RTCA, Incorporated
1140 Connecticut Avenue, Northwest, Suite 1020
Washington, DC 20036-4001 U.S.A.

Guiding Principles for Air Traffic Services Provided Via Data Communications Utilizing the ATN, Builds I and IA

RTCA/DO-250
January 11, 2000

Prepared by SC-194
ã **RTCA, Inc 2000**

Copies of this document may be obtained from

RTCA, Incorporated
1140 Connecticut Avenue, Northwest, Suite 1020
Washington, DC 20036-4001 U.S.A.

Telephone: 202-833-9339
Facsimile: 202-833-9434
Web Site: www.rtca.org

Please contact RTCA for price and ordering information.

FOREWORD

This document was prepared by Special Committee 194 (SC-194) of RTCA, Inc. and approved by the RTCA Program Management Committee (PMC) on January 11, 2000.

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 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 and the International Telecommunication Union and other appropriate international organizations can be based.

The organization's recommendations are often used as the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration Technical Standard Orders.

Since RTCA is not an official agency of the United States Government, its recommendations may not be regarded as statements of official government policy unless so enunciated by the U.S. government organization or agency having statutory jurisdiction over any matters to which the recommendations relate.

© RTCA, Inc. 2000

This page intentionally left blank.

TABLE OF CONTENTS

Executive Summary....1
1.0 Introduction....3
1.1. Purpose....3
1.2. Background....3
1.3. Global Context for the Provision of ATS via Data Communications Utilizing the ATN....5
1.4. Coordination of CNS/ATM Ground System Deployments....6
1.5. Definitions....6
2.0 Operational Objectives....9
2.1. Setting the Context....9
2.2. Defining the Problem and the Industry-Consensus Solution....9
2.3. Operational Objectives Being Addressed by CPDLC Build IA....11
3.0 Infrastructure....13
3.1. Partners....13
3.2. Operational Context....13
3.2.1. Build I....14
3.2.2. Build IA....14
3.3. Airspace....14
3.3.1. Generic Airspace....14
3.3.2. Build I – Miami ARTCC....14
3.3.3. Build IA-CONUS Implementation....15
3.4. Architecture....15
3.4.1. Interoperability....15
3.4.2. Build I Components....15
3.4.3. Build IA Components....16
4.0 Procedural Requirements....19
4.1. Basis for Operational Approval....19
4.2. Aircrew & Operators Procedures....20
5.0 Operational Acceptability Principles....23
5.1. System Operational Principles....23
5.1.1. Build I and IA Operational Principles....24
5.2. FAA Ground System Operational Principles....24
5.3. Airborne System Operational Principles....24
6.0 Data Link Services....25
6.1. Introduction....25
6.2. Operational Services....25
6.2.1. ATC Clearance Service (ACL)....26
6.2.1.1. Scope and Objectives....26
6.2.1.2. Service Operational Context....26
6.2.1.3. Build I ACL Services....26
6.2.1.4. Build IA ACL Services....27
6.2.2. ATC Communication Management (ACM)....28
6.2.2.1. Scope and Objective....28
6.2.2.2. Service Operational Context....29
6.2.2.3. Build I and IA ACM Services....29
6.2.3. ATC Microphone Check (AMC)....29
6.2.3.1. Scope and Objective....29
6.2.3.2. Service Operational Context....29
6.2.3.3. Build I and IA AMC Services....29
6.3. Data Link Initiation Capability (DLIC) Service....30
6.3.1. Scope and Objective....30

© RTCA, Inc. 2000

6.3.2. Service Operational Context and Definitions 30
6.3.2.1. Operational Context 30
6.4. Logical Acknowledgement 31
7.0 Quality of Service 33
7.1. Global Quality of Service Requirements 33
7.2. Build I/IA Quality of Service Requirements 33
8.0 Operational Scenarios 35
8.1 Operational Scenario CPDLC Build IA (Includes Build I) Description of Operational and System Events 35
Pre-Flight And Departure Airport 35
Arrival Tracon 37

SC-194 Membership List 39

List of Tables

Table 1-1 Definitions of Key Terms 7
Table 4-1 Procedural Requirements Documents 19
Table 6-1 Logon Responses 30
Table A-1 Uplink Message Elements A-2
Table A-2 Downlink Message Elements A-2

List of Figures

Figure 1-1 Functional Relationship of Acquisition Programs to Standards 6
Figure 2-1 Data Link-Enabled Operational Enhancements in En Route (Radar Environment) Phase 10
Figure 3-1 Build IA System Architecture 17
Figure 8-1 CPDLC Build IA Operational Scenario 38

Appendices

Appendix A - CPDLC Build I and IA Message Sets and Dialogue Types
Appendix B - Background Documents
Appendix C - Acronyms and Abbreviations

Endnotes

© RTCA, Inc. 2000

Executive Summary

Aviation is the fastest growing transportation mode in the U.S., and around the world. Growth in aviation reflects the increasingly global nature of our economies and societies. Aviation is a crucial contributor to the continuing growth of the most dynamic portions of the economy.

