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Plans and Principles for the Implementation of Aeronautical Data Link System (ADLS)

Edition 1. Aeronautical Telecommunication Network (ATN) Baseline 1 Implementation and ADLS Builds IIA & IIB

RTCA/DO–287
June 25, 2003

Prepared by SC 194

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FOREWORD

This document was prepared by Special Committee (SC) 194 and approved by the (RTCA) Program Management Committee (PMC) on June 25, 2003.

RTCA, Incorporated is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. The organization functions as a Federal advisory committee and develops consensus based on recommendations on contemporary aviation issues. RTCA's objectives include, but are not limited to:

- Coalescing aviation system user and provider technical requirements in a manner that helps government and industry meet their mutual objectives and responsibilities;
- Analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;
- Developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and
- Assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization (ICAO) and the international Telecommunications Union and other appropriate international organizations can be based.

The organizations recommendations are often used as the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration (FAA) Technical Standard Orders.

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Executive Summary

What is it/

This document conveys the aviation community consensus regarding the plans and principles for the provision of Air Traffic Services (ATS) via the ADLS utilizing the ATN in the U.S. National Airspace System (NAS). In order to encourage support and investment by government and industry in the technology path and to encourage more airspace user and Air Traffic Service Provider (ATSP) input in the implementation and operational service development processes, plans and principles for the implementation of ADLS are necessary. FAA's current program for Controller-Pilot Data Link Communications (CPDLC) is termed Builds 1 and 1A. This document contributes to a broader community understanding and records a collaborative commitment to the operational benefits arising from the utilization of ADLS beyond Build 1A. For ease in understanding we will refer to this evolutionary step as Build II. Various time frames for implementation that appear in this document are based on industry desires for further development and implementation steps presented as Build II.

Why do we need it?

Plans and Principles for the ADLS are outlined in the following benefits summary to assist executive level review. The basic theme contained herein is that data link will become the principal means of air/ground communications in the NAS for provision of ATS. Data communications will replace most routine voice communications within the next decade in all operational domains. For Aeronautical Operational Control (AOC), data communications is a proven business tool. The existing Aircraft Communications Addressing and Reporting System (ACARS) continues to grow exponentially, and is expected to exceed its original Very High Frequency (VHF) subnetwork capacity before 2005. The FAA has pioneered the use of the existing ACARS networks to support ATS in both domestic and oceanic airspace. Implementation of the necessary follow-on communications service subnetwork using VHF Data Link, Mode 2 (VDL 2) for ACARS and AOC is underway. ATN compatible avionics are being developed for ATS also using VDL 2 and some user commitments are being made.

Among the component parts of the Communications, Navigation, and Surveillance/Air Traffic Management System (CNS/ATM), communications, important in its own right, is also an important enabling element of improved navigation, surveillance, and ATM systems. ADLS development beyond the current CPDLC Build 1A is a key to communications as a catalyst for reducing delays and supporting future expansion of ATS in the NAS. The argument proposed in this document demonstrates a compelling rationale for a common aviation communications system to serve the operational needs of the aviation industry over the next two decades. The need for ATN as an enabler for ATS supported by data link is well recognized, as is the need for a transition plan to accommodate legacy ATS using the ACARS network.

Plans and Principles for ADLS beyond Build 1A continues the evolution toward a common aeronautical data communications network from existing capabilities already achieved in the domestic en route environment using CPDLC Build 1 and 1A. The document reinforces arguments for both the FAA Joint Resources Council (JRC) approval of ADLS development and investment decisions to be made by airspace users. The difficulties lie in making the economic cases for both user and provider investments and satisfying political issues and constraints. This development process is defined herein as an incremental development and acquisition process for several different ground host systems. The ADLS development process focuses on meeting the needs of airspace users and ATSPs through a family of ATS capabilities supported by data link. The implementation of the ADLS is intended to address the following four major operational goals that exist throughout the U.S. and the world:

- Support growing demand for safe, secure, efficient, and timely ATS.
- Support seamless, worldwide ATS in all operational domains.

