22nd AIAA International Communications Satellite Systems Conference & Exhibit 2004
9–12 May 2004, Monterey, California

AIAA 2004-3169

Aeronautical Broadcast and Communication System

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ABSTRACT

A unique niche has been discovered within the in-flight entertainment (IFE) industry that aggregates global, regional, and local content to provide live and interactive programming to airline passengers worldwide. NUBRON's LiveWorldAir™ services allow air travelers to be continuously connected with world events. The Aeronautical Broadcast and Communication System (ABCS) enables the amalgamation of existing satellite broadcasts such as the Direct-to-Home (DTH) television broadcasts and the planned Digital Multimedia Broadcast (DMB) services in Asia, the Digital Audio Broadcast (DAB) services in the U.S., as well as entertainment based satellite broadcast services globally. The ABCS enables two-way Internet connectivity and the expansion of video content to provide an array of local program options that tailor services to flight routes, matching local market interests. The ABCS is conceived to evolve from basic existing content service provision to eventually aggregate the multiplicity of regional and local content that provides merchants access to the micro-markets present in each flight. ABCS uses satellites that link to aircraft at Ka-band, achieve high content capacity and take advantage of lower rain and path attenuation.

INTRODUCTION

The typical airline passenger moves through numerous satellite signals during their flight. Figure 1 below represents a U.S. flight that today could (and some do) receive television and audio broadcasts designed for reception on the ground. Slowly airlines are adopting

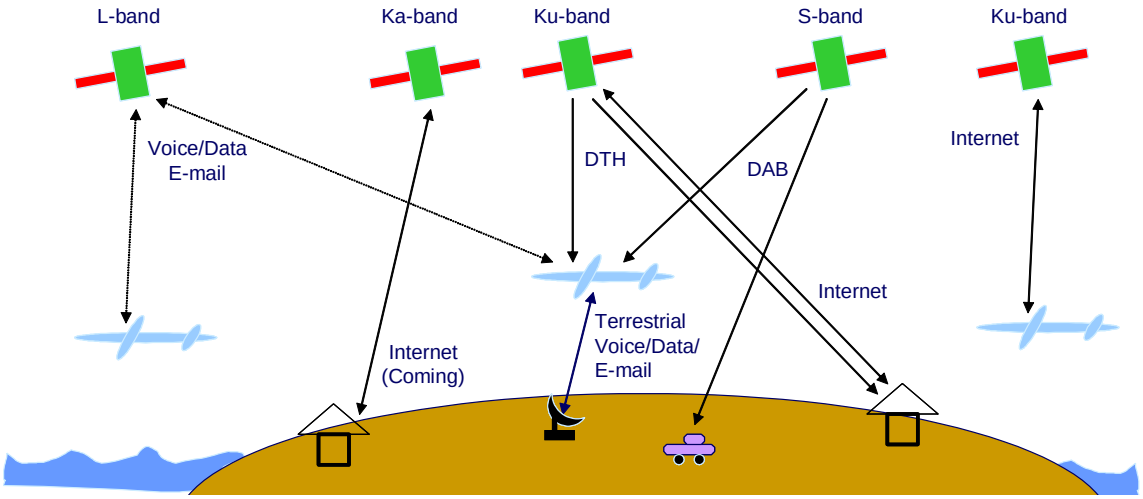

Figure 1. Airliners fly through numerous satellite signals during their flights

Satellite-based services to provide entertainment, Internet and other communications services during a flight. The ABCS is conceived to evolve from basic existing content service provision to eventually aggregate the multiplicity of regional and local content that provides merchants access to the micro-markets present in each flight. The ABCS ultimately will include a number of satellite transponders aboard a constellation of satellite platforms, each platform generating multiple spot beams which collectively cover the flight routes, most commonly the geodesic paths between two highly populated regions.

The link between the airplane and the satellite is designed to maximize available bandwidth within the 17-to-31 GHz band. As the system evolves from the use of commercially available Ka-band transponders to the application of optimized spot-beam payloads, the content uplinks from the ground will migrate from Ka-band down into Ku-band, providing more services to the passengers. Rain issues that may be solved on the ground with site redundancy for Ka-band uplinks are not present at Ku-band. The ABCS inclusion of a premium Internet service to complement the live programming assures increasing demand for bandwidth as LiveWorldAir™ service expand to give the "at home" experience to each passenger.

Thus the operational concept of ABCS is to ultimately uplink in the lower frequency Ku-band (11-17 GHz) and link to aircraft at Ka-band (17-31GHz), while first

accommodating the reception of the multiplicity of available signals presently provided or being planned for broadcast entertainment. This operational concept is depicted in Figure 2.

