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STATEMENT OF
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 TECHNOLOGY DIVISION
 BEFORE THE
 SUBCOMMITTEE ON TRANSPORTATION, AVIATION, AND MATERIALS
 OF THE
 HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY
 ON
 USE OF SATELLITE TECHNOLOGY FOR
 AIR TRAFFIC CONTROL AND NAVIGATION

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Mr. Chairman and Members of the Subcommittee:

We appreciate the opportunity to comment on the potential use of satellite technology for air traffic control and

navigation. We believe this potential use is best addressed

within the context of the national airspace system. As you know, the Federal Aviation Administration (FAA) developed and issued a National Airspace System (NAS) plan in 1981 in a major effort to modernize the nation's airspace system, including air traffic control and navigation. The NAS plan is primarily based on

ground-based systems and gives minimal consideration to satellite technology because, in FAA's opinion, satellites were not cost-effective when the plan was developed, nor could they be

operational by the time the upgraded ground-based systems were to be in place by the early 1990s.

In 1983, FAA requested the Radio Technical Commission for

Aeronautics to look beyond the NAS plan and assess the value of satellite and other technologies for civil aviation. The

Commission's recent draft report² also provides a basis for U.S. input into an international committee that is evaluating the

potential use of satellites for air traffic control on a global

basis.

National Airspace System Plan (Federal Aviation Administration, December 1981).

Draft Report of Special Committee 155, User Requirements For Future Communications, Navigation, and Surveillance Systems, Including Space Technology Applications (RTCA Paper No. 354-86/SC155-190, August 13, 1986).

Based on several studies to date on the NAS plan, our preliminary work in evaluating the use of satellite technology, and our initial assessment of the recent draft report by the Radio Technical Commission for Aeronautics, it appears that satellite technology has advanced rapidly and may be more available and cost-effective than FAA believed in 1981. At the same time the potential for satellite technology has improved, it is becoming increasingly apparent that the NAS plan may not deliver the systems and benefits expected, at the cost expected, or within the timeframe expected. Consequently, this may be a good time for FAA to re-examine its plan. FAA has some research and development projects, which, if focused properly and actively pursued, could serve to clarify the role of satellite technology. However, much work needs to be done and these new projects are largely unfunded. The emphasis should be on (1) how and when satellite technologies may be properly integrated into the plan, (2) the end objectives of the system modernization, and (3) any needed changes in FAA's investment plans and in its research and development programs.

COMMUNICATIONS, NAVIGATION, AND SURVEILLANCE SYSTEMS ARE INTEGRAL TO THE NATION'S AIRSPACE SYSTEM

Communications, navigation, and surveillance (CNS) systems, integral parts of the national and international airspace systems and the NAS plan, are predominantly ground-based, line-of-sight systems. Communications systems provide the connectivity between the pilot and controllers and among controllers. Navigation systems provide aircraft position information to pilots and

⁴The Mode S Program and Long Range Future Plans for Aircraft Surveillance (Federal Aviation Administration, June 1984).

³Review of the FAA 1982 National Airspace System Plan (OTA-STI-176, August 1982).

In 1982 the Office of Technology Assessment issued a report³ on FAA's NAS plan. The report concluded that satellites had considerable potential for communications, navigation, and surveillance and that FAA may have prematurely written off the use of satellite technology. Also, the report noted that FAA excluded satellite CNS technology from its 1981 plan because, in FAA's opinion, satellites were not cost-effective at that time, nor could they be operational by the time the upgraded ground-based systems were to be in place in the early 1990s. A 1984 FAA report⁴ to the House Appropriations Committee restated this

decisionmaking. Including increasingly automated air traffic control ground communications and increased ground-based automation, controllers, would come from improved ground-to-air and air-to-ground communications and increased ground-based automation, improving the effectiveness and efficiency of air traffic control (30,000 feet) of the airspace. Most FAA benefits, such as routes of their choosing in the higher areas (generally above 30,000 feet) of the airspace. Most FAA benefits, such as both users and FAA. Most user benefits, such as fuel savings, would come from the users' ability to select and operate on systems, CNS systems are expected to produce large benefits for both users and FAA. Most user benefits, such as fuel savings, when combined with the agency's new advanced automation

facilitate landing. Surveillance systems provide the current aircraft position data to controllers.

