Research and Technology

Program Plan

Airspace Systems Program (ASP)

Version 2.0

It is the responsibility of each of the signing parties to notify the other in the event that a commitment cannot be met, and to initiate the timely renegotiations of the terms of this agreement.

____ _______________
Dr. John Cavolowsky — Date
Program Director
Airspace Systems Program

____ _______________
Dr. Jaiwon Shin — Date
Associate Administrator
Aeronautics Research Mission Directorate

Table of Contents

LIST OF TABLES

RESEARCH AND TECHNOLOGY
PROGRAM PLAN
AIRSPACE SYSTEMS PROGRAM

1.0 PROGRAM OVERVIEW

This Program Plan is organized into two primary sections, the main body and a set of appendices. The appendices contain information that will be updated at least annually, including the Airspace Systems Program (ASP) President's Budget and the associated Annual Performance Goals (APGs). Any change to the main body would result in a new review and signature process. Information in the appendices will be updated as appropriate by the ASP to ensure that they are current. These updates do not require a new signature process unless the change reflects a significant redirection of the program.

1.1 INTRODUCTION

The Airspace Systems Program (ASP) performs foundational air traffic management research to enable the development of revolutionary improvements to, and modernization of, the NAS, as well as the introduction of new systems for vehicles whose operation can take advantage of the improved, modern air traffic management (ATM) system. The benefit to the flying public from ASP research, although clearly focused on development of capabilities that enable more efficient operations and reduce flight delays, will be realized as a reduction in doorstep-to-destination trip duration.

In order to achieve these revolutionary improvements, ASP has taken a leadership role in NASA's partnership with other agencies supporting the Joint Planning and Development Office (JPDO). The JPDO has outlined the vision of the NextGen by developing a concept of operations (ConOps), an Integrated Work Plan, and an Enterprise Architecture to achieve NextGen. ASP research is focused on achieving the vision of NextGen through a strategy that includes: accommodating projected growth in air traffic while preserving and enhancing safety; providing all airspace system users more flexibility and efficiency in the use of airports, airspace, and aircraft; meeting U.S. civil aviation, national defense, and homeland security needs as a national priority; and maintaining pace with a continually evolving scientific and technical environment.

ASP is comprised of two projects: NextGen Concepts and Technology Development (CTD) and NextGen System Analysis, Integration, and Evaluation (SAIE). The two projects are formulated to make major contributions to air traffic needs of the future through the development and research of foundational concepts and technologies and their analysis, integration, and maturation in relevant, system-level environments. Both projects are, much like the airspace system itself, highly integrated and pay close attention to critical system integration and transition interfaces in the NAS.

Additionally, NASA provides workforce, analysis tools, and funding directly to the JPDO in order to assist with the JPDO's responsibility of planning, coordinating, and overseeing the research and implementation for NextGen. For ASP, this includes providing subject matter expertise supporting the development of detailed operational concepts and leadership of JPDO divisions and working groups, along with participation on special study teams.

The program, in collaboration with each of the projects, has established a discrete set of technical challenges for each project that represents the specific areas of emphasis in which NASA research efforts will have impact. These technical challenges serve to focus the project efforts. Some technical challenges may be applicable to more than one project. They are largely multi-disciplinary and require the integrated technical efforts of researchers, technologists, and managers across multiple aeronautics Centers.

1.2 PROGRAM GOALS, OBJECTIVES AND METRICS

To achieve the NextGen vision, the systems and processes of today's National Airspace System (NAS) must be rigorously and systematically transformed through the sustained, coordinated, and integrated efforts of many stakeholders. The transformation will be achieved through the deployment of new operational concepts and capabilities, twenty-first century technologies, and ASP's long-term transformations to the national system of airports. The program's role in supporting this vision is established with guidance from the NASA 2006 Strategic Plan, the NASA 2011 Strategic Plan, the 2010 National Aeronautics Research & Development (R&D) Plan, and Aeronautics Research Mission Directorate principles.

In support of NASA Strategic Goal 4, ASP targets ARMD Performance Outcome 4.1 develop innovative solutions and advanced technologies through a balanced research portfolio to improve current and future air transportation.

ASP is also closely aligned with the 2010 National Aeronautics R&D Policy and Plan that provides "high-level guidance for foundational, advanced aircraft systems, and air transportation management systems R&D through 2020." The ASP technical content directly supports the needs identified in this National Plan and provides a strategy to enable stable and long-term fundamental research necessary to achieve the advances and breakthroughs. While ASP technologies can have a widespread impact, the program portfolio is primarily aligned with the following goals from the National Aeronautics R&D Plan:

- Mobility Goal 1: Develop reduced aircraft separation in trajectory and performance-based operations.
- Mobility Goal 2: Develop increased NAS capacity by managing NAS resources and air traffic flow contingencies.
- Mobility Goal 3: Reduce the adverse impacts of weather on air traffic management decisions.

- Mobility Goal 4: Maximize arrivals and departures at airports and in metroplex areas.

- Mobility Goal 5: Develop expanded manned and unmanned aircraft system capabilities to take advantage of increased air transportation system performance.

- National Security Goal 6: Develop capabilities for UAS NAS integration.

- Aviation Safety Goal 2: Develop technologies for manned and unmanned systems to reduce accidents and incidents through enhanced aerospace vehicle operations on the ground and in the air.

- Energy and Environment Goal 2: Advance development of technologies and operations to enable significant increases in the energy efficiency of the aviation system.

