ORDER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

7100.10A

4/7/99

SUBJ: AIR TRAFFIC SATELLITE NAVIGATION IMPLEMENTATION PLAN

1. PURPOSE. This order prescribes the Air Traffic Satellite Navigation Implementation Plan and the overall strategy for the integration of a satellite-based navigation system into the air traffic control (ATC) environment. It summarizes Air Traffic (AAT) goals for satellite navigation (SATNAV) implementation in support of the Federal Aviation Administration's (FAA) national objectives, and it defines the roles and responsibilities of AAT organizations accountable for SATNAV implementation. In addition, this plan describes the processes for submitting and approving initiatives to support Air Traffic goals for implementing satellite technologies into the ATC environment.

2. DISTRIBUTION. This order is distributed to the branch level in Washington headquarters Air Traffic, Flight Standards, and Airway Facilities Services; the regional Air Traffic Divisions; the FAA Academy; the William J. Hughes Technical Center; and all Air Traffic field offices and facilities.

3. CANCELLATION. Order 7100.10, Air Traffic Implementation Plan for the Use of the Global Positioning System, dated December 27, 1993, is canceled.

4. BACKGROUND.

a. Initial FAA SATNAV Efforts. The FAA, in conjunction with the International Civil Aviation Organization (ICAO) and other members of the civil aviation community, has recognized that the primary navigation system of the future will be provided by a Global Navigation Satellite System (GNSS) that will present the opportunity for improvements in safety, capacity, and service flexibility. Since GPS is owned and operated by the United States Government, Global Positioning System (GPS) is the focus of initial FAA SATNAV efforts. The FAA has developed two programs to alleviate GPS accuracy, integrity, and availability (continuity of service) limitations to meet civil aviation's requirements. The deployment of these two systems will possibly allow for the decommissioning of ground-based navigational aids (NAVAID). To take full advantage of the enhancements provided by satellite technology, civil aviation will require the full support and approval of the air traffic control community.

(1) Wide Area Augmentation System (WAAS). WAAS improves the accuracy, integrity, and availability of the basic GPS system. When fully deployed, it allows GPS to be used as a primary means of navigation for en route, terminal, and non-precision approach phases in the United States, as well as Category I approaches to selected airports.

(2) Local Area Augmentation System (LAAS). LAAS is intended to complement WAAS by providing additional augmentation for Category II and III precision approach capabilities. LAAS will

also provide a Category I capability at locations where the WAAS cannot, and will provide a signal that could be used for surface navigation in and around the airport area.

b. Air Traffic Satellite Operational Implementation Team. The Air Traffic Satellite Operational Implementation Team (ATSOIT) was created in September 1998 to guide and direct the safe and orderly implementation of SATNAV into the National Airspace System (NAS). An Air Traffic SATNAV Implementation Office (ATO-402) has been established to support the ATSOIT and manage daily activities. In addition, each region has assigned a focal point to facilitate coordination and implementation activities at the regional and facility level. The Air Traffic SATNAV Implementation Plan provides the mechanism for an effective and timely transition to a satellite-based air traffic control environment. As more aircraft equip with GPS, several initiatives have been launched by regions, supported by the SATNAV Product Team, to allow properly equipped aircraft to realize the advantages of GPS. These projects were closely coordinated with various customer groups. This close working relationship with customers has proven to be integral in successful implementation activities and will continue.

5. EXPLANATION OF CHANGES. This order reflects the *Air Traffic Services Concept of Operations for the National Airspace System in 2005*. Thus, Order 7100.10 has been changed to incorporate this new direction. Further, this document was developed in coordination with the user community to provide for a common approach and ideology to the implementation of satellite navigation directly into enhanced operations. The title was changed to conform to current terminology for the application of GPS as a navigation aid.

6. AIR TRAFFIC GOALS FOR SATNAV IMPLEMENTATION. The overall objective of the FAA's Satellite Navigation Program is to support the operational use of SATNAV by all civil aviation users in all phases of flight. The *Air Traffic Services Concept of Operations for the National Airspace System in 2005* describes the characteristics of the future air traffic control environment that supports FAA and industry objectives for the future SATNAV environment. The following summarizes ongoing or necessary air traffic initiatives to meet the SATNAV goals of increased airspace and landing capacity, flexible use of airspace, and increased ground facility capacity and safety. It is important to note that there will be a challenging transitional period when aircraft are using a mixture of satellite- and ground-based navigation systems in the NAS. Both navigation systems must be accommodated. SATNAV goals by phases of flight:

a. Airport Surface Movement Operations and Services.