- Integrate and accommodate legacy ATS capabilities supported by data link.
- Accommodate the increasing need of the airspace users to maintain economically viable operations in the growing world of air travel.

When do we need it?

Growing worldwide airspace congestion is contributing to a reduction of effective system capacity and efficiency and is raising safety concerns. In the U.S., voice frequency congestion routinely results in NAS delays, which have a negative economic impact. The benefits of solving communications problems include:

- Providing optimal operational procedures that can be used when congested voice communications exist.
- Eliminating congested voice channels that limit airspace capacity due to reduced Air Traffic Control (ATC) effectiveness which result in blocked and stepped-on transmissions.
- Reducing operational errors that threaten safety resulting from misunderstood instructions and readback errors.
- Improving integration of Decision Support Tools (DSTs) and ATS thus providing increased system efficiency.
- Providing for a modernized air/ground information exchange mechanism between operators and ATSPs.

An FAA study indicates that the current means of providing ATS and AOC services in the NAS are reaching the point that they will no longer support anticipated demand in the 2005 to 2010 timeframe. Evolution of the current system to a robust CNS/ATM —enabled Free Flight environment necessitates timely and synchronized investment by all stakeholders. Industry strongly suggests that 2008 is the target time for IOC of the ADLS Build IIA and IIB. In the interim, it is desired that the ground system proceed from the 4 current advisory services environment defined in Build 1 to one containing the 9 services (including clearances) originally planned for Build 1A. This document reflects the aviation community's consensus for the continuing implementation of data communications in all regions of the NAS, in conjunction with the airspace user's voice only communications, to support free flight operations that accommodate airspace user preferences.

The FAA's commitment to the initial implementation of ATN data link was reflected in the initial plans for CPDLC Builds 1 and 1A for domestic operations. The FAA's follow-on effort beyond Build 1A (ADLS Build II not yet funded) is intended for gate-to-gate operations in all domains. The FAA's commitment to ATS supported by data link is manifested in the domestic Pre-Departure Clearance (PDC) and Aviation Terminal Information Service (ATIS) services at most major airports and the oceanic Future Air Navigation System (FANS-1/A) CPDLC services that utilize the ACARS communication network.

The airspace users and communications service providers are making forward-fit investments to utilize Build 1 and 1A services as they become available. This document supports stakeholder decisions regarding the return on investment for these follow-on capabilities. Finally, it is recognized that user equipage is generally a function of the benefits received divided by the cost of equipping.

Three phases of avionics implementation are planned that will accommodate the seven stages of ground system evolution. The following approach will contribute to lowering avionics life cycle cost which would have occurred by matching each stage of the ground system evolution.

- Initial Level D certification of a Communication Management Function (CMF) that is compatible with the FAA Build 1 services.

- ATN Baseline 1 as defined in RTCA Document (DO)/European Organization for Civil Aviation Electronics (EUROCAE) or EUROCAE Document (ED): DO-280/ED-110, "Interoperability Requirements Standard for ATN Baseline 1 (INTEROP ATN B1)."

  Note: *DO-280/ED-110 Revision A is pending to add FAA and EUROCONTROL requested messages to ATN Baseline 1.*

- ATN Baseline 2, which will add security provisions, additional ATN applications, and messages to meet the operational service environments for continental En route, Terminal Area, and Oceanic airspace.

Ground system equipage involves the phases of capability outlined in the next section. These capabilities are expected to be installed in five different systems, En Route Automation Modernization (ERAM) with embedded Data Link Applications Processor (DLAP), Automated Radar Terminal System (ARTS), Standard Terminal Automation Replacement System (STARS), Tower Data Link System (TDLS), and the oceanic platform in order to cover all operational domains.

How to do it?