- Energy and Environment Goal 3: Advance development of technologies and operational procedures to decrease the significant environmental impacts on the aviation system.

In line with the above goals, the objectives of ASP are to:

- Perform research to enable new aircraft system capabilities and air traffic technology to increase the capacity and mobility of the Nation's air transportation system.

- Perform research to maximize operational throughput, predictability, efficiency, flexibility, and access to the airspace system while maintaining safety and environmental protection.

- Explore and develop concepts and integrated solutions to define and assess the allocation of centralized and decentralized automation concepts and technologies necessary for NextGen.

In order to meet these objectives, ASP uses APGs, the High Priority Performance Goal (HPPG) and program milestones to track program performance. The technical challenges are associated with achieving the previously discussed goals and objectives. These technical challenges are closely linked with specific areas of research within the program portfolio and are in Appendix A.

ASP's support of the Agency Strategic Plan is captured in the APGs.   These APGs are reported to the Agency with the Performance and Accountability Report. The milestones identified as APGs are challenging, pivotal, specific, measureable, and have a set deadline.

ASP is also supporting NASA's contribution to building a transparent, high-performance government. This contribution is measured and tracked by means of NASA's HPPGs. These HPPGs are of high direct value to the public, reflect achievement of key agency missions, require coordination across multiple agencies, and are significant challenges unlikely to be overcome without a concerted focus of agency resources.

Lastly the program designates specific activities as program milestones. Program milestones can be research milestones or milestones associated with demonstrations, field trials, development of specific analysis tools or other critical steps in the research process. The APGs, HPPG and program milestones are all closely linked to the technical challenges and are contained in Appendix B.

These goals and principles guide NASA's commitments to mastering the fundamental technology of ATM, and to focus NASA's unique research capabilities in areas that have the potential to expand the application of future aircraft in an advanced ATM operational environment for the greatest national benefit. As the Airspace Systems Program pursues its goals and objectives, it maintains a steadfast commitment to safety and mission success.

More information about the Agency and HPPGs goals can be found on the NASA and Office of Management and Budget websites. For more information about ASP, please see *http://www.aeronautics.nasa.gov/programs_asp.htm*.

1.3 CUSTOMER/BENEFICIARY AND STAKEHOLDER DEFINITION AND ADVOCACY

The principal beneficiary of ASP research is the American public which desires a safe, predictable, affordable and efficient air travel experience. Program stakeholders include the portions of Federal Agencies, Industry, and academia that govern, manage, provide and improve air transportation services. This "air transportation community" includes the air transportation industry, (including the major commercial airline companies), as well as a host of smaller corporations and subcontractors, the academic research community, the airport authorities, the aircraft manufactures, state and local airport authorities, and their systems suppliers, existing and new commercial aviation operators, the aircraft developers and their system suppliers and, by extension, the users of the services that all of these entities provide.

These beneficiaries and stakeholders are also ASP's strongest advocates. These groups recognize the constrained state of the current system, the magnitude of the challenges of this transformation to NextGen and see ASP as part of a national team working to address those challenges. Program engagement with this community is described in Section 3 of this plan.

Development of integrated solutions for NextGen requires that a breadth of scientific and technical skills be present in our workforce. Consequently, research within ASP includes long-term investments in cutting-edge research in traditional aeronautics disciplines, as well as new emerging disciplines and multi-disciplinary coupling and interaction across many fundamental disciplines. Because of these requirements, ASP maintains a vested interest in not only the near-term availability of researchers but a need for researchers in the next generations. Consequently, the research performed by academia not only benefits educational goals, but forms the foundation for future ASP researchers, stakeholders and future advocates and supports "*the development of a world-class aeronautics workforce,*" as described in the R&D Policy.

1.4 PROGRAM AUTHORITY AND MANAGEMENT STRUCTURE

The authorization to proceed with the ASP is documented in the original PCA, signed in July 2007 by the ARMD Associate Administrator (AA) or the Mission Directorate AA and the NASA Associate Administrator. The ASP and all projects within the program are governed by NPR 7120.8, *NASA Research and Technology Program and Project Management Requirements*. The governing Program Management Council (PMC) for the ASP is the Agency PMC with oversight responsibility delegated to the ARMD AA, who also is the approval authority for addition of new projects. Execution of this oversight responsibility will be accomplished through the use of independent assessments, as well as regular program status meetings and reviews.

Program management authority is delegated from the ARMD AA to the ASP Program Director (PD) who resides at NASA Headquarters. Responsibilities of the PD include setting top-level goals and objectives, establishing program direction and structure, and assigning projects to NASA Centers. In addition, the PD will define, fund, and evaluate program implementation to ensure that technical outcomes meet program-level goals and objectives, schedules, and cost.

The PD reports directly to the AA and oversees program portfolio formulation, implementation, evaluation, and integration of results with other ARMD/NASA Programs. The PD has the authority, accountability, and responsibility to manage the Airspace Systems Program risks so that the Program meets all funding, technical and schedule requirements. Staff at NASA Headquarters supports the PD and includes:

- The Deputy PD is responsible to the PD for the formulation, implementation, and execution of the Program.
- The Technical Integration Manager (TIM) is responsible to the PD for the overall technical consistency and coherence of the program and the development and management of policies, procedures, and operational schedules for formulation and execution of the projects.
- The NextGen Technical Integration Manager is responsible to the PD for assuring integrity of the program schedule with focus on cross-project integration and tracking milestone progress and technical performance progress against the program and project plans.
- The Program Integration Manager is responsible to the PD for the management of Program budget and resources, and programmatic operations.
- Program Management Specialist is responsible to the PD for execution of program management activities.