The Ku-band uplink signals to the satellite from the ground are shown from multiple sites to be thick paths that easily penetrate the rain. Likewise a downlink from the satellite is shown also as a thick line piercing the rain clouds.

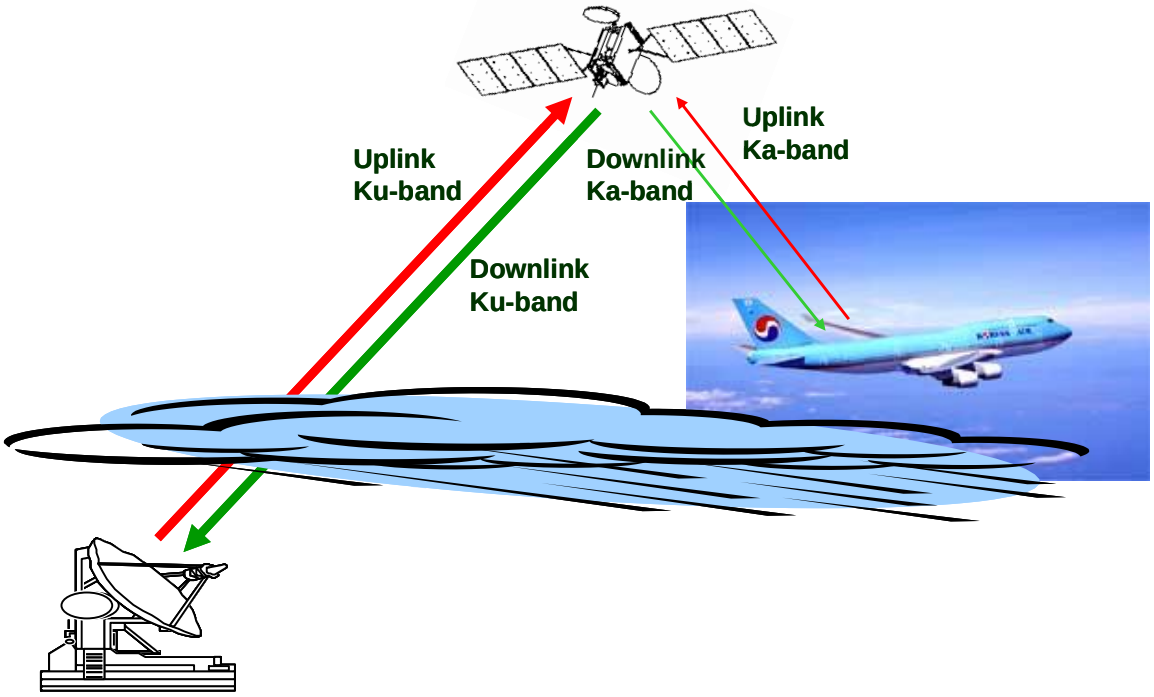

Figure 2. The ABCS Operational Concept of Ku-for-ground & Ka-for-plane

The links between the aircraft and the satellites are shown in Figure 2 as thin lines unable to penetrate the rain. ABCS equips each aircraft to receive a numerous variety of satellite broadcast transmissions, ultimately including those containing content aggregated by NUBRON to be provided on a tailored basis, flight-by-flight, as best serves the airlines and their clients.

This paper describes the aeronautical broadcast and communications system from the earliest deployment phase through its final implementation phase as an incremental progression of capacity added as market demand provides. The purpose of this paper is to describe a system that starts with passive reception of service provider signals for which selective availability access has been agreed, grows through the use of commercial transponders to deploy full capacity with partial coverage in selected regions, to culminate in its final configuration where a constellation of platforms provides tailored coverages to the global, regional and local flight routes to match demand growth.

BACKGROUND

NUBRON was established in 2000 to provide satellite related engineering services. NUBRON is focused on the business of bringing LiveWorldAir™ to the global travel industry by the application of an innovative satellite system architecture that delivers entertainment to airline passengers LIVE.

MARKET REQUIREMENTS

Market opportunity for the LiveWorldAir™ service provision through ABCS is illustrated in the composite of four graphics in Figure 3 that depict the initial market focus. This year over 300 Million passengers are projected worldwide based on the figures for 2001 given in Figure 3.

