerability of NAS information to loss, misuse, or unauthorized access. Security capabilities will be built into NAS systems currently being developed. As part of this effort, the interfaces with administrative systems will be addressed. The FAA CSA program addresses other administrative security issues.

Facility Security. All elements of the FAA's critical infrastructure need physical facility security protection. As a Federal agency, the FAA and its facilities are required to comply with minimum facility security standards identified in the June 1985 Department of Justice (DOJ) report, *Vulnerability Assessment of Federal Facilities*. The FAA is currently conducting facility physical security surveys and assessments to identify critical security risks. The surveys will lead to risk-reduction measures, ensuring that each facility meets baseline security standards identified in the DOJ report and FAA Order 1600.6C, FAA Physical Security Management Program.

The FAA is also implementing security monitoring and control systems in its ARTCC's. Capital investments supporting this focus area are the Integrated Security Management System and the new Facility Security Risk Management program.

Domestic Aviation Security Baseline. The FAA is responsible for establishing and enforcing Federal Aviation Regulations (FAR) for airport security. The principal guidelines governing airport security are found in FAR Part 107, which sets forth specific requirements for airport security programs, physical security and access control, and law enforcement support. The airport may be public or private and operated by the city, county, state, or specialized airport authority. Airport ownership also shapes the law enforcement support structure, with the primary organization providing this support being state and local police forces, or in some cases, special airport authority police. Regardless of the law enforcement organization, the FAA requires a specific level of security service as specified in FAR Part 107.

The FAA has formed a joint FAA/industry IPT composed of acquisition and security experts to implement recommendations by the White House Commission on Aviation Safety and Security to purchase and install advanced security equipment for use by air carriers at major domestic airports. The Advanced Airport Security Systems program has been established to support this effort.

System Efficiency—NAS Modernization Functions and Investments

Strategic focus areas for the system efficiency goal include NAS modernization, Free Flight, and system integration. CIP programs supporting these areas are outlined in the following discussions.

Information Services for Collaboration and Information Sharing. The NAS will transition from collaboration based on limited information and data sharing to a full NAS-wide information service. The service will have common data standards and protocols and will support automated information exchange among systems and between authorized NAS user and service providers. A CIP program is being developed to support this new service as part of the joint FAA/industry concept of operations (CONOPS).

Traffic Flow Management (TFM) Automation. The modernized TFM architecture will provide TFM through an information-rich, collaborative system with advanced decision support capabilities. Increased automated exchange of information and CDM between service providers and users will facilitate more dynamic, adaptive traffic flows. Programs are currently underway to provide en route, oceanic, and terminal automation systems, which are platforms for NAS TFM capabilities. These platforms and displays are the foundation to providing user benefits.

The modernized TFM system will allow seamless interaction between TFM and other NAS service providers. For TFM specialists, automation will facilitate information sharing, NAS performance monitoring, and better management of the impact of demand-capacity imbalances. Common information services will be provided by national and local applications, and integrated national TFM applications will be developed and merged with existing applications. Several TFM CIP projects are in progress.

Open-systems hardware and software will replace the existing Enhanced Traffic Management System (ETMS) to reduce the cost of system development and future upgrades.

New TFM capabilities will be provided via phased upgrades of infrastructure and applications, including Data Exchange, CDM, NAS Analysis and Prediction, and Departure Flow Management.

New ATC capabilities will be provided through decision support tools for surface, terminal, and en route ATC, which include CTAS/(pFAST, CTAS/TMA, surface management advisor (SMA), and descent advisor (DA)).

En Route Automation. Modernizing en route automation systems requires replacing existing radar and flight data processors and their associated displays. It also requires new applications for conflict detection to support the accommodation of user-preferred routes.

The Display System Replacement (DSR) project replaces the aging en route controller consoles and display channel equipment with new, color workstation consoles. The Host interface device/NAS local area network (HID/NAS LAN) will provide a network infrastructure for ATC and TFM capabilities. New capabilities, such as CTAS, will access the Host via the HID/NAS LAN. The Host computer will be replaced by the Host/oceanic computer system replacement (HOCSR) program to solve current supportability and potential year 2000 problems. Other CIP en route automation programs will replace the direct access radar channel (DARC) and the peripheral access module replacement item (PAMRI). The En Route Domain Infrastructure (ERDI) program will sustain and upgrade en route systems to meet supportability, capacity, and functional requirements.