Capitalizing on the investment in ATN-compliant subnetworks and Baseline 1 avionics, this edition of the document focuses on ATN Baseline 1 avionics and their use for ATS in the en route domain (Build IIA) and the terminal area domain (Build IIB). Future editions of this document will contain the Plans and Principles as outlined below for the full set of follow on ADLS implementations:

Build IIA

- A component of the FAA ground system, the ERAM/DLAP is upgraded to include the Baseline 1 CPDLC Message Set which supports enhanced ATC Clearance Operational Service (ACL) for User Preferred Trajectories (UPTs) and weather deviations as defined in the RTCA/EUROCAE Initial Continental Operational Safety and Environment Definition (OSED) and in the Interoperability Specification (DO-280/ED-110).
- Ground system ATN authentication and integrity services to support security mandates are expected to be implemented in Build IIA and IIB, however Avionics ATN security services are currently not expected to be implemented until such time as a rule-making process is completed that mandates these security services
- Data link functions in ground automation are integrated with en-route DSTs (e.g., User Request Evaluation Tool (URET) and Traffic Management Advisor -- Single Center (TMA-SC) and Multi-Center (TMA-MC).
- The Avionics CMF ATN Baseline 1 Message Set is implemented.

Build IIB

- Operational capability is extended to major Terminal Radar Approach Control (TRACON) facilities for non-time-critical communications using ATN Baseline 1 capabilities.
- ATC software partitions are re-hosted to the greatest extent possible in the Common ARTS host system.
- CPDLC Data link functions are integrated with Terminal-oriented DSTs.
- Approach/departure operations necessitate enhanced flight crew display capability including display in the primary forward field of view.

The following incremental Builds of the ADLS program will be addressed in later editions of this document. These are further defined in Appendix B and are expected to include:

Build IIC

- ATN Baseline 2 operational capability is extended to Oceanic centers and upgrades are made to Air Route Traffic Control Centers (ARTCCs) and TRACONs.
- End-to-end system complies with ATN Standards and Recommended Practices (SARPs) Edition 3 security requirements impacting ground and airborne ATN end system implementations
- Dual Stack (FANS-1/A and ATN) is supported by the oceanic ground system.
- Automatic Dependent Surveillance (ADS) functionality is required to support non-radar operations.
- Interface to the Flight Management System (FMS) is required to support ADS functions and to include auto-load of selected CPDLC messages into the Flight Management Function (FMF).
- Integration of additional subnetworks [Satellite Communications (SATCOM), High Frequency Data Link (HFDL)] is required to support non-line-of-sight operations.
- Avionics CMF and ATS ground systems are upgraded to include the ATN Baseline 2 Message Set.

Build IID/E

- Approach/departure functionality and ATN Baseline 2 functionality are co-hosted in the STARS automation platform.
- ATN Baseline 2 capability Departure Clearance (DCL) Service is implemented in the TDLS.
- Operational capability is extended to surface taxi operations.
- Data link functions in ground automation are integrated with surface DSTs.

Principles

Individual Air Traffic and Data Link Service providers, users, avionics and aircraft manufacturers are in the process of implementing ATN-based data communications, therefore SC 194 recommends that planning be driven by the following Principles:

- Data communications are an essential part of the integrated CNS/ATM system endorsed by ICAO. A key tenet of this principle is the need to closely coordinate the ADLS implementations with other CNS/ATM-related programs and operational procedure developments.
- Data Communications such as AOC, have become a proven aviation industry business tool. Data link for ATS, when added to data link for company communication provides for additional cost and operational benefits as has been demonstrated for oceanic operations with FANS-1/A.
- Baseline data capture of the existing voice and data communication systems should be conducted so that benefits of new capabilities can be assessed.
- Data link is anticipated to become the principle means for routine, non-time-critical ATS communications, which currently comprise the majority of transmissions. Human factors play an important role in this transition, therefore a definitive training and procedures plan should be developed and implemented to insure smooth transition to the integrated capabilities in all operational domains including surface, terminal area, domestic en route and oceanic.
- The next steps in the evolution of data link for ATS beyond CPDLC Build 1A should be recognized in the FAA NAS Operational Evolution Plan (OEP).
- In the absence of rulemaking activities relating to "sunsetting" (terminating use) of non-secure data communications, aircraft equipped with the full ATN Baseline 1 CPDLC Message Set will

be able to participate in ADLS Build IIA and B with no changes to their aircraft configurations for ATN security and on-board data link message recording. Rulemaking on the sunset of non secure data communications will have an impact on the avionics.

