

STATEMENT OF ALBERT P. ALBRECHT, ASSOCIATE ADMINISTRATOR FOR DEVELOPMENT AND LOGISTICS, FEDERAL AVIATION ADMINISTRATION, BEFORE THE SENATE COMMITTEE ON COMMERCE, SCIENCE AND TRANSPORTATION, SUBCOMMITTEE ON AVIATION CONCERNING THE APPLICATION OF SATELLITE SYSTEMS FOR AIR NAVIGATION--MAY 23, 1984

Madam Chairmen and Members of the Subcommittee:

It is a pleasure to be here today to discuss Senate Concurrent Resolution 69, expressing the sense of the Congress that the Secretary of Transportation should make available for civilian use certain satellite-directed navigational aids developed by the Department of Defense for the guidance of aircraft. I would like to address this issue by giving you some background information on FAA's involvement in exploring the use of satellite systems for civil air navigation.

The Federal Aviation Administration has been studying the applications of satellite technology to civil aviation since 1961, and since 1976 has been actively investigating and conducting research and development activities relating to the potential future use of the satellite systems for civil air navigation. In recent years those efforts have been concentrated on NAVSTAR GPS.

Over the past several years, we have intensively studied NAVSTAR GPS navigation system performance for various potential NAVSTAR GPS constellations, and we are continuing our investigations on system coverage, reliability, and integrity in conjunction with the Department of Defense.

We have sponsored comparative navigation system cost and transition analyses.

FAA has done extensive R&D work on NAVSTAR GPS airborne equipment. Specifically, we have:

- o Completed avionics cost studies.
- o Conducted analyses of several satellite navigation system proposals.

- o Developed and tested a dual channel GPS receiver functionally acceptable for national airspace system applications.
- o Extensively tested the DOD-procured "Z-Set" GPS receiver in the en route, terminal and nonprecision phases of navigation.
- o Conducted extensive flight simulator tests of GPS to establish its performance in several regimes of flight.

We are currently studying the possible effects of helicopter rotor modulation on navigation performance. In addition, DOT has a representative in the NAVSTAR GPS Joint Program Office, which has helped us keep abreast of system activity on a day-to-day basis.

We have worked closely with the Department of Defense in assessing the characteristics of NAVSTAR GPS as they will apply to civil aviation use. Our conclusion is that the system has the potential and the accuracy to perform virtually any air navigation task, down to and including nonprecision approach. Unlike other systems we have examined closely, NAVSTAR GPS has the potential to provide navigation in any part of the world. Further, it can provide services in mountainous terrain essentially to the surface of any airport in the world.

Nevertheless, in extensive public discussions of future navigation needs in the civil aviation community, held in mid-1982, no compelling near-term requirement was expressed for NAVSTAR GPS, nor was there firm indication that civil users would be ready to embrace it in the near term. The general sentiment was that if NAVSTAR GPS is implemented, in the longer term the marketplace would bring about civil use, at least for certain navigation applications.

The user community has not stated a clear requirement for significantly improved domestic navigation except to serve helicopter operations. Over oceans, inertial navigation systems (INS)—good and getting better—have been approved as a "sole means" of navigation. The INS system may be used in appropriately redundant installations, without need for other navigation aids. However, the more accurate navigation available from satellite navigation

systems may well be desired in the future as oceanic traffic builds and reduced aircraft separation standards are sought.

Like INS and Omega, NAVSTAR GPS will have the capability to provide aircraft position data which can be automatically remoted by data link systems to ground air traffic controllers. This function, termed automatic dependent surveillance, is an attractive system improvement for both safety and efficiency in areas where radar is not available. In addition, NAVSTAR GPS may provide a lower undetected error probability, thus potentially enhancing the functional utility of automatic dependent surveillance.

In the wake of the tragedy of KAL 007, the President stated that NAVSTAR GPS services would be made available to civil aviation if the potential for future tragedies could be averted thereby. No one knows whether the availability of a back-up navigation system, such as NAVSTAR GPS, or Omega, could have prevented the Korean Air Lines tragedy, but it was the President's wish to assure that the unique worldwide navigation capability of NAVSTAR GPS would be available in the interest of international aviation safety.

Initial civil use of NAVSTAR GPS is expected to be on a supplementary system basis with other inputs required to assure continuous navigation capability throughout the world's airspace. We have considered various approaches to providing the supplementary inputs. These include pressure altitude inputs from a precision altimeter system onboard the aircraft, a more precise clock which forms a part of the GPS receiver system in conjunction with other systems such as, inertial and VOR/DME navigation systems. We believe that in the long term NAVSTAR GPS must be a "sole-means" system if it is to realize its full civil potential. We are working with the Department of Defense to determine the best method of resolving the remaining questions on system reliability, coverage, integrity, and cost recovery.

We are looking to see how many satellites will be required in order to provide reliable U.S. and worldwide coverage. It appears that at least five satellites must be visible above a 10 degree elevation angle, with each combination of

four satellites providing good position fixing accuracy. Certain technical changes may be needed in the monitoring of the system to assure a rapid, system-wide failure detection and warning capability—a critical requirement for civil aviation operations. If those changes are made, NAVSTAR GPS with its high accuracy perhaps could become a "sole-means" air navigation system in the United States and potentially in other parts of the world.