Air Traffic Control: FAA's Advanced Automation System Acquisition Strategy is Risky (GAO/IMTEC-86-24, July 8, 1986).

operational feasibility of this system's advanced automation System. To date, FAA has not demonstrated the technical and of one of the systems in this program--the Advanced Automation 1986 report⁵ questioned the technical and operational feasibility fully implemented until after the year 2000, if at all. Our July productivity benefits, have slipped 5 to 10 years and will not be to deliver most of the user fuel savings and FAA controller which, when combined with the planned CNS systems, are expected In particular, those key NAS plan automation features,

risen substantially. be, much lower than originally estimated; and cost estimates have technical and management problems; FAA's benefits are, or will the schedules of most major programs have slipped because of within the timeframe expected. Operational problems have grown; the systems and FAA benefits expected, at the cost expected, or It appears that the current NAS plan is not going to deliver

CONCERNS WITH THE NAS PLAN

as FAA had projected. slipped or if benefits as compared to costs did not materialize technologies warranted re-examination if the NAS plan's schedule Office of Technology Assessment concluded that satellite needed to support surveillance could be in place, if at all. The belief and added that it might be 30 years before the satellites

features and is having difficulty in defining how these procedures can be developed with ground-based systems. The 1981 plan estimated that beginning in 1989, this system was supposed to allow more flexible and direct routes in the higher areas of the airspace, thus providing fuel savings to users (primarily air carriers) using that airspace. It now appears that the first installment of such capability will not be available until 1997.

There also appears to be increasing concern about the technical and operational performance of FAA's planned CNS systems. Two come to mind. The first is the precision landing system. This system is supposed to deliver added airport capacity through more efficient landing approaches, as well as additional fuel and time saving benefits to users. The second is a new data-link, which is supposed to provide ground-to-air and air-to-ground digital data communications, thus improving controller productivity. The full implementation of these systems is also slipping toward the year 2000.

As timeframes and costs increase, it becomes more questionable whether FAA benefits expected from the NAS plan will exceed the costs. Our work to date indicates that through the year 2000 the NAS plan will now cost \$16.55 billion instead of the \$11.7 billion estimated in 1981. Overall, the discounted benefit estimates for FAA through the year 2000, which are currently being re-examined, have fallen from \$24.5 billion to \$16.5 billion.

aircraft, thus improving search and rescue operations. safety. Satellites may further facilitate the location of downed

to the aircraft, which can be critical to improved airspace conflicts in lower areas of the airspace and communicate warnings may improve the controllers' ability to better identify aircraft more comprehensive, look-down view. For example, such coverage coverage down to the earth's surface because of their strategic, and to satisfy most user needs. Satellites essentially provide appear to be the only effective way to address these limitations Based on our limited assessment, satellite CNS technologies

services.

aviation without any substantive improvement in coverage or leaves the large number of commuter, business, and general carriers) who fly in the higher areas of the airspace. This via direct routes only to those users (primarily major airline if successfully implemented, will provide fuel saving benefits radar's beam. Additionally, as mentioned earlier, the NAS plan, earth, leaving an increasing gap in coverage underneath the from the ground, which rises away from the curvature of the of the earth's surface because of their short-range line-of-sight current and planned CNS systems do not provide complete coverage community users' CNS needs for the next 25 years. For example, successfully implemented, it will not meet many of the aviation recent draft report, even if the NAS plan were to be fully and Perhaps more important, as identified by the Commission's