(1) Future Characteristics. The service provider's objective is to remove system constraints on flights from pushback to the runway and from the runway to the gate. Controlling and monitoring airport surface movement becomes increasingly difficult, especially as visibility decreases.

(2) Goals. The FAA is examining ways to use GPS, in conjunction with LAAS, to provide surface navigation to aircraft and vehicles on runways, taxiways and other airport movement areas during all weather conditions. This surface navigation capability could enhance surveillance systems by datalinking position information to airport surface detection systems.

b. Departure and Arrival Operations Services.

(1) Future Characteristics. Departure and arrival route structures are expanded, within environmental constraints, to allow increased usage of area navigation (RNAV), SATNAV, and routes flown automatically by onboard Flight Management Systems (FMS).

(2) Goals. The Air Traffic SATNAV implementation goals that will contribute to improved terminal characteristics include:

(a) Establishing ATC procedures to provide improved service to GPS-equipped aircraft operating in a mixed satellite- and ground-based navigation system environment.

(b) Structuring a flexible system of departure procedures (DP), Standard Terminal Arrival Routes (STAR), and profile descents to more efficiently transition to/from the en route structure.

(c) Using the capability of GPS to reduce terminal separation standards.

(d) Developing exclusive GPS procedures/routes between major metropolitan areas at all available altitudes.

(e) Providing VFR waypoints for visual reporting points, flyways, corridors, and transitions.

(f) Establishing and certifying "rotorcraft only" instrument approach procedures (IAP), DP's, and STAR's to enhance the flow of both fixed-wing and rotorcraft traffic within terminal areas.

(g) Developing flexible, alternative GPS route capabilities and procedures that will permit flight through and/or around special use airspace (SUA).

(h) Transitioning ground-based NAVAID approaches to SATNAV-based.

(i) Developing GPS direct routes that overlay portions of airways and jet routes as well as routes within uncontrolled airspace.

(j) Developing and evaluating a GPS-based terminal airspace system to include procedures/routes for instrument flight rules (IFR), visual flight rules (VFR), and special VFR operations.

(k) Developing precision missed approach procedures.

c. En route Operations and Services.

(1) Future Characteristics. By the year 2005, en route structures and boundary restrictions are expected to be unconstrained by communications and computer systems, and aircraft are not normally required to fly directly between NAVAID's along routes defined by the FAA. As a result, en route operations are characterized by the following:

(a) Traffic flies optimum descent profiles, remaining at higher altitudes for longer periods during the arrival phase of flight.

(b) With the completion of the National Airspace Review, the airspace structure has been adjusted to meet user needs. Tools and procedures are expected to be in place for frequent evaluations

of the airspace structure and anticipated traffic flows are accommodated by adjustments to sector boundaries.

(c) Automated, seamless inter-/intra-coordination and communications within and between facilities will enable airspace structure flexibility and reduced boundary restrictions.

(d) Structured routes are the exception rather than the rule and exist only when required by high-density traffic environments, to provide for terrain avoidance and active SUA's, and to facilitate the transition between areas with differing separation minima. Demand and capacity imbalances have been resolved, in collaboration with the users, via voluntary changes in trajectories or through the establishment of temporary routes and transition points in the affected area.

(2) Goals. The Air Traffic goals for SATNAV implementation that contribute to the en route characteristics identified above include:

(a) Establishing lower minimum en route altitudes (MEA) in mountainous areas using GPS as the navigation aid.

(b) Developing flexible routes to accommodate GPS-based direct routings (fixed wing and helicopter) and expansion of the National Route Program (NRP).

(c) Establishing an altitude stratum in domestic airspace designated for GPS-equipped aircraft.

(d) Developing a non-radar low altitude route structure.

(e) Developing GPS low altitude route structure and air traffic procedures to support nonradar IFR offshore helicopter operations.

(f) Establishing ATC procedures for providing improved service to GPS-equipped aircraft operating in a mixed environment.

(g) Developing GPS direct routes overlaying portions of victor and jet airways as well as through unused airspace.

(h) Developing flexible alternative GPS route capabilities and procedures that will permit flight through or around SUA.

(i) Using GPS capabilities to reduce domestic en route separation standards.

d. Oceanic Operations and Services.

(1) Future Characteristics. GPS is used as a primary means of navigation in the oceanic environment. In 2005, the greatest percentage increase in air traffic is projected to occur across the Atlantic and Pacific Oceans. To accommodate this growth, improvements in air traffic management tools, navigation, communication and the use of surveillance are paramount enablers of capacity enhancement in oceanic airspace. Additionally, procedural reductions in separation standards are facilitated through an improved infrastructure. Automation and procedural changes help service providers become strategic in solving potential conflicts, traffic congestion, and the demand for user preferred trajectories. Oceanic separation minimums have been significantly reduced, allowing a corresponding increase in system capacity.

