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Aircraft Position Report Demonstration Plan

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16. Abstract

This plan describes the Aircraft Position Report Demonstration which was designed to implement and verify an aircraft/satellite data link for aircraft position reports. The demonstration will implement the Automatic Dependent Surveillance (ADS) function which will provide frequent aircraft position updates for oceanic flights outside the coverage of land-based radar. Aircraft equipped with satellite communication avionics will transmit position reports to a satellite which will relay signals to a ground receiving station. From the ground station, the messages will be sent via the Aeronautical Radio, Inc. (ARINC) network to the Federal Aviation Administration (FAA) Technical Center at the Atlantic City International Airport. The position reports will be processed and displayed on a map showing routes, sectors, and fixes at the FAA Technical Center and a remote processor and display will allow demonstrations to be viewed at Air Route Traffic Control Centers.

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EXECUTIVE SUMMARY

This plan describes the design of the demonstration for aircraft position reporting via an aircraft/satellite data link. The demonstration will implement the Automatic Dependent Surveillance (ADS) function which will provide frequent aircraft position updates for oceanic flights outside the coverage of land-based radar. Aircraft equipped with satellite communication avionics will transmit position reports to a satellite which will relay signals to a ground receiving station. From the ground station, the messages will be sent via the Aeronautical Radio, Inc. (ARINC) network to the Federal Aviation Administration Technical Center at the Atlantic City International Airport. The position reports will be processed and displayed on a map showing routes, sectors, and fixes at the FAA Technical Center. A remote processor and display will allow demonstrations to be viewed at Air Route Traffic Control centers.

INTRODUCTION

OBJECTIVE.

This plan describes the Aircraft Position Report demonstration. The demonstration is designed to implement and verify the Automatic Dependent Surveillance (ADS) function in a real time flight environment and display live ADS targets at an Air Route Traffic Control center.

OVERVIEW.

A one-way data link will be established from the aircraft to the Federal Aviation Administration (FAA) Technical Center. A Federal Express DC-10 equipped with satellite communication avionics will transmit live position information to a satellite via an L-band link. The information passed along will consist of aircraft identification (ID) number, latitude, longitude, and altitude. The satellite will relay this information to a ground receiving station. From there a link to the FAA Technical Center will connect to the processing and display system that will show the live ADS targets and may monitor conformance with the expected flightpath. The system will also have a remote display capability so that the demonstration may be viewed at remote sites (see figure 1).

BACKGROUND.

The ADS function is an enhancement to the Oceanic Display and Planning System (ODAPS), a computer-based air traffic system for oceanic flights in United States airspace which are outside the coverage of land-based radar. ADS consists of a downlink of aircraft position information to Air Route Traffic Control Centers. A satellite-based air/ground data link will provide the means by which the information is transmitted. ADS information will provide air traffic controllers with more frequent position updates than at present. This will improve the controller's ability to detect potential problems and could eventually allow reduction in the separation distances for aircraft in oceanic airspace. Demonstration capabilities for ADS need to be developed in the near term. The ADS demonstration is a cooperative effort with manufacturers, airlines, and the FAA which will produce a display of live ADS targets in late 1988.

To facilitate the earliest possible demonstration, the FAA is teaming up with Federal Express. In the near future, there will be two aircraft equipped with prototype satellite communication equipment: one owned by Federal Express and another which will be flight tested by Boeing for delivery to Northwest Airlines. After considering the many issues involved, Federal Express was chosen to participate due to the lower risk technical issues and an earlier time frame for flight tests - December 1988.

RELATED DOCUMENTATION.

1. Aeronautical Radio Inc., Standard Text Formats for Air/Ground Operator Transcribed and ACARS Messages, ARINC Document No. SE-84017, April 17, 1984.

