STATEMENT OF MARTIN (Marty) POZESKY, FAA ASSOCIATE ADMINISTRATOR, SYSTEM ENGINEERING AND DEVELOPMENT, BEFORE THE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION, SUBCOMMITTEE ON AVIATION, JULY 28, 1993

Mr. Chairman and Members of the Committee -- Thank you for this opportunity to appear before you to discuss what is clearly the most significant air navigation program the FAA has undertaken in recent times. I am joined here today by my colleague, Mr. Anthony Broderick, the FAA Associate Administrator for Regulation and Certification, who is well known to you.

The satellite technology used in the Global Positioning System has incredibly far reaching potential for the future of aviation. Two years ago, a satellite-based navigation system for civil aviation was still only hope. Today, we are well on our way to having a single navigation system that can handle all phases of flight all over the world with unprecedented accuracy. GPS, combined with advanced telecommunications and higher levels of automation, offers unlimited opportunities for improvement in aviation safety, capacity, and efficiency.

Major operational benefits are expected to accrue from use of this combination of GPS, automation, and data link. These include fuel savings, reduced flight time, reduced avionics requirements, more efficient flight paths, and reduced delays --all made possible by procedures that flow from more accurate area navigation information and improved surveillance. These benefits will be realized first in the oceanic airspace where

this technology will be used to provide optimized flight paths to greater numbers of aircraft. Using a combination of GPS position information relayed back to the ground through a commercial satellite communication link (such as currently provided by the INMARSAT system) this technology combination will provide a pseudo-radar surveillance capability over the ocean where no such capability exists today. Thus, more aircraft can safely make use of the "best-wind" tracks across the ocean saving significant fuel and operating cost.

General Aviation may even enjoy greater benefits from this capability. Consider the approach and landing capability alone. The real possibility exists to provide both precision and non-precision approach capability to virtually every airport in the country as well as the world through this combination of systems. Both general aviation and the major commercial carriers will enjoy far greater operational flexibility by having available (at minimal cost) a huge number of additional instrument approaches without the need for very expensive ground investments.

The FAA is a strong advocate of GPS, as we hope the Committee will be at the conclusion of this hearing. What is also very exciting is the fact that the FAA has played a leadership role in the application of this exciting new technology to aviation. Working cooperatively with the Department of Defense and with system users, we have progressed on the technological,

operational and institutional fronts simultaneously. I believe that by any reasonable measure of achievement, we have progressed at "lightning speed" thus far.

While our enthusiasm will be clearly evident in the course of these hearings, please be assured that we are very mindful of the safety implications of the system and are taking all the necessary steps to insure that this future system will be at least as safe and reliable as the systems that have served us so well over the past decades. What we are talking about is enormously more capability at equivalent (or even enhanced) levels of safety and integrity through the proper mixture of satellite technology, separate integrity and monitoring systems data links, cockpit, and ATC automation. Focus again on the combination, because that is what is needed -- GPS for precision navigation, data link for error free computer-to-computer communication, ATC as well as flight automation to develop the optimum integration of traffic and the best combination of capabilities.

Until now, air navigation has made use of a variety of radio-navigation systems which provide reasonably precise and reliable position information. Systems such as VOR/DME (Very-High Frequency Omni-Directional Range/Distance Measuring Equipment), Loran-C (for long-range navigation), Omega and ILS (Instrument Landing System) have provided excellent, wide-ranging navigation capabilities; but for some phases of

flight all are limited in either coverage or accuracy, or both. Therefore, users must carry several types of receivers to obtain navigation service for all phases of flight.

Satellite technology, and specifically GPS, will provide continuous, reliable, accurate position information for all phases of flight to users worldwide. By the end of this year, DOD will declare Initial Operational Capability for GPS. However, even before this formal declaration, we have begun to use GPS in domestic and oceanic airspace. The FAA has approved use of GPS as a supplemental aid for enroute and terminal navigation and for non-precision approaches. We are conducting tests to allow the private use of GPS for precision landings and at least one airline is intending to make use of that capability this year or early next. We have already issued our Technical Standard Order for supplemental use of GPS in the national airspace system and have issued procedures for use of GPS as a non-precision approach landing aid. In fact, I must tell you that this is the first time that I can remember that we have had procedures in place for new technology before the certified avionics equipment became available.