Oceanic and Offshore Automation. Technical advances in automation and in satellite communications and navigation offer the opportunity for increasing user flexibility while increasing capacity and safety in the oceanic domain. Oceanic architecture will provide the flexibility to change flight trajectories in response to wind-optional routes, rather than having to adhere to predefined routes. Oceanic service providers will have situation displays or traffic in oceanic airspace and DSS tools, allowing procedural separation from the displays at reduced separation minima.

Pilots will have a cockpit display of nearby traffic received via ADS-B from other aircraft. Both pilots and service providers will be able to initiate and exchange data link messages via satellite communications of HF data link.

The role of the oceanic service provider will evolve from procedural separation using paper strips to procedural separation employing situation displays and controller decision support system tools for separation and strategic planning.

NAS-wide information sharing will facilitate collaboration between national and international service providers to determine the daily airspace structure (based on weather, demand, and user preferences), identify and explore alternatives to capacity problems, and manage traffic flow at gateway entries.

The HOCSR project will replace the Oceanic Display and Planning System (ODAPS) hardware and the Offshore Flight Data Processing System (OFDPS) hardware.

Terminal Automation. Modernizing terminal automation requires replacing terminal radar data processing systems and their associated display systems. It also requires implementing decision support systems that support flexible satellite-based departure and arrival route structures.

The Standard Terminal Automation Replacement System (STARS), jointly sponsored by the FAA and the DOD, will replace all terminal automation systems. STARS, an all-digital air traffic control automation system, is based on an open system architecture that supports new ATM functions.

STARS P^3I (for example, interfaces, surveillance processing enhancements, improved weather displays, and data link) will be introduced to support new ATM functions. A local information system will provide the capability to exchange terminal-related information across the NAS.

Tower/Surface Automation. The degree of modernization required at an ATCT is determined by the combination of traffic volume and complexity of airport operations.

STARS will provide a tower display workstation (TDW) to support the tower. The TDW is the basis for integrating applications in the tower. It will provide a combined display of surface and airborne traffic, runway incursion alerts from the AMASS, graphic weather overlays, and traffic flow management information. New information display systems (IDS) will display status and control information (for example, lighting, nongraphic weather information, and electronic flight data, including predeparture clearance). Selected towers will have conflict alert processing for surface vehicle and aircraft incursions, and decision support tools.

Flight Service Automation. The modernized flight service station will increase pilot self-reliance through a computer network that will allow pilots to acquire preflight briefings, file flight plans (VFR and IFR), obtain in-flight weather reports, and secure flight following services.

The Operational and Supportability Implementation System (OASIS) for the Flight Service Automation System program will be implemented in the near term. OASIS will be a leased service that will replace obsolete Flight Service Automation System (FSAS) equipment and software. It will also incorporate existing direct user access terminal (DUAT) service functions and Graphical Weather Display System (GWDS) functions. OASIS enables increasing emphasis on pilot self-reliance for preflight services; however, some level of human assistance will always be available to pilots. The national flight service workload will be balanced and redistributed in accordance with daily weather conditions and seasonal demands (dynamic flight advisory areas).

Communications. To modernize communications systems, resolve deficiencies, and meet future needs, the ground/ground network will be fully digital and integrated to provide both voice and data capabilities, as well as information and control. The network will carry both operational and administrative communications over the same physical network and will enable information sharing among all NAS users.

ARTCC's will be equipped with digital voice switches, and modularly expandable digital voice switches will replace terminal and flight service station switches.

Next generation air/ground communications (NEXCOM) digital radios will be used to meet air/ground communications requirements. A CIP program has been established for this effort. NEXCOM ground radios will be initially installed as analog systems and then switch to digital without requiring replacement of the physical radio. The military will continue to need ultra high frequency (UHF) analog radios.

Modernization will expand data link capabilities to exchange alphanumeric and graphic information between NAS ground systems and the cockpit. The Aeronautical Data Link (ADL) program supports this effort.

Data link capabilities will be expanded in the terminal/tower environment, and data link services will be introduced to the en route environment. Two-way data link and broadcast-mode data link capabilities will be provided. The Tower Data Link System will continue to operate at towers. Initial data link capability will be achieved using a commercial service provider.

Future data link applications may use satellite transmissions, depending on system performance and cost of this emerging technology. New services supported by data link include flight information service (FIS), traffic information service (TIS), and controller-to-pilot data link communications (CPDLC).

Navigation and Landing. The NAS will transition from ground-based navigational aids to satellite navigation to modernize navigation and landing capabilities, resolve current deficiencies, and meet future needs. The satellite-based system consists of the GPS, augmented by systems being developed by two CIP projects, WAAS and Local Area Augmentation System (LAAS). The satellite-based navigation and landing systems will provide the basis for NAS-wide direct routing, provide guidance signals for precision approaches to most runway ends of public use airports in the NAS, and reduce the variety of navigation avionics required aboard aircraft.