2. Federal Aviation Administration, Integration Test Plan for Oceanic Display and Planning System, March 1987.

Aircraft Position Report Demonstration

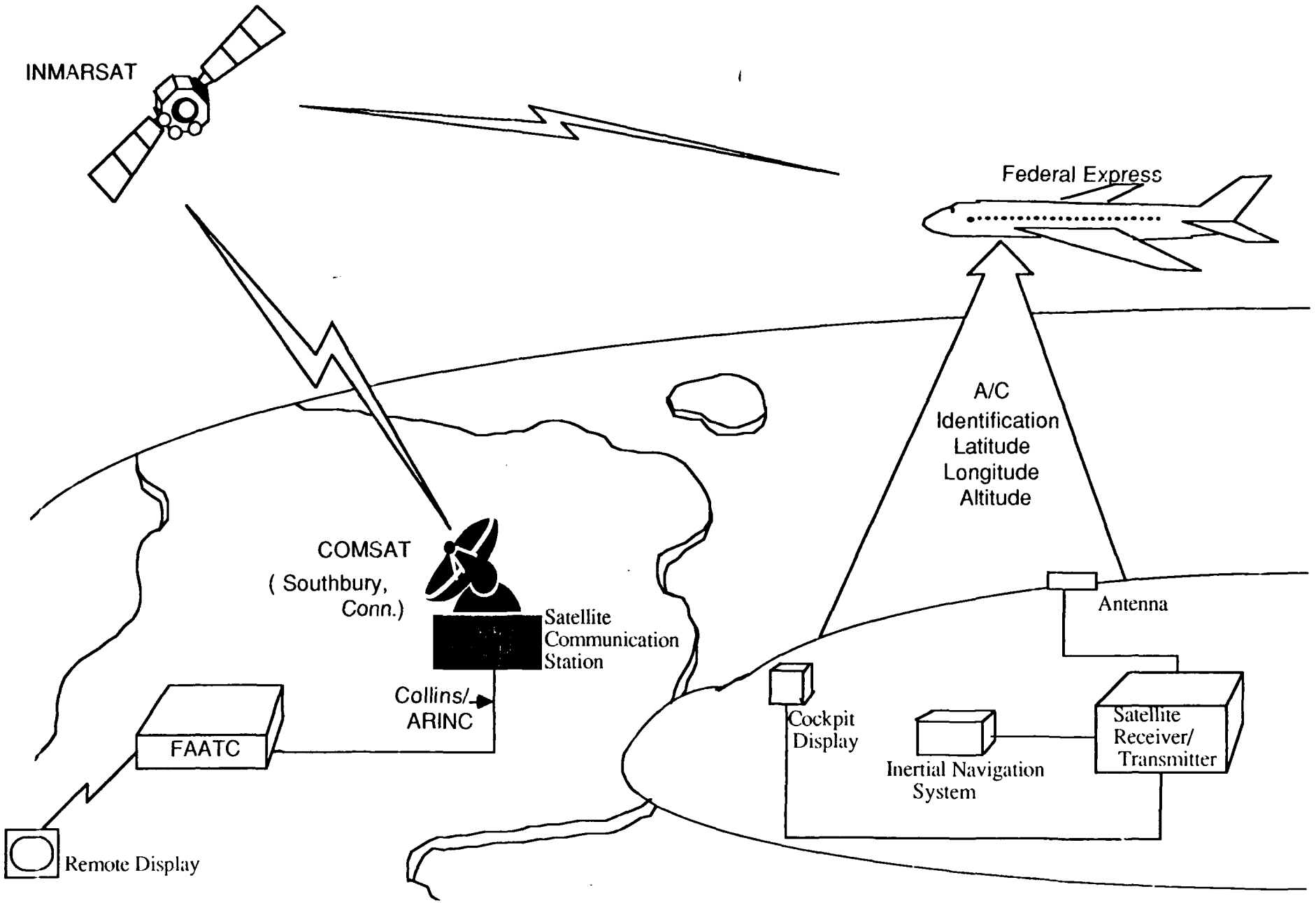


FIGURE 1. AIRCRAFT POSITION REPORT DEMONSTRATION

3. Federal Aviation Administration, Specification for Automatic Dependent Surveillance (ADS) Function for an Oceanic Air Traffic Control System, FAA-D-2836, December 1987.

4. SASC Technologies Inc., Oceanic Display and Planning System Computer Program Functional Specifications Message Entry and Checking, NAS-MD-4311, September 11, 1986.

EQUIPMENT

The equipment required for the demonstration will be provided by the various participants. Equipment consists of satellite communication avionics, a satellite link, two Apollo 4000 workstations with color displays, related software, modems, and communication lines. The avionics will transmit the aircraft position data, derived from on-board navigation equipment, to an INMARSAT communication satellite in geosynchronous orbit. Messages will be in standard ARINC message formats. The ground earth station will relay messages received from the satellite to the Technical Center via the ARINC network. The equipment at the Technical Center includes an Apollo computer and display, its related software, modems, and communication lines. The Apollo computer will interface with the ARINC network and a remote processor and display.