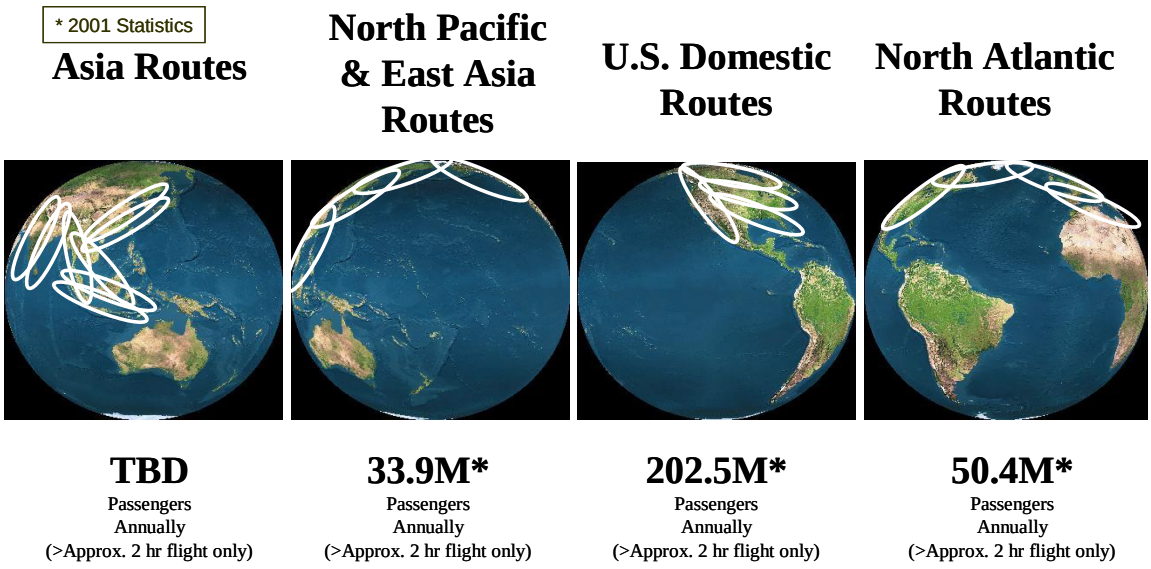

Figure 3. Markets[1-3] of the global flights covered by elliptical satellite beams

The markets are initially addressed to the degree possible with existing commercial transponder capacity as limited coverage, full service ABCS capability is deployed. Figure 3 postulates orbital locations and ABCS payloads aboard representative operator satellites as noted to achieve a full coverage, full service ABCS capability throughout entire international flight routes. The ABCS grows to offer the greatest global capacity for live broadcasts to airliners. In addition ABCS provides the return link so premium high-speed Internet accompanies the broadcast services. Each regional market can ultimately be segregated into the micro-markets of custom aggregated live programming represented by each single flight that provides the merchant an opportunity to interact with a well-known class of customers.

ABCS Detailed Description

The ABCS comprises its aeronautical, space and ground segments into a real-time interactive entertainment broadcast and communications service designated LiveWorldAir™. The service provider employs the ABCS to aggregate and segregate a set of program line-ups tailored to each receiving flight's passenger list based upon a composite of global, regional and local programs. In this way ABCS will target distribute audio and video entertainment and Internet through satellites into each airliner throughout its flight.