The Defense Department pioneered this system 20 years ago and had the foresight in their original concept to include a civil mode. Without that visionary foresight on the part of a few individuals, we might not have this capability today. Cooperation between the DOD and FAA on this system has been

outstanding. The FAA has been working closely with the user and supplier community, as well as with the international community through ICAO, to gain the full and early benefits of this vastly improved technology for civil air navigation. For example, about 18 months ago, the FAA asked RTCA -- a preeminent aviation organization -- to be the forum for the development of a US aviation industry-wide consensus on moving toward satellite navigation. That landmark effort was completed in September 1992 resulting in broad community support for early transition to GPS and satellite technology.

On the international scene, the FAA has been working through ICAO to foster the early introduction of satellite technologies to world-wide aviation applications. Last year, in a coordinated effort, the US Government formally offered the Standard Positioning Services (or "civil" mode) of GPS to ICAO for aviation use throughout the world without direct user costs. It was envisioned to use this as a transition step to enable early movement toward satellite technology. We are moving, the world is moving, and it is exciting to see the momentum build in support of this transition.

There are still a number of legitimate policy and technical issues to be addressed as we begin to rely on this new technology and make plans to phase-out the older systems. On this front, we are very sensitive to the need for an overall government strategy to address all of these issues -- not just

an FAA strategy, but a US government strategy. This include fine-tuning of a set of issues ranging from national security protection of GPS to system accuracy, and operational integrity. These questions, however, will not prevent us from beginning operational use -- and learning from our experience -- as we continue to develop the means to rely solely on GPS for air navigation. We are addressing all of these issues in our research & development, testing, and operational activities.

Most importantly, a comprehensive set of policies and strategies to provide for civilian use of this system are being developed under the leadership of a working group already chartered by Secretary of Transportation Pena and Secretary of Defense Aspin. This group got started shortly after the new Administration took office and is expected to complete its initial work in November of this year. The goal, simply stated, is to insure the long term availability of GPS as an asset to all modes of transportation -- not just aviation.

Let me step back for a few minutes and describe a little about the GPS system. The GPS satellites have been placed in orbit by DOD 11,000 miles above the Earth and emit continuous, identical radio signals. A simple receiver measures the distance from at least four satellites by calculating the time it takes the signal to arrive and thus pinpoints its own location. The satellites provide complete worldwide coverage at both low and high altitudes. As it becomes more refined, it appears as if GPS can substitute for most other aviation navigation systems.

The Standard Positioning Service is available to any GPS user worldwide with a commercial receiver at no direct charge to the user. It is specified to be accurate to within 100 meters, horizontally, and 140 meters, vertically 95% of the time. The Precise Positioning Service (PPS) is more accurate and will be limited to military and specifically authorized civil users.

The Basic SPS signal, while providing a significant improvement over existing methods of navigation, needs augmentation to meet the full range of anticipated aviation applications. As it currently exists, GPS can be used as a supplemental system for oceanic, domestic en route, terminal and non-precision approach navigation. The next step will be to use GPS for Cat I precision approaches. To meet these requirements, we are developing a feature called "Differential GPS."

Differential GPS will enhance the accuracy of GPS for all users within coverage of this differential capability. Simply stated, the system will correct for known errors in the satellite signals and transmit error correction messages directly to the aircraft GPS receivers. This will effectively remove most of the errors in derived GPS position within coverage of this differential system. GPS, with this differential capability, should allow precision landings at a very modest cost at virtually every runway end in the world. In addition, this improved accuracy would allow GPS to be used to navigate around the surface of an airport in low visibility conditions -- thus

a safety enhance to provide further protection against runway incursions. Even an improved GPS based TCAS (what we have begun to call TCAS IV) is possible.

There are two types of Differential GPS: Local-area and wide-area. Local areas systems will make use of simple data-link transmitters located, say, at an airport. These are not much more complicated than a normal VHF radio and are available now. Because of their low cost and simple design, they are reasonable affordable and can be provided by local operators and communities to meet their needs. Local differential systems will have a coverage radius of about 20-25 miles and probably will provide a little more accuracy than the wide-area system.

The wide-area system is a more elaborate system and will involve the transmission of correction signals from geo-stationary satellites that will cover large land areas such as the whole of the U.S. It will require a fully integrated network of ground monitors and a few broadcast satellites to transmit the corrections. Our current belief is that wide-area DGPS will use 20 ground-based monitors evenly spaced across the United States. The ground-based monitors will effectively correct the satellite information. We are doing the development work now and have recently completed some testing of this capability at Technical Center in Atlantic City.

