

SatNav Integration



The FAA's Global Positioning System (GPS) implementation activities are dedicated to enhancing the National Airspace System (NAS) infrastructure to accept satellite navigation (SatNav) technology.

In short, implementation enables a system to be used operationally in the NAS. The SatNav Operational Integration Team develops the operational infrastructure and certification procedures for SatNav, and provides the technical basis for the development of GPS, Wide Area Augmentation System (WAAS), and Local Area Augmentation System (LAAS) operational procedures for all phases of flight. The Team is instrumental in ensuring that each aspect of the NAS infrastructure is prepared for satellite navigation through the management and coordination of a variety of interrelated projects. These projects fall under the following project areas:

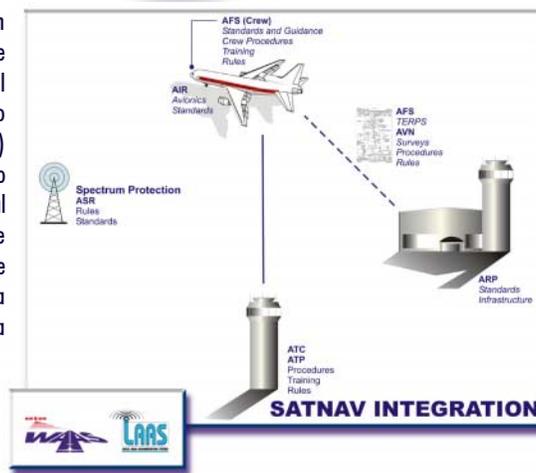
- Avionics Development and Certification
- Air Traffic Control
- Flight Standards
- Procedures Development and Validation
- Interference Identification and Mitigation

Avionics Development and Certification . . . This project area establishes certification standards for avionics installations and includes engineering support and guidance in the development of current and future GPS avionics Minimum Operational Performance Standards (MOPS), FAA Technical Standard Orders (TSOs) and Advisory Circulars (ACs).



To use SatNav technologies in the NAS, avionics equipment, requirements, and certification standards must be developed and validated. Decisions concerning the appropriate avionics suites include examination of operational objectives; development of navigation system

requirements through participation in RTCA, (the government and industry entity for development of standard performance requirements for implementation of new avionics technology) development of prototype equipment for data collection and analysis, and



validation of proposed criteria and policy based on flight testing and model simulation.

The FAA's Aircraft Certification Service (AIR) is the organization responsible for developing these products, coordinating the requirements standards with the US equipment manufacturers through RTCA committee work, and harmonizing the requirements with the international community through the International Civil Aviation Organization (ICAO). Avionics Certification includes the following activities:

- Development of MOPS, TSOs, and ACs for avionics
- Validation of MOPS requirements
- Harmonization of MOPS and ICAO Standards and Recommended Practices (SARPS)
- Avionics Certification

There have been three generations of WAAS avionics since the start of the WAAS program. The third generation receiver (GNLU-930 Multi-Mode Receiver (MMR)) is currently under development to add WAAS functionality to this LAAS-capable receiver. This equipment will be certifiable, and comply with RTCA DO-229C (the final version of the WAAS MOPS for single frequency WAAS receivers). The MMR is being integrated with typical Flight Management Systems (FMS) for which the testing has provided the collateral benefit of gaining flight test data for Instrument Procedure Design Criteria for FAA Flight Standards.

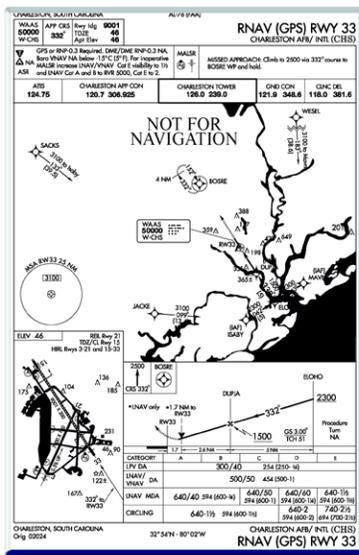
Air Traffic Control . . . This project area includes initiatives related to the evolution of the NAS, formerly tied to ground-based navigation aids, to a system based upon Area Navigation (RNAV) using satellite based technologies, such as GPS, WAAS, and LAAS. This includes the development of air traffic services (ATS) routes, en route and terminal procedures, phraseology, air traffic controller training on GPS, WAAS, and LAAS, and the identification and mitigation of risk through GPS outage simulation studies. Not limited to national implementation and planning, these developments are presented at the various ICAO panels for global implementation.

The FAA's Air Traffic Procedures Division (ATP) is responsible for oversight of regional site work, coordination of air traffic control procedures for WAAS and LAAS, US representation to ICAO, integration of WAAS and LAAS into the NAS, and oversight of controller's handbook updates. In a cooperative effort with the FAA, MITRE has developed the Terminal Area Route Generation Evaluation and Traffic Simulation (TARGETS) tool, which is used in procedure development to overlay RNAV routes on existing airspace.