DISPLAY.

The display system will be based upon existing MITRE equipment and software. It will consist of an Apollo 4000 workstation with a color display based at the Technical Center and another Apollo which will have remote dial-up and display capability.

The display will show, at the minimum, ADS and possibly non-ADS aircraft in the domestic and oceanic airspace. For each ADS equipped aircraft the reported position will be displayed, and for non-ADS aircraft the extrapolated flight plan position may be displayed. A map overlay will show sectors, routes, and fixes, and possibly alerts for targets which are out of flight plan conformance.

SOFTWARE.

Input processing software for ADS position reports via ARINC network will be developed. Flight plan extrapolated position will be displayed and conformance of ADS reported position to extrapolated flight plan may also be displayed. Manual inputs of flight plans and data recording will be included as well as software required to drive both the Apollo workstations.

MITRE will deliver the fully functional prototype software to the Technical Center in August 1988 where it will be used for integration testing. The Technical Center will conduct final operational testing of the complete system when the final software is delivered.

INTERFACES.

The Technical Center will supply the various interfaces to the display system. Initially, modems and lines will be provided to link the Apollo display to the ARINC network, which will provide ADS data from the ground earth station and possibly Aeronautical Fixed Telecommunications Network (AFTN) data. Another line will be provided which will permit the remote processor and display to access the Apollo at the Technical Center (see figure 2).

Ground Earth Station. Collins Division of Rockwell International, which is building the avionics for Federal Express, has also developed a prototype interface to the satellite provider's ground earth station. This interface converts satellite signals for transmission on phone lines in the form of a latitude-longitude position report. These reports will be sent to the ARINC network and be available for FAA use.

ARINC. A dedicated line from the ARINC network will be available at the Technical Center. Collins equipment at the ground earth station will send ADS position reports to the ARINC network addressed to the Technical Center. Initially, a dial-up ARINC line will be connected to the Apollo workstation via a 1200 baud Hayes compatible modem. Later, a dedicated line will be used. The Apollo will have input processing capabilities for the messages which use the standard Air Transport Association/International Air Transport Association (ATA/IATA) formats. Message content, or Standard Message Texts (SMT's), to be sent over the link has not been determined, but it is known that the Position Report Without Weather (POS), as per NAS-MD-4311, will be included. Modifications for addressing is expected for ADS usage. AFTN data may be obtained through the ARINC network for aircraft not in domestic airspace.

Remote Display. The Apollo workstation based at the Technical Center will interface with an Apollo workstation and display that can be moved from site to site. The remote will have local display processing capability and communicate with the Technical Center Apollo which will do the ARINC input processing and possibly flight conformance processing. The Apollos will communicate over a standard dial-up phone line using compatible modems.

