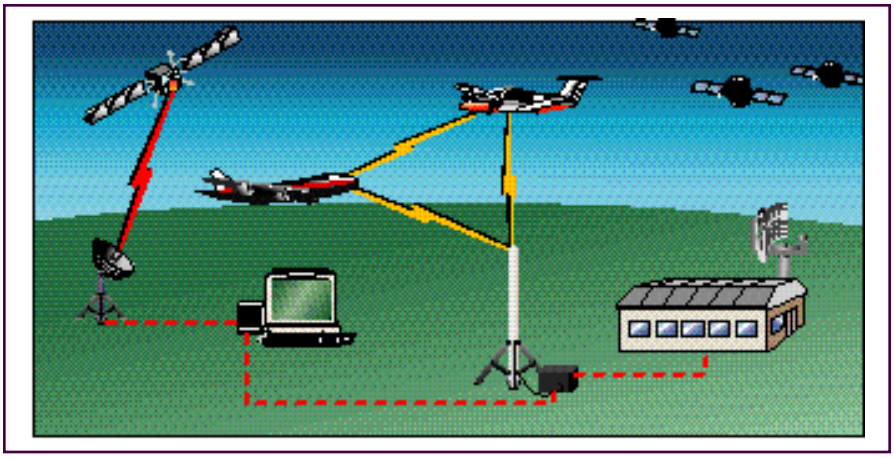
MULTIPURPOSE BROADCAST DATA LINK ARCHITECTURE



The aviation community has recently expressed significant interest in a broadcast mode of data link services. A broadcast mode of delivery is well suited for applications of a general interest to many users and for applications that require periodic updating. Broadcast delivery is also attractive because of the protocol simplicity and spectrum efficiency. A data link system supporting broadcast services represents a unique opportunity for rapid implementation of a system with high utility that can be largely independent of existing infrastructure.

The Universal Access Transceiver (UAT) is an experimental data link being developed as an independent research and development project at The MITRE Corporation's Center for Advanced Aviation System Development (CAASD) (a Federally-Funded Research and Development Center sponsored by the Federal Aviation Administration) to illustrate and evaluate the concept of a multipurpose broadcast data link architecture that can meet aviation's needs in a cost-effective manner.

The UAT supports two basic types of broadcast transmissions. The first is broadcast transmissions from aircraft supporting aircraft-to-aircraft or aircraft-to-ground surveillance applications. These include position reports, velocity vector, intent and other relevant information about the aircraft. This type of transmission is referred to as Automatic Dependent Surveillance-Broadcast mode (ADS-B) and is considered a cornerstone of the Free Flight concept. Unlike ADS, which operates on a contract mode with a ground ATC facility, all users that are within transmission range can receive and use an ADS-B report. Thus, aircraft in the same airspace can "see" each other through ADS-B. ADS-B is a cooperative service that relies on a high level of user equipage to maximize utility and benefit. Providing immediate benefits by including uplink products will help to foster early equipage. Therefore, the second type of transmission supported by UAT is uplink broadcast of information from fixed ground stations. Potential services that can be supported with this uplink broadcast capability are listed below:

- Weather broadcasts and aeronautical information (e.g., status information on airports, navaids, special-use airspace, and uncharted obstacles), referred to as Flight Information Services - Broadcast mode (FIS-B)
- Traffic information broadcasts derived from ground-based surveillance systems referred to as Traffic Information Services - Broadcast mode (TIS-B)
- Global Position System differential correction data (DGPS)

The objective of the UAT development was to design a transceiver that is simple, inexpensive, robust, and able to operate in a consistent manner in any airspace density or on the airport surface. To meet this objective, the design employs a single frequency with a bandwidth of approximately 2 MHz. The UAT will transmit and receive on the same frequency to allow full aircraft-to-aircraft connectivity for ADS-B with a minimum of new hardware. To keep channel management simple and robust, all aircraft will access the channel autonomously, at random, and without the need for centralized ground control.

In conjunction with the broadcast transceiver, CAASD is also investigating the use of cockpit display avionics and ground broadcast servers. The prototype cockpit display and data management system is capable of integrating digital communication, navigation, and surveillance data on a unified graphical display. Much of this data can be obtained over the broadcast data link, but the display can be configured to operate with any link.

The ground broadcast servers process data transmitted and received over the data link and interface the broadcast architecture with other communication channels. Various data received from private and FAA sources can be uplinked to aircraft. Data received from aircraft can be sent to air traffic control facilities, airline operation centers, or other appropriate entities.

Flight testing of the UAT began in November 1995 at Melbourne, Florida, with the assistance of the Florida Institute of Technology Aviation Program and Embry Riddle Aeronautical University. Test aircraft transmit and receive ADS-B reports while simultaneously receiving uplink broadcast transmissions (TIS-B, FIS-B, and DGPS). Ground Broadcast Servers located at Daytona and Melbourne, Florida receive ADS-B transmissions from aircraft and uplink radar-derived traffic data, real-time weather radar imagery, lightning, surface observations (METAR), and terminal forecasts (TAF) data obtained from WSI, Inc., a commercial weather products provider.

In addition to demonstrating these initial services, the flight testing has focused on the propagation and self-interference characteristics of the UAT waveform, over a range of air-air, air-ground, and airport surface geometries. Test results to date have been encouraging and appear to achieve the ADS-B Minimum Aviation System Performance Standards.

CAASD is transferring the UAT technology to the aviation industry through a non-exclusive, royalty-free license. The transfer is intended to facilitate an industry evaluation of alternative ADS-B technologies and the commercialization of a broadcast communication system that enables beneficial applications and services.

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