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TARGETS can simulate aircraft flying the procedure with existing traffic flows and evaluate flyability of a proposed procedure. Other Air Traffic work includes Notice to Airmen (NOTAM) generation and GPS outage studies. The present NOTAM development effort is targeted toward automation, with the software being developed at the DOT's Volpe Transportation Center. The interface to the automated NOTAM system is in the process of being defined. This project is intended to incrementally improve the WAAS NOTAM software and to develop a status monitoring system for air traffic controllers. In another effort, there is a plan to conduct evaluations of the effect of GPS outages on en route and terminal air traffic.

Flight Standards . . . This project area includes activities related to instrument procedure criteria research, design, testing, and standards publication, as well as development of aircrew guidance and procedures. The shift from ground-based to space-based navigation sources has shifted the primary focus used in obstacle clearance determination and standards development. New GPS-based (RNAV) instrument procedures are a result of these activities. Improved safety, flexibility to maintain capacity under normally disruptive weather conditions, and providing operators with economic benefits is the goal of moving the system to space-based navigation. Participation is required in national and international forums to ensure benefits to manufacturers and operators on a worldwide basis.



This international cooperation is essential for streamlining requirements worldwide so that manufacturers can develop equipment that can be used across borders, benefiting the airlines and flying public by reducing the avionics equipment required for international flight.

The creation of instrument procedures design criteria leverages the avionics development efforts. A Universal UNS-1F FMS will be used at the FAA's William J. Hughes Technical Center and the Mike Monroney Aeronautical Center to support data collection for Terminal Instrument Approach Procedures (TERPS) criteria for Category C/D type aircraft. Data collection for Category A/B aircraft is being accomplished through a cooperative agreement with the University of Oklahoma and slightly different equipment (typical to that used in general aviation) is being used. These efforts are accomplished under direction of the FAA's Flight Standards Flight Procedures Standards Branch (AFS-420). The objective of TERPS data collection is to:

- Obtain measures of flight technical error (FTE), navigation sensor error (NSE), and total system error (TSE) under controlled conditions
- Obtain pilot evaluations of satellite navigation and guidance provided by TERPS
- Provide early measures of human factor conditions on safety of flight hazards caused by the new proposed equipment or procedures.

The collected TERPS data is then analyzed and used to develop standards, criteria, and implementation policy. This encompasses all phases of flight (en route, terminal, and approach) and includes (1) the coordination and resolution of comments from industry, FAA, and other government agencies, and (2) the publication of FAA Orders and AC's that provide criteria, policy, and guidance for procedure design. AFS-420 also provides

technical review and an approval process for procedures that do not meet published standards.

Procedures Development and Validation . . . This project area includes the provision of instrument procedure development and flight inspection of GPS-based routes and instrument procedures. A key part of this work involves WGS-84 surveys. Since SatNav instrument procedures are based on a series of geodetic waypoints, accurate surveys are necessary for waypoint definition.

Similar to Flight Standards, The FAA's Aviation Systems Standards Office (AVN) at the Mike Monroney Aeronautical Center uses the MMR/UNS-1F to flight inspect WAAS (LNAV), LNAV/VNAV, and LPV approaches. Flight inspection ensures the integrity of instrument approaches and airway procedures that constitute our NAS infrastructure and FAA's international commitments. In addition to integrating the MMR and UNS-1F, AVN needs to interface this equipment with the flight inspection data collection system. There will be an MMR hardware upgrade in 2003 to support increased GPS, WAAS, and LAAS throughput requirements. In addition to the accomplishment of surveys and flight inspection activities, another initiative includes the development of a low cost aeronautical database for approach procedure tracking and receiving Navcard generation.

Interference Identification and Mitigation . . . This project area includes the development and fielding of airborne, ground, and portable interference detection systems. These efforts are critical to ensuring the safe use of GPS and its augmentations in the NAS.

Several studies, including the FAA GPS Threat Assessment, the Johns Hopkins University GPS Risk Assessment, and the Volpe GPS Vulnerability Assessment, describe the vulnerability of GPS to intentional and unintentional interference. Reporting procedures have been developed for pilots and are being incorporated into formal documents for Airways Facilities and Air Traffic Control personnel. The SatNav Operational Integration Team has worked closely with the FAA's Office of Spectrum Management (ASR) to support development, testing, and analysis of various interference detection options.

In summary, the role of the SatNav Operational Integration Team is to ensure that the infrastructure/regulatory development and operational development for WAAS and LAAS move forward together, so that one element does not get too far out in front of the other.



The Satellite Operational Implementation Team (SOIT), an organization co-sponsored by the FAA's Flight Standards Flight Operations and Aircraft Certification directorates, provides a leadership role in coordinating operational implementation activities. The SOIT meets quarterly to discuss pertinent

implementation issues. Every other meeting is an Open Forum with Industry, which provides industry and user groups an opportunity to exchange their views on SatNav issues

For more information about the SatNav Operational Integration Team, please visit the NAS Implementation section of our website at: <http://gps.faa.gov/programs/index.htm>.