The ASP consists of two R&T portfolio projects whose portfolio investment is guided by a set of technical challenges that capture the high priority, revolutionary improvements to, and modernization of, the NAS. The ASP projects are managed as R&T portfolios but with select areas that may have content typical of technology development projects. Each project is organized around the key research focus areas necessary to overcome the predominant technical challenges within the ATM system. Each ASP project is led by a project manager using a multi-Center team that is responsible to the PD for developing and executing a project plan to ensure successful achievement of technical objectives within schedule and resource guidelines.

The NextGen CTD and NextGen SAIE project leadership teams are made up of the Project Manager (PM), Deputy Project Manager (DPM), Project Scientist (PS), Deputy Project Manager for (DPMF) Ames and DPMF Langley, and multiple task leads. While the PM, DPM, and PS, reside at Centers, their functions are to provide a broad agency view with respect to the accomplishment of project objectives. The task leads have the technical expertise to address the specific technology challenges in their respective RFAs. The budget-performance integration aspect of the project RFAs is managed by the DPMFs. The DPMFs support both projects at their Centers. Specific responsibilities and duties for each of the project management staffs are contained in their respective project plan. In addition, the Project Manager and inter-Center team are dependent on their respective Center management structures for successful implementation. The Center Director is accountable to ensure that institutional resources are providing adequate support for execution of activities performed at their Center. Note that this is a transition in the title of the Project Lead for ARMD Projects from Principal Investigator to Project Manager.

The ASP projects are being executed principally at two NASA Centers: Ames Research Center (ARC) and Langley Research Center (LaRC), through collaboration with a variety of external partners. ARC is the host center for both ASP projects.

NASA Centers are not consistent in organizational structure or naming conventions. In general, under the guidance of the Center Director (CD), the Center has the authority, accountability, and responsibility for the technical excellence of its personnel and capabilities, and implements the elements of the Project milestone records assigned and executed at that Center. The ARMD Center Point of Contact (POC) is responsible for overall Center resource commitment in support of the project plans. The research managers (a generic term for branch managers, division managers, etc.) are responsbile for support of milestone records implementation at their Centers with regard to research conducted within their organizations.

ASP has formulated an ASP Portfolio Panel (APP) to evaluate research concepts and or technologies both within or as new candidates for the program's portfolio. Specifically, the APP will review progress and maturity of ASP research activities (tools, concepts, and technologies), evaluate new candidate research concepts for seed funding/investment, evaluate partnering opportunities for collaboration (partnerships, technology demonstrations, field tests), evaluate concepts as candidates for system level integration, evaluate research activities life cycle (research initiation, transition and termination) and recommend future actions/research paths. Additionally, APP members participate in key decision points and the review of experiment and demonstration plans.

The APP consists of the following members:

- NextGen TIM – Panel Chair
- Deputy Program Director, ASP
- Airspace Systems Program TIM
- Senior Research Advisors (4 from Centers)
- POC Representative from each Center (ARC and LaRC)

The APP will meet at the direction of ASP Program Director, to address changes in the research portfolio or available resources.

2.0 PROGRAM BASELINE

2.1 PROGRAM REQUIREMENTS/OBJECTIVES

ASP is an R&T program as defined by NPR 7120.8. The projects in ASP are managed as R&T portfolio projects that include both basic and applied research. As such, the program management and performance measurement functions balance the need to appropriately track and manage the technical progress of the program with the high-risk, organic attribute of the R&T portfolio research content.

The Airspace Systems Program was structured to support National and Agency goals by directly addressing the air traffic management research needs of the NextGen in collaboration with member agencies of the JPDO. National planning documents served as the guidelines to the ASP leadership in identifying the program objectives and project structure.

To achieve these goals and the vision of NextGen, ASP research is conducted by two projects. Project research will consider user needs and performance capabilities, utilize trajectory-based operations, and optimally utilize human capabilities, automating, where appropriate, the functions performed by pilots and controllers. Research will also facilitate achievement of the NextGen vision for human roles within the system to move toward strategic decision-making, and for the tactical separation role to move toward full automation. Additionally, research will be designed to accommodate global use and environmental constraints.

Specifically, the CTD project develops and explores fundamental concepts, algorithms, and technologies to increase throughput of the NAS and achieve high efficiency in the use of resources such as airports and en route and terminal airspace. In pursuit of that aim, researchers will develop and explore gate-to-gate concepts, algorithms, and technologies along three thrusts: 1) innovative research and new directions, 2) JPDO NextGen-related research and development (within the scope of NASA's core competencies and where NASA is responsible), and 3) advance concepts and technologies for stakeholder benefits (collaborating with SAIE).

The SAIE project is responsible for facilitating the maturation of the ASP portfolio's concepts and technologies by providing systems-level analysis of the NAS characteristics, constraints, and demands such that a suite of capacity-increasing concepts and technologies for integrated system solutions are enabled and facilitated. The technical objectives in support of this goal are: 1) integration, evaluation, and transition of more mature concepts and technologies in an environment that faithfully emulates real-world complexities, 2) interoperability research and analysis of ASP technologies across air traffic management functions performed to facilitate integration and to take ASP concepts and technologies to a higher Technology Readiness Level (TRL), and 3) analyses conducted on the program's concepts to identify the system benefits or impacts. System-level analysis is conducted to increase understanding of the characteristics and constraints of the airspace system and its domains.