- The FAA should commit to the complete ADLS Build II incremental development path, IIA through IIE, and establish an Integrated Requirements Team (IRT) to confirm FAA commitments and ensure integration of data link with ATS Flight Data Processing (FDP), DSTs and other CNS/ATM related programs and thereby encourage user equipage.
- An Implementation Team, comprised of the four major stakeholder groups (Airspace Users/User Groups, Avionics/Airframe Manufacturers, Communications Service Providers and ATSPs) will be necessary to insure that the ADLS Build II envisioned in this document becomes reality. The charter of this group should include configuration management, system performance monitoring, problem reporting and resolution, data collection and analysis. This data will support benefits assessment.
- Transition planning to accommodate legacy systems and their associated operational procedures, for a finite period of time, is essential to seamless, worldwide ATS.
- These Plans and Principles will reflect a continuing requirement for international harmonization including close coordination with adjacent FIRs (e.g., Canada and Mexico).
- Operational requirements for ATS, supported by data link beyond Build IA, should be validated via current in-service experience with legacy systems, human-in-the-loop simulations and/or +
- ATN Baseline 2 includes the necessary SARPs Edition 3 capabilities and applications. Of necessity, avionics systems are designed for worldwide operation and therefore must be compatible with all ground system implementations. Individual ground system operators may decide to only allow for operational use of subsets of ATN functionality. When a ground system does not operationally support a particular message the sender will be notified with no adverse effects on the data link connection.

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1 INTRODUCTION

1.1 Purpose of This Document

These plans and principles include the context, infrastructure, operational capabilities, and expected benefits arising from the provision of ATS via data communications utilizing the ATN. Multiple phases of ATSP ground system implementation are planned to cover all of the ATS ground systems for domestic en route, terminal area, oceanic and airport surface domains with each phase accommodating or replacing legacy functions of the previous phases. The legacy ATS supported by ACARS data communications to be accommodated include: oceanic FANS-1/A CPDLC; the domestic PDC; Digital Automated Terminal Information System (D-ATIS); Data Link Delivery of Taxi Clearance (DDTC); and the Terminal Weather Information for Pilots (TWIP).

Three phases of avionics implementation are planned that will accommodate the seven stages of ground system evolution. The following approach will contribute to lowering avionics life cycle cost which would have occurred by matching each stage of the ground system evolution.

- Initial Level D certification of a CMF that is compatible with the FAA Build 1 services.
- ATN Baseline 1 as defined in RTCA/EUROCAE, DO-280/ED-110.

  Note: *DO-280/ED-110 Revision A is pending to add FAA and EUROCONTROL requested messages to ATN Baseline 1.*

- ATN Baseline 2, which will add security provisions, additional ATN applications, and messages to meet the operational service environments for continental En route, Terminal Area, and Oceanic airspace.

This document will undergo revisions as necessary so as to ultimately describe the end-state data communication system for all flight domains and between ATSPs. This edition intends to highlight the role that the follow-on phase of the FAA program to Builds I and 1A, identified as ADLS Build IIA and IIB and the avionics implementation that uses the ATN Baseline 1 CPDLC Message Set as defined in DO-280/ED-110, will play in achieving the larger goal of a seamless ATN-compliant CNS/ATM system.

This edition will address the phased implementation process of the ADLS beyond Build 1A in all operational domains and phases of flight. It will focus on Build IIA for domestic en route and Build IIB for terminal area operations. Issues addressed include accommodation, transition and the development of new operational services using data link and integration with ATS DST. It also describes the aviation community consensus regarding the evolution and implementation path for the provision of ATS over ATN in the NAS. This consensus is reflective of the reality of the existing FAA commitments to ADLS.