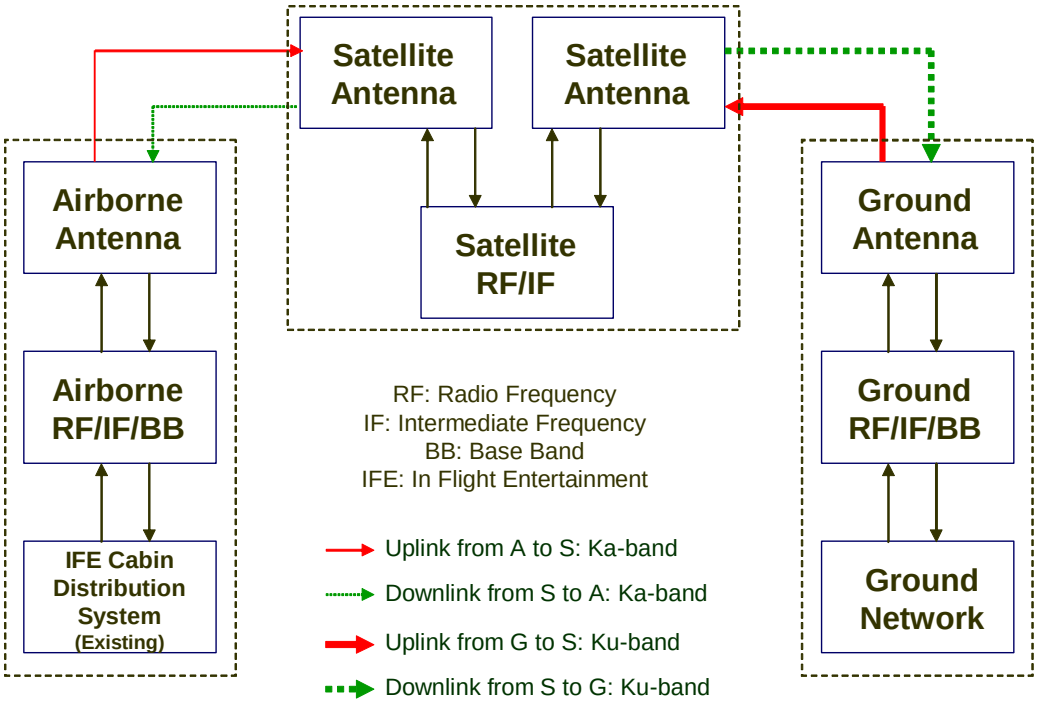

Figure 4. Functional block diagram for the ABCS operational concept in Figure 2

Ideally the satellite node of ABCS would involve Baseband processing to switch programming between satellite beams independent of the ground. However, that commercial reality remains some years out. For the present the satellite payload consists of a number of single heterodyne ka/ka-band or ku/ka-ka/ku-band RF translating spot-beam transponders. The airborne antenna tracks the ABCS satellite and provides a block conversion to that intermediate frequency interface with the particular aircraft in-flight entertainment system.

The ground network is configured to collect numerous program feeds from a variety of content providers. Proprietary aggregation and segregation software allocates programming to satellite capacity in real time covering each specific flight to allow for ongoing live content customization. Separate satellite control and uplink facilities

receive uplink content from the network operations center and transmit through the satellite to the aircraft.

ABCS begins by providing the aircraft with equipment to receive existing satellite services.[4] The concept of modular RF interfaces and common Baseband equipment extending from the commercially successful DTH, DMB, and DAB services drives the architecture. Figure 5 illustrates this modular interface concept, shows the multi-band feature of ABCS and establishes the central role of the Multi-Service Programmable IF Receiver/Decoder & IFE Interface Unit, as the subsystem that accepts the various service receiver schemes and includes software features that allow for aggregation and customization on each flight.