Please refer to each Airspace Systems Project Plan, accessible via the web at *http://www.aeronautics.nasa.gov/programs_asp.htm*, for respective schedule, milestones, and measures that flow down from the ASP objectives.

2.2 PROGRAM SCHEDULE

ASP's schedule commitment consists of two parts both performed on an annual basis: the program planning and review cycle and the program technical progress commitment. This schedule ensures that the program portfolio content is planned commensurate with the Agency's budget planning processes. It further ensures a timely review and evaluation of the technical and programmatic execution of the program.

The second part, the program technical progress commitment, consists of the program's HPPG and APGs. Achievement of these goals is an indication of performance in a specific area of a large R&T portfolio. Progress against these goals, combined with progress against the program- and project-level milestones, is used in the review process to assess program performance.

2.3 PROGRAM RESOURCES

ASP resources are defined as part of the Agency Planning, Programming, Budgeting, and Execution (PPBE) process (refer to NPR 9420.1 for details). As part of this annual process, the ASP gathers input, assesses any potential redirection for the program, and sets project resource levels. Subsequently, the specific research portfolio investments within the projects are implemented consistent with the set levels and in support of the technical challenges. The current official budget is provided in Appendix C.

3.0 SUBPLANS

3.1 CONTROLS AND COMPLIANCE

3.1.1 PERFORMANCE ASSESSMENT

The program utilizes a four-step cycle to manage achievement of its objectives:

Step 1 Planning: Regular reviews of program and project objectives and plans to ensure they remain responsive to the national need, consistent with the National Aeronautics Research and Development Policy and aligned with Agency mission and resources. The content of these multi-year plans includes research relevance and impact, technical challenges, research approach, milestones and deliverables, resources, partnerships and schedule. Solicitation of interest in key areas from the external community to form non-reimbursable cooperative partnerships also ensures relevance to stakeholders. Prioritization of work is in accordance with overall national impact and NASA's major strengths and capabilities. Program and project plans will be updated after taking into account all of the above.

The program-level performance objectives and goals for each project are delineated in the Program Overview section of this document. The technical challenges in Appendix A further specify these goals, and objectives and are organized by project and RFA. Acceptance of the projects' plans to meet these goals, objectives and challenges is through the project plan approval process.

Step 2 Executing: Research is conducted by NASA researchers or via several avenues. Space Act Agreements entered into by NASA and a partner or partners engage institutions in mutually beneficial cooperative research activities in support of the Airspace Systems Program. Such partnerships leverage opportunities that would not be available otherwise, thus maximizing the return on investment to the taxpayer. Memoranda of Understanding are used to foster partnerships with other government agencies. Mutual benefit and open and wide dissemination of the results of the collaboration are emphasized in this process. NASA Research Announcements are used to (1) stimulate close collaboration among NASA researchers and NRA award recipients to ensure effective knowledge transfer, (2) supplement and/or enhance our in-house capabilities, and (3) generate advanced research ideas that foster NASA's goals and objectives. NRA awards are made as grants, cooperative agreements or contracts, depending on the nature of the proposing organization and/or program requirements. Execution is performed by multi-center, multi-disciplinary teams across the two projects.

Step 3 Monitoring and Controlling: ASP's evaluation and validation for compliance with program requirements is based on technical and schedule compliance assessments. The NextGen TIM monitors technical performance and benefits analyses for specific project technologies at key milestone decision points. The Program Director uses the project information and independent assessment to judge performance against requirements and to reach decisions on any needed changes.

In addition to technical compliance, schedule compliance is accomplished by formal acceptance of milestone completion by the Program Director. Projects formally submit a memo and technical documentation certifying that they have met the requirements and their justification for such assertion. If acceptable, the Program Director formally concurs on the memo. The program specifically tracks program milestones which consist of APGs, the HPPG, and designated program milestones. It is important to recognize that success is defined by knowledge gained and not just achievement of the milestone metric. ASP recognizes that with well-planned, well-managed, high-risk research, some milestones may not be achieved within the projected schedule and that some performance metrics may not be met.

Continuous evaluation of progress toward stated goals is accomplished through assessment of overall quality and impact of work accomplished in ASP utilizing both internal and external peer reviews. Continuous risk management identifies programmatic, schedule and technical risk, assesses the risk and identifies risk management or mitigation measures to address the identified risk.

Step 4 Closing: Transition of research results occurs through dissemination, integration and transition. Dissemination occurs at technical interchange meetings, conferences and briefings through articles, papers, algorithm documentation and presentations. Integration of results occurs internally through system level activities and externally through partnerships with academia, industry and other government agencies. Integrated results are incorporated into roadmaps, and systems architectures or inform policy decisions. Transitioned research is incorporated into both system acquisition programs and existing systems.

3.1.2 SAFETY AND MISSION SUCCESS

To ensure program safety and mission success, the projects use Center specific procedures as appropriate. No mission critical software or hardware is developed by the Airspace Systems Program. The program does not envision project software creating any impacts to the safety of NAS operations. Analysis software used or developed by ASP projects is not operational software and will not have operational safety impacts. Existing simulation facilities that make use of the Project-developed software will continue to observe all facility specific safety protocols.

Foundational research places the software in laboratory-only environments with no operational implications. In cases where research and technology is transferred to a government partner, hardening and certification of the software for operational use is the responsibility of the government partner or contracted software developer of that government partner.