Surveillance. To modernize surveillance and meet future needs, aging analog radars are being replaced by new digital radars; automatic dependent surveillance using GPS data will be implemented; and radar data sharing will be expanded between terminal and en route systems.

New digital radars and surveillance distribution will be used to share terminal radar data with the ARTCC's, which will allow the FAA to maintain airspace coverage with fewer radars in the en route environment. The ADS-B system relies on GPS satellites as a source of aircraft position and velocity data, broadcasting aircraft position to other aircraft and the air traffic control system.

Weather. Modernized aviation weather systems will provide weather information to NAS users via tailored broadcasts over a common network as well as via voice. The weather information will include graphical, textual, and voice data; gridded weather products; and current and forecast data. Aircraft and controllers will receive time-critical information simultaneously and, thus, will have common situational awareness.

Windshear detection will be improved by using the airport surveillance radar-windshear processor (ASR-WSP). The Terminal Doppler Weather Radar (TDWR) situation display will be replaced by the Integrated Terminal Weather System (ITWS), which integrates windshear, microburst, and gust front alphanumeric and graphic products to provide improved automated weather information and predictions to controllers. The Weather and Radar Processor (WARP) will be deployed to convert weather data from next generation radar (NEXRAD) and other sources for display to controllers at their ARTCC's. Safe Flight 21 will demonstrate and evaluate delivery of similar weather products directly into the cockpit.

NAS Infrastructure Management. The NAS infrastructure management modernization will improve workforce efficiency and provide centralized, remote monitoring and maintenance of communications, navigation, and surveillance systems; weather sensors; and other systems, such as the ATM DSS's.

The NAS Information Management System (NIMS) program will implement a three-tiered management system. A national operations control center will furnish overall management and direction. Four operational control centers will monitor, prioritize, and direct maintenance activities within their geographic areas, while multiple work centers in each geographic area, staffed by maintenance technicians, will perform onsite maintenance.

The ability to prioritize maintenance actions on the basis of impact on ATC service delivery is a key feature of the modernized maintenance system. Remote monitoring and control of NAS assets will allow the operational staff to take corrective action without dispatching field personnel, which will enable more efficient use of maintenance personnel. Additionally, before field maintenance personnel are dispatched, they will be able to make more informed decisions regarding the tools, test equipment, and repair parts needed.

NIMS will also provide a common repository of maintenance data for monitoring and evaluating NAS performance (i.e., reliability, maintainability, and availability). This data will be shared with service providers and users for internal planning and collaborative maintenance and operational decisions.

Facilities and Associated Systems. Buildings and structures that house and support FAA personnel and equipment need to be modernized or expanded to support ATM system modernization. For example, power systems need replacing; heating, ventilating, and air-conditioning systems need refurbishing; and DOD facilities that are being transferred to the FAA must be upgraded. Many ATCT's are beyond useful life. Many terminal facilities are extremely limited in space and represent a significant maintenance challenge. The 21 ARTCC's are 40 years old. While some of the unmanned facilities can be decommissioned with transition to satellite-based navigation, facility work must continue to extend useful life.

NAS modernization efforts will continue to sustain, modernize, and replace FAA buildings consistent with the NAS modernization schedule. CIP programs will provide new ATCT's and large TRACON's to support increased capacity and demand. Flight service stations, ARTCC's, NAS support facilities, and structures that house navigation, communications, and surveillance systems will be modernized and improved, as needed, to support the new NAS infrastructure.

Systems Integration—Mission Support. Among the key functional disciplines required to execute NAS modernization are support services for NAS Architecture development, system integration, spectrum engineering, procedures development, training, testing, logistics, system analysis, engineering, design, implementation, and maintenance.

Information technology programs need to be established or enhanced to ensure access to information that will facilitate management of NAS modernization. CIP programs supporting this area include continued contract support for system integration and implementation, technical services, and support leases; NAS Spectrum Engineering Management; Asset Supply Chain Management (including National Bar Coding); Test Equipment Modernization and Support; NAS Training Modernization; Operational Data Management System, Independent Operational Test and Evaluation; and other programs identified under "FAA Reform and Work Environment."

System Efficiency—Free Flight Investments

Free Flight is one of the major system efficiency focus areas of the FAA Strategic Plan. Free Flight will allow aircraft operators to choose routes, speeds, altitudes, and tactical schedules in real time.