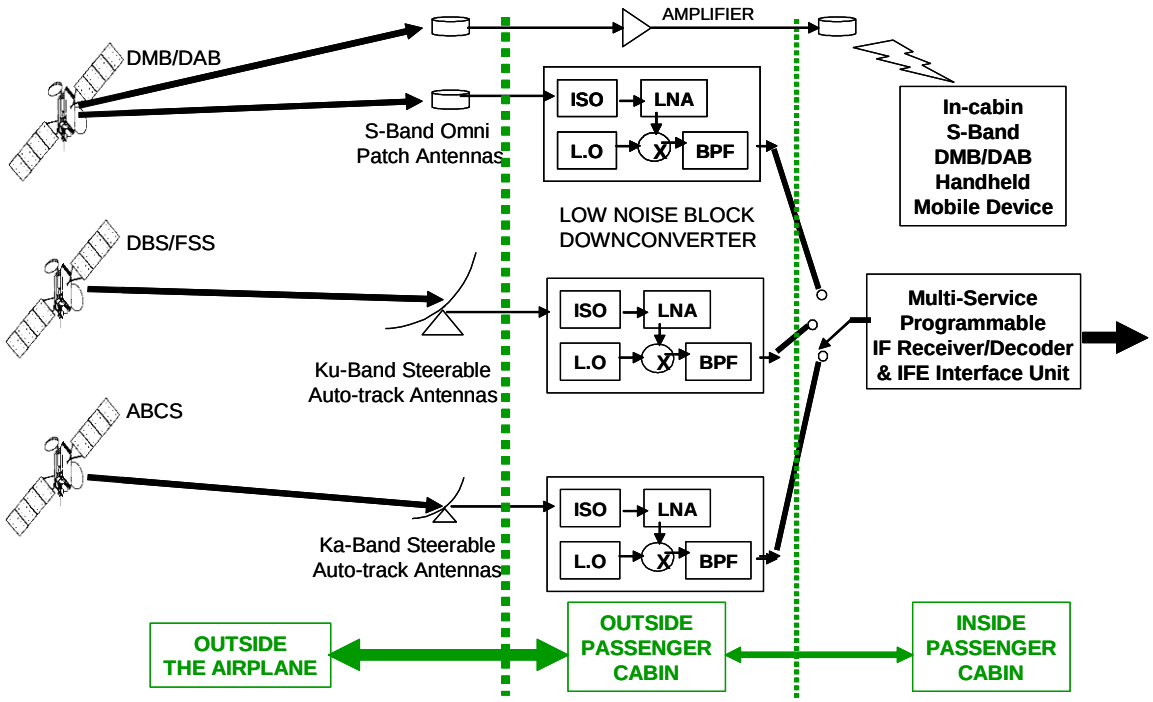

Figure 5. ABCS Multi-Band Aircraft Interface

The subsystems identified in this modular concept depicted in Figure 5 correspond directly with the airborne subsystems in Figure 4. Figure 5 highlights the multi-satellite, multi-frequency and multi-service aspects of the ABCS aircraft interface. A common interface is replicated with the block down conversions from S-band, Ku-band and/or Ka-band. Details of the airborne RF/IF were considered in the above. The antenna represents the most difficult physical interface to the aircraft. Greater detail is considered in Figure 6 where features of LiveWorldAir™ Aircraft Data Services are revealed, multiplexed together with the in-flight entertainment and Internet distribution system into the re-coder unit.

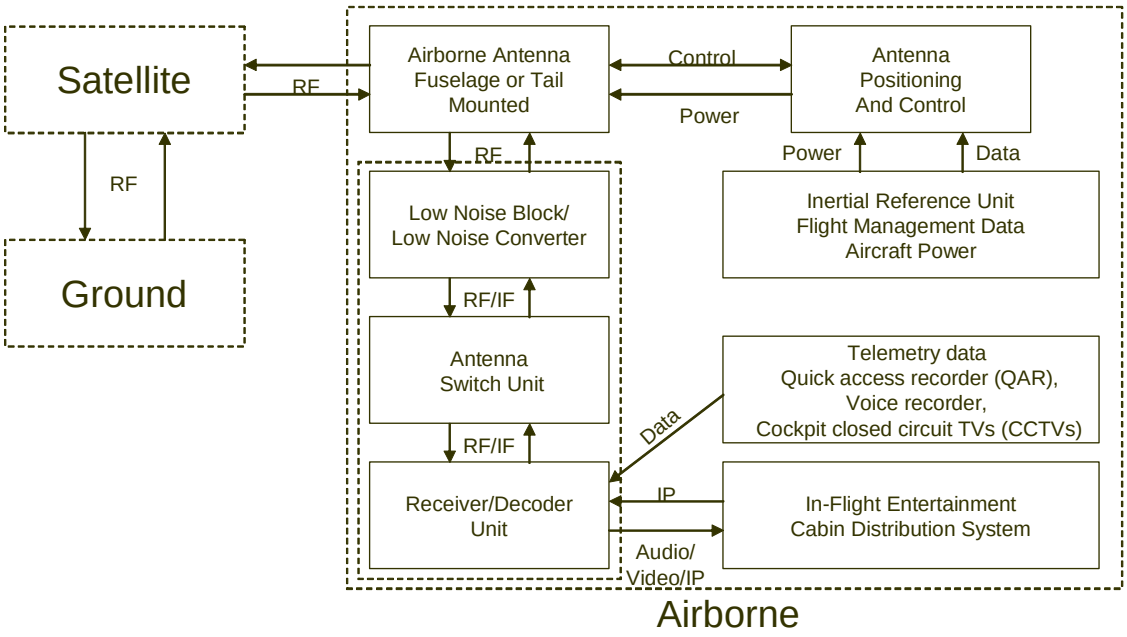

Figure 6 Detailed Airborne Subsystem Block Diagram

Antenna positioning and control are increasingly demanding as the frequency increases. The Ka-band antennas for this application have yet to be developed, while the Ku-band antennas are in commercial use and no directionality will be required on the commercially available S-band antennas. Overall, the airborne segment of the ABCS requires straightforward digital design and some Ka-band RF equipment development to achieve full implementation. Immediate implementations at S-band and Ku-band are currently planned. Demonstration at Ka-band is planned first with the use of a commercial transponder for LiveWorldAir™ service in a domestic or regional flight application.

CONCLUSION

A novel approach to airline in-flight entertainment delivery employs Ku-band between satellites and ground and Ka-band between aircraft and satellites to best advantage the communications links for capacity and quality of service. Incremental system capability is envisioned as service provider agreements for content aggregation consolidate passenger demand for live programming services on airline flights worldwide.

ACKNOWLEDGMENT

The author deeply appreciates the collaboration with Ed Elizondo and Nick Laprade during the course of the present work. The author is also indebted to numerous others whose technical and business input and comments were invaluable in formulating the system and system performance.

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