3.1.3 ENVIRONMENTAL IMPACT

There is no environmental impact from the conduct of this program. Most of the program is based upon the use of computer laboratories or flight simulator facilities having no adverse environmental interactions. Experiments conducted at partner field sites take advantage of existing flights of commercial or government aircraft subject to federal environmental regulations under the responsibility of the partner organization.

3.1.4 PHYSICAL AND INFORMATION TECHNOLOGY SECURITY

In order to ensure that the Airspace Systems Program/Projects members, hardware, and software are secure from intentional and/or unintentional breaches, program/projects members are required to successfully complete, on an annual basis, NASA Agency-wide information technology security training.

3.2 RELATIONSHIPS TO OTHER PROGRAMS AND ORGANIZATIONS

3.2.1 INTERNAL

ASP is not dependent on other NASA programs outside ARMD to meet program objectives. However, ASP will work with other Mission Directorates, as appropriate, to make efficient use of Agency resources and to foster the implementation of ASP technologies into a broad range of applications that support Agency and national goals. Representatives from other Mission Directorates will be invited to events, briefings, and interchanges in areas of mutual technical interest.

3.2.2 EXTERNAL AGREEMENTS

Each project within ASP has established multiple partnerships with academia, industry, and other Government agencies. The distribution varies across projects. The principal role of the partnerships, the FAA in particular, is to collaborate on the joint achievement of the NextGen vision. Partnerships are also used to expand the scope and accelerate the development of new capabilities.

ASP adheres to the following ARMD guidance to establish external agreements:

- Collaborations are set up only when there is significant benefit to NASA and its constituencies (aerospace community, aerospace industry, academe, and, ultimately, the taxpayer).

- Once the collaboration is set up, the results can be appropriately disseminated and validated through a peer-review process.

- Collaborations are only initiated when there is full program commitment to see them through to completing objectives.

ASP looks to collaboration with industry to provide insight into issues associated with new aircraft system capabilities and air traffic technology to increase the capacity and mobility of the Nation's air transportation system. Along with research to maximize operational throughput, predictability, efficiency, flexibility, and access into the airspace system while maintaining safety and environmental protection, ASP leverages these opportunities with industry via Space Act Agreements (SAAs) as described under NPD 1050.1, Authority to Enter into Space Act Agreement.

In addition to SAA-based partnerships, the program also uses other means to partner with other Government agencies (OGAs), industry, and academia. Memoranda of Understanding (MOU), Memoranda of Agreement (MOA), and InterAgency Agreements (IAA) are used to foster partnerships with OGAs. These include the 2008 MOU supporting the JPDO and multiple IAAs with the FAA. Additionally, even though it is a competitive procurement process, ASP considers that the NRA process is another mechanism to establish partnerships with academia, industry, and non-profit organizations. One other form of partnership is NASA's participation in various technical interchanges or working groups with industry and academia in support of

OGAs. ASP also encourages and supports participation in professional technical society conferences and workshops, professional society technical committees, and standards development committees. These events provide forums for technical communication and coordination, as well as transfer of research results.

Specific details of partnerships are not documented in this PCA. The program relies on the NASA Space Act Agreement Maker (SAAM) database to catalog SAAs. At the program level, a database is maintained to summarize partnerships that have been established through the NASA NRA process. Details of the projects' participation in technical interchanges and/or working groups are maintained by the individual projects.

3.3 BUDGET AND ACQUSITION STRATEGY

Acquisitions within the program provide the basic elements for foundational research, tools, and methods development, enabling technologies, and validation and verification of research results. The acquisitions support the performance of the research as described in the program plan and the supporting project plans. The acquisition strategy for the program includes an assessment of the best source/provider for conduct of the research (e.g., a given area of research may be best accomplished by being conducted by entities outside of NASA or by in-house researchers). For those research areas best accomplished by entities outside NASA, multiple competitive procurement options are considered including, but not limited to, a NRA and Request for Proposals (RFP). For those research areas deemed best accomplished at NASA research Centers, research support is competitively procured. Sole source awards are occasionally used, but only when these procurements meet stringent, sole source justifications. The program executes acquisitions according to Agency policy for small and large purchases, utilizing the open competitive bid process.

The acquisition strategy also includes the possibility of partnerships (with industry, other Government agencies, and other NASA Mission Directorates) as the principal means to acquire platform and system-level verification and validation opportunities.

Investment decisions across the program, projects, and technical challenges are made based on a number of factors, including alignment with national needs and priorities, the potential impact of the technology on current and future vehicle fleets, the skill mix availability at the NASA Centers, the potential impact on other NASA Mission Directorates and other Federal agencies, and the necessary critical mass to make impact in a technology area. Changes in investment distribution across the projects will be based on ongoing assessments of such factors, as well as technical progress.

3.4 COOPERATION AND COMMERCIALIZATION

In additional to cooperation discussed above, ASP engages other beneficiaries, stakeholders and partners through meetings, symposiums and conferences. NASA participates multiple forums that are open to the public. ASP personnel are frequent panel chairs and presenters at domestic and international technical conferences and symposium. Both this participation and attendance is critical to ensuring the widest possible collaboration and conservation of resources across all areas of ASP's portfolio and is a key part of achieving dissemination, transition and possible commercialization of ASP research.