(2) Goals. The Air Traffic goals for SATNAV implementation that contribute to the oceanic characteristics identified above include:

(a) Increasing system capacity by reducing longitudinal, lateral, and vertical separation minima.

(b) Increasing system flexibility by replacing oceanic track systems with user-preferred routes.

(c) Developing automated surveillance and traffic information capabilities.

7. ORGANIZATIONAL RESPONSIBILITIES.

a. Air Traffic Operations (ATO). The Air Traffic Operations Program Director (ATO-1), in coordination with the Air Traffic Airspace Management Program Director (ATA-1), is responsible for the overall implementation of SATNAV within AAT. To facilitate this responsibility, ATO-402 is assigned with the following roles and responsibilities:

(1) Serves as the headquarters' Air Traffic focal point for SATNAV implementation.

(2) Provides the overall day-to-day management of national and regional air traffic initiatives directed at implementing SATNAV.

(3) Serves as a member of the ATSOIT and provides national interface with regional SATNAV focal points and working groups.

(a) Coordinates the activities required to meet plan objectives with ATSOIT and offices of primary/collateral responsibility.

(b) Produces and maintains a master schedule depicting the activities necessary to achieve NAS-wide SATNAV implementation as determined by the *NAS Architecture* and *Air Traffic Services Concept of Operations for the National Airspace System in 2005.*

(4) Updates, changes, and revises this plan in coordination with the ATSOIT, as needed.

b. Air Traffic Satellite Operational Implementation Team (ATSOIT). Although ATO has primary responsibility for SATNAV implementation, close coordination and support are required of ATA. Therefore, ATO and ATA co-sponsor the ATSOIT.

(1) Purpose. The ATSOIT guides and directs the safe, orderly, and efficient integration of satellite-based technologies into a national air traffic control system.

(2) Responsibilities. ATSOIT responsibilities are defined in Order 1110.126, Air Traffic Satellite Operational Implementation Team, and include:

(a) Establishing national SATNAV implementation policies and priorities that are in the best interest of the NAS, the aviation community, and that meet FAA goals and objectives for future air traffic control systems.

(b) Providing oversight of Air Traffic SATNAV implementation activities including the review, approval, and monitoring of Headquarters' and regional SATNAV initiatives.

(c) Reviewing the results of regional initiatives and recommending national implementation, as appropriate, to the office of primary responsibility (OPR).

c. **Regions.** The implementation of SATNAV capabilities into the NAS will require a concerted effort on the part of all regions and facilities. Each region will assign an Air Traffic focal point for SATNAV activities, and regions are strongly encouraged to establish a SATNAV Implementation Group with specified roles and responsibilities. The union has designated a focal point in each region to assist in SATNAV implementation projects, and to participate in regional working group activities. Regional SATNAV focal point roles and responsibilities:

(1) Provide the day-to-day management and oversight of regional air traffic SATNAV initiatives.

(2) Ensure regional plans are developed and incorporated into national SATNAV objectives.

(3) Provide direction and guidance to air traffic facilities within their region.

(4) Serve as the lead of the Regional SATNAV Implementation Group.

8. IMPLEMENTATION APPROACH. SATNAV implementation will require a systematic, incremental approach to ensure the benefits and capabilities of SATNAV are implemented efficiently. It must be assured that the same quality of service is provided to ground-based system users during the transition. This section addresses the overall strategy, actions, and the processes required to enable Air Traffic to meet FAA objectives in a safe, timely, and cost effective manner. FAA and Air Traffic SATNAV objectives are supported by national and regional initiatives that address operational enhancements, constraints, and issues anticipated from the use of new satellite-based navigational capabilities in the near-term. These initiatives require coordination with and the approval of the headquarters' ATSOIT. The purpose of this approach is to ensure that limited available resources are directed at national goals and objectives, and to reduce duplication of effort.

a. **SATNAV INITIATIVES.** Key to the successful national implementation of SATNAV applications is the establishment of a central coordinating and control function. The ATSOIT provides the management functions as described above. This section describes the general guidelines for the development and implementation of SATNAV initiatives nationally and regionally. The inclusion of users in the development of SATNAV projects is critical to the successful implementation of SATNAV and is strongly encouraged in the process, both nationally and regionally.