We feel the consideration of early civil aviation use of NAVSTAR GPS for over selected oceanic areas, such as the North Pacific, before 1988 is not a practical possibility. Such an implementation would add additional costs to the program and possibly compromise operational capability by disrupting an already tight DOD plan aimed at systematically testing NAVSTAR GPS component elements and attaining the presently conceived operational satellite constellation that would provide a worldwide capability for civil aviation by 1988. The alternatives we have examined would only allow a limited early use period of about one year ahead of the present schedule, and would require the provision of an expensive airborne atomic clock as well as precision altimeter inputs. We suggest instead that the current planned schedule for GPS be maintained, and starting in 1988 NAVSTAR GPS could be used with INS or OMEGA as an aviation oceanic navigation system until the NAVSTAR GPS system is upgraded to where it can be approved for "sole means" use. Domestic use of NAVSTAR GPS by civil aviation would be as a supplement to existing approved systems until the requirements for "sole means" are met.

We are aware that the Department of Defense plans to use NAVSTAR GPS to phase out use of a number of other navigation services now being used by them. We will work with DOD and the civil user community to establish Minimum Operational Performance Standards for NAVSTAR GPS starting in 1985 for use of GPS as a supplementary or as a primary navigation aid, depending on the specific capability and the resolution of the remaining issues. We see no reason why NAVSTAR GPS cannot be used in the civil system as soon as its coverage, performance, and failure detection capabilities are defined.

While we believe that VOR/DME, the current international standard short-distance navigation aid, will continue as a primary domestic civil navigation

system for the foreseeable future, it may be that other systems currently in use or coming into use by civil aviation worldwide may no longer be needed. Systems like Loran C and Omega may no longer be needed after NAVSTAR GPS equipment cost is reduced to a level so that its purchase would not be an economic burden for existing users, and an appropriate transition period is allowed.

Let me turn now to the question of a special charge for NAVSTAR GPS services. This Administration supports the principle that users pay for the services they utilize. As you know, the Congress has already provided a system of user charges through the airline ticket tax, aviation fuel taxes, waybill taxes, international departure taxes, etc. to finance the capital investment for aviation facilities. In the past, as new services have been brought on, they too have been paid for by this means. Thus, a reasonable approach would be to recoup the cost of GPS operation allocable to civil users through their existing taxing methods.

An alternative approach, of course, would be to levy a "special" charge. The practicality of such an approach is questionable, however. Of particular concern to us are the difficulties of administering a recurring charge in both the domestic and international setting, as well as maintaining access to the system for as many users as possible.

While we believe the United States would not in any way force others to use NAVSTAR GPS, the system has potential attractions and capabilities which may give it wide appeal, especially as the costs for airborne equipment come down with mass production. United States industry, which has been working actively with GPS for a number of years and has amassed substantial expertise, stands to gain if the world chooses to utilize this service.

U.S. aircraft operators who fly in virtually all parts of the free world would gain in another way from universally available high-quality navigation service. There are many parts of the world where only minimal electronic navigation services exist. Universal availability of services from a satellite system such as NAVSTAR GPS would benefit U.S. operators, as well as all others.

In addition, optimum route and flight profiles--at closer than present separations--resulting in reduced fuel and flight time benefits in oceanic areas appear possible through the use of GPS in combination with the use of automatic dependent surveillance systems. Automatic dependent surveillance, in which air-derived navigation position information is automatically transmitted to controllers, is one of several improvement options recommended by the International Committee to Review the Application of Satellite and Other Techniques to Civil Aviation. This Committee was formed as a follow-on to the AEROSAT project, which was to have provided oceanic aeronautical satellite communications services. The Committee was established to examine the needs, and means available to meet the needs, for ATC system improvement, primarily in oceanic areas.

After working for more than two years, the Committee made a series of recommendations which included support for reduction of vertical separation above Flight Level 290 to 1,000 feet; implementation and carriage of an airborne separation assurance device--that is, a collision avoidance system; improvements in navigational performance, probably within the capability of inertial navigation systems, but not excluding other options; automatic dependent surveillance--that is, the automatic readout of on-board navigation data and its transmission and presentation to the controller without human intervention, as a by-product of improved high frequency (HF) radio or satellite data link communications capability; and improved quality and presentation of information to controllers on aircraft position and intent.

FAA is moving forward on a number of these recommendations.

After the international Committee's work was completed and strongly endorsed by a number of governments, including the United States, it was recommended that the International Civil Aviation Organization (ICAO) carry the work forward and extend it to issues which deal with the longer term needs for communications, navigation, and surveillance system improvement of various areas of the world, and the technologies available to help satisfy those needs. After consideration, the Council of ICAO established a policy-level Committee to deal with these issues.

We believe that the ICAO activity is important, and expect to participate fully. We also want to assure that the contribution the United States makes to this worldwide consideration truly represents the best interests of the United States and its aviation user community. For this reason, FAA proposed the formation of a Special Committee of the Radio Technical Commission for Aeronautics.

The RTCA Committee will examine the NAS Plan system now being built, the need for additional capabilities, and the conditions under which we can realistically expect new technologies to find their way into the world aviation system. The National Aeronautics and Space Administration is offering its technology assessment expertise in this activity. New technologies are not free, and it is essential to compare the new approaches with the ones being implemented around the world to assure that they in fact do something which needs to be done, that they do it better, and that they do it at a cost which, all things considered, is reasonable.

In conclusion, we believe NAVSTAR GPS has the inherent potential to provide an enhanced worldwide "sole means" air navigation capability for all services except precision approach and landing, providing that matters of coverage, reliability, integrity, and user costs are favorably resolved. The future acceptance by the user community, strongly dependent on assured availability of the service and on availability of competitively-priced avionics, will have a large impact on determining if and when air use of such navigational aids as Loran C and Omega can be phased out. The potential of NAVSTAR GPS to support eventual system improvements in oceanic and other areas of the world through improved navigation performance, and as an input source for automatic dependent surveillance in nonradar areas with a low undetected-error probability, could help make NAVSTAR GPS attractive to the international community.

That concludes my prepared statement, Madam Chairman. At this time, I would be pleased to respond to any questions you may have.