3.5 DATA MANAGEMENT AND DISTRIBUTION

The results of the research in ASP are widely disseminated to support the Nation's aerospace industry in accordance with NPD 2200.1, Management of NASA Scientific and Technical Information. Verbal and written dissemination of program results may be subject to export control (ITAR and EAR) and classification restrictions. Intellectual property and data rights for SAAs and other collaborations are negotiated and protected, as appropriate, in accordance with Agency policy, such as The Grants and Cooperative Agreement Handbook and NPD 1050.1. Written dissemination is accomplished principally via journal papers, conference proceedings, and NASA publications such as technical memoranda, technical papers (NASA TMs or TPs), or contractor reports (CRs). Verbal dissemination is accomplished via program and project participation within technical working groups, committees, technical conferences, and review panels.

The types of data and information to be produced by ASP include, but are not limited to, technology and concepts studies; analysis, design, and optimization methods (including both theory and validated/verified software); ground and flight test data, procedures, and methods; component and system-level conceptual designs; and both ASP and project plans.

ASP ensures rapid and effective dissemination of all of its research results to the widest practical and appropriate constituency. Since dissemination of knowledge is such an important program consideration, ASP plans to hold periodic public meetings (referred to as the ASP Technical Interchange Meeting) specifically for this purpose. These meetings will be held in addition to participation in other technical venues such as technical conferences or professional meetings.

Research Transitions Teams (RTTs) are a major component of ASP's external transition efforts. NASA and the FAA have established RTTs to ensure that research and development needed for NextGen implementation are identified, quantified, conducted, and effectively transferred to the implementing agency. This will be accomplished through collaboration among researchers, system planners, and implementers within the RTT. The proposal to establish RTTs and a coordinating committee to guide them was approved on October 22, 2007, by the FAA's Air Traffic Organization Senior Vice President for NextGen and Operations Planning and by NASA's ARMD AA. The objectives of the RTTs are to: 1) provide a structured forum for researchers and implementers to constructively work together on a continuing basis; and 2) ensure that planned research results will be fully utilized and will be sufficient to enable implementation of NextGen air navigation services concepts.

3.6 RISK MANAGEMENT STRATEGY

ASP performs highly challenging, cutting-edge, long-term research, which, by its nature, has inherently high risk. Risk is managed in accordance with NPR 7120.8 and NPR 8000.4. Overall, research risk is managed by setting up a balanced portfolio of research investments that include a mix of risk level in the specific objectives. Periodic assessment of progress toward expected goals is used as input on decisions to adjust the balance of the portfolio. In addition to the inherent research risk, three additional sources of risk are identified:

1. In-house availability of critical skills required for the research in ASP. Risk mitigation options include acquisition of the skills outside the Agency (via the NRA or through work year equivalent workforce, where applicable,) the delay of key milestones, or the reorganization of some of the research task plans.

2. Redirection of resources to meet other Agency or national priorities. The impact of substantial changes in the budget will be reexamined periodically to assess the necessary changes to the PCA and the program and project plans.

3. A degree of external dependency resulting from partnerships introduces a manageable risk associated with the ASP execution strategy. These partnerships provide many benefits, but also introduce external dependencies that could influence schedules and research output.

In addition to these risks, certain components of the projects in ASP include more traditional risks that derive from research tests and experiments that are managed according to Agency standards.

3.7 REVIEWS AND OPTIONAL KDPS

Since ASP is a research program, technical excellence and relevance are the top priorities, and project plans will be adjusted on an annual basis to satisfy those priorities. The annual review is a forum in which the project, Center, and program representatives discuss the program-level direction and technical content including input that may affect the cross-project investment levels. This meeting is a means to gather input (and insights from the participants) that will be considered in the program planning process. The ASP PD retains decision authority for program direction, content, and distribution of resources. The technical progress and schedule commitments of ASP will be thoroughly reviewed at the 12-month point in the fiscal year by the ARMD AA. ASP's schedule and milestone commitments will be assessed and may be adjusted, based on findings from these reviews and as recommended by the PD. Changes to program schedule and/or program-level commitments will be approved by the ARMD AA. The status of the projects is assessed through milestone completion reports submitted by the projects. These reports identify technical and programmatic accomplishments, issues, and challenges facing the project as well as project financial execution against plans. The top-level status of ASP, including high-level issues, will be reviewed by the Mission Directorate on a monthly basis.

There are no optional Key Decision Points (KDPs) that apply to the ASP. ASP may be subject to a termination review based on established Agency guidelines.

3.8 WAIVERS

None.

3.9 CHANGE LOG

The ASP will maintain a log of all program plan revisions that reflect all changes and waivers to the original program plan. This includes events such as bi-annual revalidations of the plan, the addition or cancellation of a project, or events requiring an update to the plan such as a program restructure. This information may be supplemented with an attached addendum for each change, describing the change.

				Cancellation	**MDAA or MSOD**	**Associate Administrator**
Date	**Event**	**Change**	**Addendum**	**Review Req'd**	**Signature**	**Signature**
11/04/10	Biennial Update	Revalidation Version 2.0	Appendix A, B, C & D added	No		