The Radio Technical Commission for Aeronautics is a long-standing association of U.S. government and private aeronautical organizations. The Commission does research to develop technical solutions to aeronautical problems involving the application of electronics and telecommunications. At FAA's request, the Commission established a special committee in July 1983 to develop representative civil user views of the needs and requirements and forecasts of airspace conditions for technological applications, including satellite technology, for at least the next 25 years. The Commission was also to assist the U.S. Government in formulating a position on CNS user needs as input to an international committee examining a similar issue. The Commission looked beyond the NAS plan and outlined a

**THE RADIO TECHNICAL COMMISSION
FOR AERONAUTICS PROVIDES A
DIFFERENT PERSPECTIVE ON AIRSPACE
MANAGEMENT AND SYSTEM ARCHITECTURES**

Finally, we are concerned that if implemented, the NAS plan may well constrain options for future cost-effective transitions to the use of satellite technology. For example, the currently planned Advanced Automation System is oriented to ground-based data processing and automated decisionmaking. This type system does not appear to be operationally or economically extendable to a satellite-based system that is conducive to more shared data processing, automation, and decisionmaking in the aircraft. In addition, because of power and antenna limitations, it does not appear at this time that the plan's new ground-based data-link system for communications will be able to economically operate with satellites.

transition into possible but not yet available systems. Essentially, the Commission's work assumed that the current NAS plan would become operational and deliver benefits by the early to mid-1990s.

We believe that the Commission's work is notable because it presents a different view on future airspace management. The Commission concluded that future airspace management systems should, with more flexible real-time monitoring, permit each flight to operate on its most favorable and fuel-efficient path without intervention, except as necessary to avoid severe weather or collision with another aircraft. This represents a substantive change in control philosophy from either the current close control to fixed altitudes and preset routes or the currently planned automated control to preset flight plans. In addition, the Commission proposed that future CNS systems should provide coverage from the earth's surface to 70,000 feet and eventually even higher. The benefits of the Commission's proposal rely almost totally on the extent to which this airspace management concept can be achieved.

The Commission also concluded that even if fully and successfully implemented, the NAS plan would not provide the capabilities necessary for the future airspace management system. For example, it said the plan would not meet all user requirements, such as (1) coverage of low altitude areas, (2) landing of aircraft in areas that do not have precision landing capabilities, and (3) control of airspace where flight is

restricted due to limited CNS capabilities. The Commission concluded that the use of satellite CNS technology, along with automation technology, appears to be the most effective way to overcome most air traffic control deficiencies and satisfy users' unmet needs. The Commission's work also included an assessment of the operational, economic, and technical feasibility of alternative technology, including satellite technology. The Commission observed that satellite technology would likely become cost-effective in the near future.

The Commission assumed that, since the NAS plan would deliver interim capabilities and benefits in a timely fashion, the plan should not be delayed to wait for the benefits of the new airspace management system. The NAS plan, it assumed, would be flexible enough to accommodate the new satellite technology as it became available in the near future.

We believe that the Commission's assumption of timely safety and economic benefits from the NAS plan may not be valid under existing conditions--judged by the current status of many projects in the plan. As mentioned earlier, our review of existing documents has shown that (1) the schedules of most major programs have slipped, (2) FAA benefits are much lower, and (3) cost estimates have risen substantially. Estimates of user benefits are currently being restudied. Also, as mentioned earlier, we believe it is not clear as to whether the NAS plan has sufficient flexibility to economically or technically accommodate satellite technology in a timely manner. Therefore,

9GAO Questions Key Aspects of FAA's Plans To Acquire the Multi-Billion Dollar Advanced Automation System and Related Programs (GAO/IMTEC-85-11, June 17, 1985).

8Interim Observations on FAA's Plans for Major Systems Acquisitions (GAO/IMTEC-84-14, May 4, 1984).

7Should NAVSTAR Be Used For Civil Navigation? FAA Should Improve Its Efforts To Decide (GAO/LCD-79-104, April 30, 1979).