In Phase 1 of the NAS Architecture, FFP1 will be deployed in selected ATC facilities to obtain early benefits for NAS users and service providers. FFP1 comprises a limited deployment of automated decision support, communication, and traffic flow planning tools as a subset of ATM capabilities. FFP1 will require support from the HOCSR, DSR, and STARS.

The FFP1 automated decision support tools consist of the following CIP projects:

- Air Traffic Management program (CTAS/TMA; CTAS/pFAST; CDM; and SMA)
- Conflict Probe program (URET CCLD)
- FFP1 Integration program (integrates FFP1 and provides such supporting infrastructure as procedures development, training, and en route automation software enhancements).

FFP1 is a subset of NAS modernization activity, and other modernization activities will continue according to the relevant program plans, as described in this document. This parallel development results in architectural and programmatic dependencies between FFP1 and certain other NAS modernization efforts that need to be aggressively managed.

System Efficiency—
User Operational Integration

The FAA is establishing programs to support user integration with NAS modernization, and work has begun in three areas.

Avionics Integration. Avionics is the electronic link between aircraft and the NAS. It includes displays, navigational signal receivers, surveillance transponders, and radios for communications. Cockpit displays will provide information in textual and graphical formats, including ATC clearances and messages. Moving maps with terrain and weather overlays will present positional and weather information.

Avionics and NAS equipment must interoperate domestically, and avionics equipage must take into account international interoperability. To fully benefit from the modernized NAS, users—who bear avionics costs—will need to equip with the necessary avionics to receive, process, and display data. The NAS Architecture V4.0 provides schedules to support avionics equipage and estimates of avionics costs.

Airports Integration. Airports have a complex interrelationship with the other NAS components. Therefore, good communications among FAA, state, and local officials are essential for NAS modernization to enhance airport system performance.

Capacity enhancements are expected as a result of planned new runway construction at certain airports and also from such ATC improvements as the CTAS/pFAST ATC spacing and sequencing tool that promotes a more efficient flow of air traffic. The effects of these improvements will vary from airport to airport, and site-specific analyses are needed to provide a reliable estimate of the combined effect of all anticipated improvements. Other airport improvements include new GPS-based approaches, new surveillance systems, and increased information sharing and collaboration.

The FAA is currently developing an operational concept to integrate airport needs into the NAS Architecture.

Commercial Space Transportation Integration. The U.S. commercial space transportation industry is growing. The expected growth of the commercial launch industry, coupled with the anticipated growth in air travel, will create aggressive competition for a finite amount of airspace capacity. This outlook dictates reexamination of the agency's approach for satisfying user demands for NAS services.

The FAA has commenced an effort, led by Commercial Space Transportation (AST), to fully and seamlessly integrate new and existing space transportation operations into the NAS. The first task, in progress, is to complete a concept of operations document. In the future, this operational concept will be reflected in the NAS Architecture.

FAA Reform and Work Environment Functions and Investments

FAA is reforming its business practices to emphasize acquisition management, personnel management, and financial management. The FAA is also enhancing its work environment to aid in achieving its mission goals. CIP programs that support acquisition, personnel, or financial reform, or the FAA work environment include: Acquire, the new acquisition information system that supports the AMS; Acquisition Process Streamlining; NAS In-plant Support Services; NAS Regional/Center Logistics Support Services; the Resource Tracking Program (RTP); NAS Management Automation Program (NASMAP), Air Traffic Operational Management System (ATOMS), NAS Training Modernization, and the Corporate System Architecture.

These programs assist the FAA in improving its business processes, obtaining timely management information, and enhancing the FAA workforce. Other programs identified under the system efficiency topic also support these mission areas.

Environment and Energy Functions and Investments

The FAA must reduce the environmental impact of aerospace in ways that do not constrain aviation and commercial space transportation activities. CIP environmental projects support the strategic focus area of quantifying and mitigating environmental impacts of FAA internal activities. These projects include: Environmental, Occupational Safety and Health, and Energy Conservation Compliance; Environmental Cleanup; and Fuel Storage Tanks. The FAA has established these comprehensive agencywide projects to ensure that mandated requirements are incorporated into FAA operations.

Global Leadership Functions and Investments

Strategic global leadership focus areas include international safety oversight, global safety action plan, global CNS/ATM development and implementation, and international regulatory harmonization. Several capital investment programs identified for safety, security, and system efficiency support the global leadership goal. The FAA has briefed the International Civil Aviation Organization (ICAO) on the NAS Architecture. The agency has also entered into formal intergovernmental agreements with EUROCONTROL to collaborate on aviation architecture work, and the FAA and EUROCONTROL have held several successful joint architecture meetings.