Table 1 Activities Log

APPENDIX A PROGRAM TECHNICAL CHALLENGES

Responsible Project	Title	Description
CTD	Efficient Arrival Operations	With limited decision support, air traffic controllers rely on sub-optimal arrival routes and inefficient level-offs to keep aircraft safely separated. Develop new concepts, procedures and algorithms to maximize arrival rates to single airports and metroplexes, while also reducing fuel burn, emissions, and noise. Improved arrival area operations rely on effectively integrating multiple concepts, including high-precision scheduling, flight deck merging and spacing, and terminal area (near-airport) conflict detection and resolution.
CTD	Efficient Arrival/Departure/Surface Operations	Controllers lack decision support systems to strategically plan optimal airport resource use across arrivals, departures, and surface operations. Coordinated scheduling of departing and arriving flights with surface operations improves efficiency and throughput at and near the airport.
CTD	Separation Based on Wake Prediction	Static wake vortex separation standards may lead to lost capacity in some cases. Improve airport capacity through use of dynamic wake vortex standards. Advanced sensors, models, and decision support systems allow controllers to apply appropriate wake separation standards based on aircraft characteristics and atmospheric conditions.
CTD	Optimize NAS Performance and Environmental Protection	Sub-optimal strategic flow management decisions, particularly in the presence of hazardous weather, can lead to extensive delays. Develop modeling, simulation, and optimization techniques to minimize total system delay (or other performance functions), subject to airspace and airport capacity constraints, while accommodating three times the traffic in the presence of uncertainty.
CTD	Minimize Impact of Weather	Traffic flow managers have only limited decision support for planning efficient flows in the presence of hazardous weather. Develop strategies, algorithms, and decision support tools that allow traffic flow managers to minimize disruptions caused by hazardous weather. Algorithms incorporate probabilistic weather information, contributing to more accurate and efficient decisions on in-flight weather deviation and ground-delay programs.
CTD	Increase Efficiency through User Collaboration	Air traffic service providers face significant challenges in developing traffic flow strategies that provide system-wide efficiency and user equity. Develop and validate concepts and technologies that meet the needs of diverse stakeholders, under high traffic and severe weather conditions. Advanced models also offer greater flexibility to flight operators and service providers when allocating flights and traffic flows to constrained resources.
CTD	Address Demand/Capacity Imbalance	With limited exceptions, today's airspace sectors are static and cannot support higher capacity. Develop concepts, algorithms, and technologies that allow en route capacity to be allocated as needed to meet demand. Capabilities promote more flexible airspace design and include techniques such as airspace boundary changes and dynamic flow corridors.

CTD	Optimized Surface Operations	Imprecise surface movement across multiple independent entities and lack of common situational awareness lead to sub-optimal operations. Enable more efficient surface operations that reduce delays and fuel emissions. Concepts and advanced algorithms provide coordinated, optimized, trajectory-based paths supported by high-precision taxiing and conformance monitoring.
CTD	Improve Safety of Surface Operations	Reducing runway incursions continues to be a high-profile safety need. Provide ground-based and airborne alerting capabilities that mitigate runway incursions and low altitude conflicts, even under high-traffic density operations.
CTD	Trajectory-Based Operations Enabled by Conflict Detection and Resolution	Controller workload is generally the limiting factor to increasing en route capacity and allowing wind-optimal trajectories. Explore greater levels of automation support to help mitigate controller workload. Develop separation assurance algorithms for airborne and ground-based systems that detect and resolve traffic conflicts while meeting assigned trajectory constraints, under high-traffic density and with uncertainty.
CTD	Safety Assessment for Conflict Detection and Resolution Automation	Safety assessments and certification processes generally rely on comparison between candidate and previously certified systems. Many separation assurance systems under consideration for NextGen bear little resemblance to legacy systems. Working with Aviation Safety Program, develop and evaluate new methods that allow credible safety evaluations of highly complex, automation-intensive systems. Methods contribute to formal validation and verification of separation assurance operational concepts, algorithms, and software code.
CTD/SAIE	Human/Machine, Air/Ground Functional Allocation	En route airspace capacity is limited by today's ground-based, human-centered, separation assurance system. Under NextGen, a greater reliance on automation and/or aircraft capabilities may improve efficiency, while maintaining safety. Support informed NextGen decisions on air/ground and human/automation functional allocation for separation assurance. Comparative studies evaluate different operational concepts and technologies in a variety of trajectory-based operations environments.
SAIE	Relevant Environment Integration and Evaluation	Many NASA technologies could provide benefits to the NAS, yet it has been difficult to transition them to stakeholders. Improve the potential to transition NASA technologies into the NAS through high-fidelity simulations and flight evaluations. Performance assessments concentrate on technology integration with flight and ground hardware systems, proper functioning in operational environments, and interactions with real-world data sources.

SAIE	Trajectory Prediction and Interoperability	Tactical heading and altitude changes are frequently used in today's air transportation system. These control strategies lead to large position uncertainties and inefficient operations. Advance NextGen enabling capabilities related to trajectory prediction and interoperability. Improve the accuracy and capabilities of ground-based and airborne trajectory predictors. Develop methods to reliably assess the ability of different trajectory predictors to meet the needs of NextGen applications. Contribute to common protocols for exchanging trajectory information between ground-based and airborne systems.
SAIE	Portfolio Analysis of Integrated System-Level Concepts and Technologies	Program research should focus on areas of high potential for improving system-wide capacity and efficiency. Conduct benefits assessments of single and integrated concepts to support program portfolio investment. Refine concepts to ensure effective interdependent operations across multiple air traffic domains and time horizons. Collaborate with JPDO on system-level studies and development of common metrics and scenarios.
SAIE	Application of New Solutions to Air Traffic Management Challenges	Program research should be infused with innovative approaches for improving system-wide capacity and efficiency. Identify system level demand/capacity imbalances and approximate upper ceiling of potential capacity improvements. Studies explore trends in future aviation demand and compare with operational and physical constraints that limit capacity growth. Exploratory studies consider new approaches toward addressing aviation demand, while respecting system constraints.