(1) **Project Plan.** The Product Team for Global Positioning System requires the submittal of a project plan for each initiative that requires funds. The project plan will serve as the outline for project tracking and oversight to ensure continued funding based on results. It should be clear, concise, and specific. Appendix 1, Project Plan Format, depicts the format dictated by the Product Team for Global Positioning System. All project plans will be in competition for the limited funding available for SATNAV NAS Implementation and, therefore, all requests must be fully justified. Due to NAS requirements, the ATSOIT may initiate project plans and assign them to a specific region after coordination.

(2) Project Approval. The regional Air Traffic SATNAV focal point or implementation group shall develop a process for developing and approving SATNAV initiatives prior to submittal to ATO-402 for coordination. Project plans may be submitted by headquarters Air Traffic Services (ATS) offices through the division manager. All project plans will be submitted to ATO-402 for review and comment. This office will be responsible for submitting the plan to the ATSOIT for review, approval, processing and tracking. The region submitting the plan, at the discretion of the ATSOIT, may be required to brief the ATSOIT on the plan. After ATSOIT approval, ATO-402 will forward the project plan to the Satellite Program Office for funding through the ATS GPS Product Team Lead.

(3) Review Process. Each approved project plan will be tracked by the ATSOIT to determine potential application to the NAS. The OPR for an approved initiative shall provide a quarterly status report to the ATSOIT through the Air Traffic SATNAV Implementation Office. The report shall discuss current status, problems encountered and deviations to the schedule. In addition, at the completion of each initiative a final report shall be provided with the results, lessons-learned, and a recommendation for national implementation, if warranted. A final report briefing may be requested by the ATSOIT.

(4) NAS Implementation. The ATSOIT shall review the results of each initiative and determine applicability to the NAS. Once a determination that NAS-wide employment of an initiative is feasible, the ATSOIT will initiate a systematic, incremental national implementation of the initiative. ATSOIT shall coordinate with all applicable offices of primary responsibility.

b. SATNAV TRANSITION REQUIREMENTS. In addition to applying SATNAV applications as described above, there are support requirements that must be accomplished before, during and after SATNAV implementation. The ATSOIT will be responsible for coordinating with the appropriate office of primary responsibility and providing guidance and assistance, as needed, for each of the following areas:

(1) Training. Air traffic controller training will be of paramount importance throughout implementation. Preliminary briefings on GPS began in early 1994 when personnel from FAA headquarters provided informal briefings on GPS theory and operations to a select number of large facilities and regional personnel using videotapes and handouts. A national air traffic initiative to provide basic familiarization and instruction on satellite-based navigation to the controller work force will be established. This broad initiative will be the responsibility of AAT. Training must be provided on a recurring basis and as needed to maintain the controller proficiency in field facilities. In addition to this generalized training, the regions will address site-specific training required to accomplish regional initiatives.

(2) Procedures. The Air Traffic Operations Program (ATO-100) determines if new GPS procedures are required or if revisions are needed. The WAAS, scheduled for initial operational capability in 1999, will have a profound impact on the development of WAAS IAP's. A minimum number of WAAS instrument approaches will be available during the implementation and testing of WAAS initiatives. Testing or proving the concept is an excellent way to validate interim procedures. As procedures are validated, they are formalized and implemented on a national basis. As GPS matures and benefits become more readily available, procedures validated by proof of concept will be published to permit benefits to be offered on a wide scale.

(3) Environmental. The added flexibility of SATNAV will affect the environmental examination process. The anticipated proliferation of new instrument procedures and IFR route structures caused by

GPS implementation will create new environmental challenges. This is due, in part, to the introduction of IFR operations in areas not previously exposed to low-altitude aircraft operations. It is imperative that implementers of the initiatives fully examine the environmental impact of each step of the implementation process.

(4) Flight Documents. Many of the initiatives identified have the potential to create a significant demand for airport surveys and major changes to aeronautical charts. Implementers must consider the impact of each initiative in several areas, keeping in mind that, survey teams are a limited resource, charting cycles are not easily changed, and adequate lead times are essential. Further, the early identification of requirements is essential to ensure budgetary support. It is critical that appropriate coordination is completed with Aeronautical Information (ATA-100).

(5) System Monitoring. All air traffic control facilities will require a remote status monitoring system that provides real-time information concerning system availability, integrity, and accuracy to the air traffic control specialists. The LAAS remote status monitor shall also include a control function.

(6) NOTAM's. A process will be developed to ensure that timely and effective notification is made of SATNAV outages/deficiencies to NAS users and service providers caused by failures in components or due to abnormalities, e.g., ionosphere, etc.