6Navigation Planning - Need for a New Direction (GAO/LCD-77-109, March 21, 1978).

We have reported several times over the past decade on the need to evaluate satellite technology. In a March 1978 report,⁶ we called for a new direction in navigation systems planning with the advent of the Department of Defense's Global Positioning System, a satellite-based navigation system. In 1979 we reported⁷ that FAA needed to increase its efforts in evaluating the use of this system for civil aviation. Further, in May 1984⁸ and June 1985,⁹ we suggested that there may be advantages to taking a "clean sheet" approach in evaluating the potential of alternative integrated air traffic control system architectures, including those based on satellite CNS technology.

FAA HAS THE OPPORTUNITY TO RECONSIDER SATELLITE TECHNOLOGY

we believe the Commission's assumption concerning the timeliness and benefits of NAS plan projects is a limitation. Consequently, we do not agree with the Commission's assumption that the NAS plan, as currently structured, should proceed without re-examination of its merits as compared to satellite system alternatives.

systems could improve air traffic control over currently planned

and accuracy than ground-based CNS systems; (3) satellite CNS problems; (2) satellite CNS systems could provide better coverage research, development, testing, and evaluation can overcome these We believe that (1) substantial and immediate commitment to

international air traffic control.

quality assurance questions; and institutional problems of commercial service alternatives and attendant liability and acquisition, development, testing, and integration questions; untimely notification of failure and to jamming; its cost; implementation of satellite technology are its vulnerability to example, several potential barriers to the acceptance and systems can be used to perform primarily CNS functions. For aviation community can determine the extent to which these technology. These must be thoroughly examined before the institutional questions must be answered before implementing this satisfy more user needs, important economic, technical, and Although we believe the use of satellite CNS systems may

soon be available.

communications systems are currently available, and others will also be available by the mid-1990s. Satellite voice and data potential to provide navigation and surveillance capabilities may coverage beginning in 1991. Another satellite service with the Global Positioning System is planned to provide three-dimensional satellite capabilities will soon be available. For example, the It appears that the basic elements for providing enhanced

With upcoming multi-billion dollar investment and trust fund decisions, we believe our statements today argue for an immediate and thorough re-examination of the potential use of satellite technology, including the technology's potential impact on the current NAS plan. Such a re-examination should include a full exploration of logical strategies for the transition of satellite and advanced avionics technologies to meet future air traffic

Both the positive and negative aspects of how to apply satellite technology to air traffic control need to be considered. The Commission's study results; the advances of satellite, avionics, cockpit automation, and computer technology; and the slowdown and declining expectations in achieving the current NAS plan system modernization, create--we believe--a window of opportunity. That window of opportunity is available for Congress and FAA to take a new view of the NAS plan as a "living document" with the flexibility to evolve to meet the needs of the airspace users effectively and economically with changing technology. In that view, the plan becomes a step-by-step approach to upgrading air traffic control systems in a calculated way to take advantage of emerging technologies that potentially offer better service at a better cost.

improvements--particularly in the areas of efficiency, such as traffic management, and in safety, such as aircraft separation assurance; and (4) satellite CNS systems can improve these services as well as expand them to most of the airspace and many more airspace users.

control needs. To be clear, we are not recommending either slowing down or stopping the NAS plan, but simply a thorough re-examination and some caution on the commitments to the Advanced Automation System and CNS investment commitments.

FAA has some system studies and satellite technology projects, largely unfunded, which if focused properly and actively pursued, could clarify the future role of satellite technology and how it could be integrated into the current NAS plan. However, FAA will most likely have to place a much more immediate and greater priority on research, engineering, and development efforts to solve the problems of using satellite technology effectively and economically in air traffic control. Also, based on the results of the re-examination, Congress and FAA may want to modify or reconsider a number of programs in the current NAS plan.

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That concludes my testimony Mr. Chairman. We will be happy to answer any questions you or Members of the Subcommittee may have at this time.