APPENDIX B PROGRAM MILESTONES

HPPG: Increase efficiency and throughput of aircraft operations during arrival phase of flight. Remaining milestones include:

FY11 1. Experiment plan development for field test (2QFY11).

2. Denver field test (2nd): EDA evaluation by actual controllers (4QFY11).

FY12 1. NASA delivery of EDA Technology Transition Documentation to the FAA, September 2012.

APG 10AT05: Conduct simulations of automated separation assurance with sequencing, spacing, and scheduling constraints.

Success Criteria:

Green: Human-in-the-loop (HITL) simulations produce results for air service-provider and flight deck-based concepts using comparable assumptions, scenarios, and metrics.

Yellow: HITL simulations produce results for air service-provider and flight deck- based concepts, but the results are not directly comparable (i.e., assumptions, scenarios, and/or metrics are incompatible).

Red: HITL simulations produce results for only one concept (either service-provider or flight-deck based). Comparison is not possible

APG 10AT06: Determine the feasibility and benefits of one or more candidate Multi-Sector Planner (MSP) concepts.

Proposed Success Criteria:

Green: Feasibility and operational benefits will be evaluated through data analysis of a high-fidelity, human-in-the-loop simulation. The evaluation will address the impact on both, sector operations and local traffic flow management with subjective and objective metrics. Metrics related to sector operations include controller workload, separation violations, and air traffic controller acceptability. Metrics related to local traffic flow management include traffic flow manager/MSP workload, number, and magnitude of trajectory changes and sector throughput.

Yellow: Feasibility and operational benefits will be evaluated through data analysis of high-fidelity human-in-the-loop simulation. The evaluation will address the impact on one aspect, sector operations, or local traffic flow management with subjective and objective metrics.

Red: Feasibility and operational benefits will be evaluated based on subjective metrics gathered in human-in-the-loop simulation.

APG 11AT5: Evaluate initial terminal tactical conflict prediction and resolution functions.

Success Criteria:

Green: Complete and document a human-in-the-loop simulation to evaluate an experimental approach for conducting investigations of infrequent tactical aircraft-to-aircraft conflicts (i.e., missed, late, and false conflict alerts).

Yellow: Complete a fully-integrated system evaluation to prepare for a human-in-the-loop simulation to evaluate an experimental approach for conducting investigations of infrequent tactical aircraft-to-aircraft conflicts.

Red: Complete an evaluation of individual, nonintegrated systems to prepare for a human-in-the-loop simulation to evaluate an experimental approach for conducting investigations of infrequent tactical aircraft-to-aircraft conflicts.

APG 11AT6: Specify operational requirements for performing Multi-Sector Planning (MSP) functions in the mid-term, including technical and conceptual requirements, with consideration of how requirements might change as the NAS evolves towards NextGen.

Success Criteria:

Green: Operational requirements are provided for performance of MSP functions in a mixed equipage midterm environment. The target airspace includes both datacomm and non-datacomm equipped aircraft, and a range of equipage levels are investigated. Multi-sector trajectory coordination functions are evaluated for low-, medium-, and high-equipage levels. Concept provides user and system benefits enhancements as equipage levels and technology evolve.

Yellow: Operational requirements are provided for performance of MSP functions in a mixed equipage midterm environment: the target airspace may include both data comm. and nondata comm.-equipped aircraft. The multi-sector trajectory coordination functions can accommodate both categories of aircraft. Concept addresses operational feasibility.

Red: Operational requirements are provided for performance of MSP functions in a homogeneous midterm environment with data comm. equipage in the target airspace.

APG 12AT5: Develop Initial Weather Translation Models

Success Criteria:

Green: Demonstrate an ability to estimate the weather-impacted traffic capacity of a region of airspace (e.g., a sector) or an airport in a 15-minute interval within 30% of the actual weather-impacted capacity over a one-hour prediction interval on a set of bad weather days. Since the actual weather-impacted capacity of a region of airspace or an airport is unknown, this capacity will be considered as the observed peak aircraft count over the corresponding 15-minute period.

Yellow: Demonstrate an ability to estimate the weather-impacted traffic capacity of a region of airspace (e.g., a sector) or an airport in a 15-minute interval within 45% of the actual weather-impacted capacity over a one-hour prediction interval on a set of bad weather days. Since the actual weather-impacted capacity of a region of airspace or an airport is unknown, this capacity will be considered as the observed peak aircraft count over the corresponding 15-minute period.

Red: Demonstrate an ability to estimate the weather-impacted traffic capacity of a region of airspace (e.g., a sector) or an airport in a 15-minute interval within 50% of the actual weather-impacted capacity over a 30-minute prediction interval on a set of "bad" weather days. Since the actual weather-impacted capacity of a region of airspace or an airport is unknown, this capacity will be considered as the observed peak aircraft count over the corresponding 15-minute period.

APG 12AT6: Evaluate Interval Management Procedures to a Single Airport with Dependent Parallel Runways

Success Criteria:

Green: Conduct batch and HITL simulations to quantify benefits of mid-term technologies applied in mixed operations. Benefits measured should include throughput, delay and efficiency. Evaluate pilot acceptability and workload from the HITL simulation. Assess changing human/machine function allocation as a result of increasing technology.

Yellow: Conduct HITL simulation. Evaluate pilot acceptability and workload. Assess changing human/machine function allocation as a result of any one of the new added technologies.

Red: Evaluation of throughput and delay using batch simulation only. Inferred results of pilot acceptability, workload, and human/machine function allocation without HITL simulation.