(7) Modeling/Simulation. Models will be used to assess and evaluate the operational and environmental impact of restructuring terminal and en route areas/sectors in order to achieve a seamless environment. In addition, the need to simulate the operational environment may be required to assess changes and the effects on controller workload, human factors, traffic volume, etc.

9. CONCLUSION. The implementation of SATNAV procedures will require a concerted and coordinated effort within the FAA. The ATSOIT, supported by the SATNAV Project Lead, will play a pivotal role in the effective and safe transition from the current ground-based system to a space-based system. Timely coordination and communications with organizations external to AAT, e.g., Aviation System Standards, Flight Standards Service, system users, the Satellite Operational Implementation Team (SOIT), the Airspace Liaison Team (ALT), the Air Traffic Procedures Advisory Committee (ATPAC), etc., will be vital. A concerted AAT team effort is critical to the FAA's continuing lead role in SATNAV implementation into a global navigation satellite system.

Ronald E. Morgan
Director of Air Traffic

APPENDIX 1. PROJECT PLAN FORMAT

AIR TRAFFIC/AIRWAY FACILITIES
PROJECT NO.: (Will be provided upon initial submittal)
PROJECT NAME:
OPR:

OBJECTIVES. Provide a comprehensive overview of what is expected from this initiative. Give consideration to why the project is being performed, what results are expected, and how it contributes to the overall Satellite Navigation Program goals.

TECHNICAL APPROACH. Outline the general process, methods, and techniques to be used, e.g., flight test, simulation, etc., to accomplish the initiative.

PRODUCTS AND DELIVERABLES. Break down the project into tasks, if applicable, and identify the deliverable(s), schedule, and expected cost.

SCHEDULE. List discrete milestones, activities, and events, including start, intermediate, and end dates, if applicable for each task. In general, the number of milestones should correspond to reasonable dollar portions of the initiatives budget, in order to facilitate adequate oversight. Schedules may be presented in matrix form or free text.

COSTS. Estimate the cost of completing the initiative, phase by phase, and the time required to complete each phase. Breakdown the cost by category; contract labor, travel and other direct costs/materials. Differentiate between federal and non-federal travel costs and labor.

RELATED PROJECTS/ACTIVITIES. Explain how the initiative results may be implemented nationwide, and how they will support or facilitate the overall implementation of satellite-based navigation in the NAS.

OFFICE AND PRIMARY RESPONSIBILITY. Identify the organization and individual points of contact including routing symbol and phone number(s) who are responsible for overall management of the initiative to ensure it is completed within cost and schedule. Include points of contact for budget and contracting official, if applicable. If funding is to be provided via a specific contract, provide the contract number. Indicate if any additional organizations or individuals will be involved in the initiative and what service they will provide.

SUPPORTING ORGANIZATIONS. Identify other organizations providing support with name, routing symbol and phone number.

ACCOMPLISHMENTS/STATUS. For those ongoing projects submitted for new funding, e.g., continued funding for new fiscal year, provide the current status of the project and major accomplishments.

Signatures.

APPENDIX 2. PROJECT PLAN PROCESS CHECKLIST

1.	Does the planned initiative specifically address a stated Air Traffic SATNAV implementation objective/goal? Which objective/goal?
2.	Has another region implemented or is another region implementing a similar initiative? How does/can another initiative apply to this planned initiative?
3.	Has coordination been complete with all affected facilities?
4.	Has appropriate bargaining unit coordination been completed (facility and region)?
5.	Has regional coordination been completed, e.g., AXX-520, -530, etc.)?
6.	Has the Project Plan been signed by the regional Focal Point and AXX-500?

APPENDIX 3. ACRONYMS

AAT	Air Traffic
ATS	Air Traffic Services
ATC	air traffic control
ATPAC	Air Traffic Procedures Advisory Committee
ATSOIT	Air Traffic Satellite Operational Implementation Team
DCP	Document Change Proposal
DP	departure procedures
FMS	flight management system
GNSS	Global Navigation Satellite System
GPS	Global Positioning Satellite
IAP	instrument approach procedures
ICAO	International Civil Aviation Organization
IFR	instrument flight rules
LAAS	Local Area Augmentation System
MEA	minimum en route altitudes
NAS	national airspace system
NAVAID	navigational aid
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRP	National Route Program
OPR	office of primary responsibility
RNAV	area navigation
SATNAV	satellite navigation
STAR	standard terminal arrival
SUA	special use airspace
VFR	visual flight rules
WAAS	Wide Area Augmentation System