Now that I've described what GPS is and what it can do, how can we make full use of those satellites already in place? We believe that full utilization will require ongoing progress in three areas simultaneously: technical, operational, institutional. The FAA is actively engaged in each of these areas and has made significant inroads.

Technical

Several major technical projects are underway in the FAA R&D Service to support a rapid implementation of GPS technology. First, the wide-area differential network is being designed to augment the basic satellite constellation providing integrity, more satellite availability and better accuracy. On-line testing with our wide area test bed facility at the FAA Technical Center is ongoing, with a target to provide accuracy supporting all phases of flight down to Category I precision approaches.

Local-area differential research is focusing on early Category I precision approach capability for private users. Current activities in this area are being conducted with regional air carriers, which will be the first to benefit from this technology.

Research is underway to further improve the local-area concept by demonstrating feasibility of this technology to support

Category II/III precision approaches. This feasibility demonstration should be complete by 1995. In coordination with industry and RTCA, we are also working on avionics and ground system specification development to ensure that the systems are interoperable and satisfy user requirements.

Advanced R&D projects are continuing to investigate the potential of GPS to support advanced navigation and other functions such as weather prediction, airport surveillance, height monitoring over the oceans, GPS-based attitude information, a GPS-based TCAS, to name only a few.

We are working on several bilateral agreements to undertake R&D that would enhance GPS acceptance abroad. International programs covering pilot/controller procedure development, avionics specifications and advanced GPS applications are being enthusiastically pursued by the FAA's Satellite Program Office.

Operational

Our work has been just as aggressive to move GPS along operationally. FAA has approved the supplemental use of GPS for all phases of flight, including non-precision approaches to airports. With this approval, GPS can be used to fly existing VOR, NDB and RNAV approaches. In tests undertaken in conjunction with Transport Canada, FAA has tested and approved instrument approach overlay procedures that will permit

non-precision approaches at about 2500 airports in the U.S. Further, last December, after working closely with industry manufacturers, FAA issued certification criteria for GPS receivers. These are expected to be available from U.S. manufacturers this Fall.

These and similar operational procedures in support of early satellite navigation implementation were developed by the FAA The actual development of operational procedures and standards, however, is a primary function of the FAA Satellite Operation Implementation Team, known as SOIT. SOIT is a prime example of how FAA has met the challenges of timely satellite navigation development in aggressive, new and creative ways. SOIT was formed in 1991 to establish the technical, operational, and certification requirements and procedures necessary to authorize GPS use as soon as incremental improvements in various capabilities become able to satisfy IFR requirements for a particular phase of flight. Because of SOIT's work, certain aircraft were authorized as early as last year to use GPS information, as long as traditional navaids were available to cross check the GPS readings. SOIT's aggressive pursuit of early operational implementation resulted in the development of a Technical Service Order (TSO) that redefines the minimum operating performance standards to permit navigation, thus increasing GPS availability.

Institutional

On this institutional side, I have already mentioned the DOD/DOT joint task force which is underway to ensure the long-term utility of GPS as a national asset. The Task Force will examine issues such as joint management, operation and funding. It will be the task force's job to determine the level and types of long-term civil augmentation that can best be implemented. The task force is addressing legal, liability and national security concerns, with its initial recommendations expected around November.

Ultimately, satellite navigation is a worldwide venture. The FAA, together with ICAO and other members of the civil aviation community have recognized that the primary stand-alone navigation system in the 21st century will be provided by a Global Navigation Satellite System (GNSS) of which GPS will be a part -- maybe even a major part. The FAA has offered the use of GPS for international civil aviation as a part of the ICAO Global Navigation Satellite System (GNSS) -- the international term for the future satellite navigation system. It is important to understand that there is a difference between GPS and GNSS, it is already becoming clear that the world will use GPS as a first step, if you will, toward satellite navigation.

This is a very exciting time. We are pursuing this technology as rapidly as possible but we are mindful of the safety

implications of the system and take all the necessary steps to insure that the system of the future will be as safe and reliable as the systems that have served us so will over the past decades. What we are talking about is enormously more capability without sacrifice of system integrity, reliability, or safety.

That completes my prepared statement, Mr. Chairman. We would be pleased to respond to any questions you and the other Members of the Committee may have at this time.