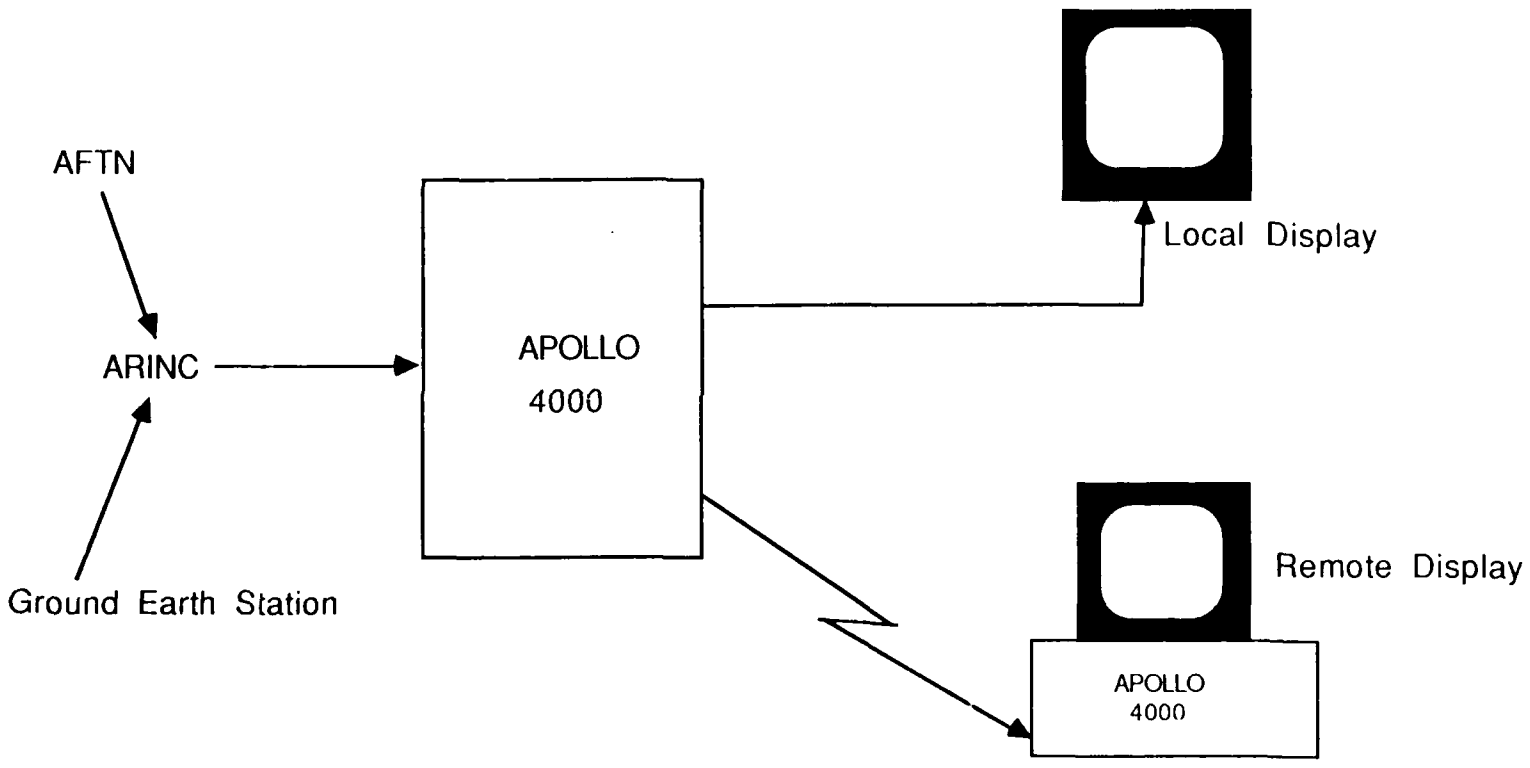
SATELLITE LINK.

The satellite will be accessed via an L-band data link. The Technical Center will coordinate the acquisition of satellite time and installation of equipment with INMARSAT, COMSAT, Federal Express, and ARINC. INMARSAT will donate satellite time for use during these tests.

AVIONICS.

The avionics to be installed on the Federal Express DC-10 are a Collins manufactured satellite receiver/transmitter with a low gain antenna. Modification of avionics to supply ADS data for transmission over the satellite data link will be performed by Federal Express. These modifications entail wiring to connect the satellite communications unit to navigational equipment and software to format the message.

DEMONSTRATION INTERFACES



FAA Technical Center

FIGURE 2. DEMONSTRATION INTERFACES

DEMONSTRATION

The initial demonstration will be conducted at the FAA Technical Center. Federal Express flights will take place over a variety of routes. The exact routes for the demonstration have yet to be determined. The live ADS data will be processed and displayed on an Apollo workstation. The remote processor and display will communicate with the Apollo at the Technical Center which will have the input processing capabilities. This will permit demonstrations to be viewed at headquarters and other FAA facilities. The first demonstration at the Technical Center will be scheduled for late 1988 with remote demonstrations shortly after (December 1988 - January 1989).

AREAS OF RESPONSIBILITY

AES-310 will be responsible for broad strategic management, program scheduling, funding, and providing MITRE resources and policy issues.

ACT-140 will be responsible for day-to-day project management, developing a project plan, coordination with the airline and satellite service providers, procurement and installation of display and processing equipment, conducting the demonstrations at designated sites, and publication of a report.

MITRE will be responsible for developing software which will be used for processing and displaying the ADS reports at the Technical Center and at designated sites.

Federal Express will provide the aircraft and perform the avionics installation and modifications.

Collins Air Transport Division will provide the avionics and the ground station interface, as developed under contract to INMARSAT.

INMARSAT will provide the satellite services.

COMSAT will provide the satellite receiving station services.

AIRCRAFT POSITION REPORT DEMONSTRATION SCHEDULE