The global aviation community, acting through the International Civil Aviation Organization (ICAO), has developed a solution to the capacity constraints it faces. The Communications-Navigation-Surveillance/Air Traffic Management (CNS/ATM) System has been designed to provide a robust and seamless environment within which airspace users and air traffic service providers can effectively and efficiently meet the growing demand for air travel.

Growing worldwide airspace congestion is contributing to a reduction of effective system capacity and efficiency and is raising safety concerns. In this country the congestion results in National Airspace System (NAS) delays, which have a negative economic impact. Communications problems to be resolved include:

- Congested voice channels that limit airspace capacity due to reduced Air Traffic Control (ATC) effectiveness and result in blocked and stepped-on transmissions.
- Operational errors that threaten safety resulting from misunderstood instructions, readback errors, and data entry errors.
- A lack of sufficient automation support in the communications between aircraft and air traffic services that result in reduced system efficiency
- The need for a more dynamic and efficient air/ground information exchange mechanism.

Air/ground data communications has been used for over a decade by airline dispatch offices for Airline Operational Control (AOC) functions. To fully realize the potential benefits inherent in the ICAO compliant CNS/ATM systems will necessitate significant changes to the air traffic control system as it has evolved over the last 75 years . Provision of Air Traffic Services (ATS) via an Aeronautical Data Link System (ADLS) utilizing the Aeronautical Telecommunication Network (ATN) will be evolutionary. This will facilitate early delivery of user benefits as well as providing an orderly transition to the use of more advanced concepts and equipment and full integration with the future NAS architecture. This evolution will be driven by user benefits, not regulatory mandates. For ease of reading the phrase “Air Traffic Services (ATS) via an Aeronautical Data Link System (ADLS) utilizing the Aeronautical Telecommunications Network (ATN)” will be condensed to “ATS over ATN” throughout the remainder of this document.

This document focuses on the implementation of the initial capabilities of the ADLS. Baseline 1 functionality is being implemented by the Federal Aviation Administration (FAA), as the ATS provider in the U.S. NAS, in two phases: Build I and Build IA. Interoperability within the entire international Baseline 1 environment is critical since airspace users will be equipping their aircraft with the full Baseline 1 set of capabilities. The proposed CNS/ATM solution is a multifaceted initiative that significantly alters the relationship between airspace users and their air traffic service providers. Build I capabilities will be implemented to allow both airspace users and air traffic service providers to gain operational experience with data link. Following an incremental implementation strategy, Build IA will use the lessons learned from Build I to the maximum extent possible and implement a larger set of services in the twenty Air Route Traffic Control Centers (ARTCC) located in the Contiguous U.S. (CONUS). The operational services available in Builds 1 and 1A are described and illustrated in an operational scenario which depicts the major operational and system events associated with the services, the service dependencies and relationships, and the controller and pilot interactions with each other and their respective CPDLC human-computer interfaces.

© RTCA, Inc 2000

The ADLS is being developed as a joint industry and FAA effort. As such, the relationship between the organizations involved is that of a partnership, where each partner has a specific capability to develop or specific equipment to acquire. All of the partners are dependent upon each other to meet their commitments for delivering system components on schedule. Unless each partner does so, the end-to-end system capability cannot be realized and user benefits will not be achieved.

The objective is to introduce ATS over ATN that is interoperable on a global basis. The limited set of ATS messages, enabled by the FAA's Build 1 and 1A implementations, is used between controllers and pilots within domestic en route airspace. In this operational context, data link is used to offload routine ATS messages thereby relieving congestion on existing voice communications. Use of data link for ATS communications is elective, based on the judgement of controllers and pilots. Agreement on appropriate and unambiguous operating principles underpins the development of an operationally acceptable CPDLC capability that will be used effectively by controllers and pilots.

© RTCA, Inc. 2000

1.0 Introduction

1.1. Purpose

The purpose of DO-250 is to document the aviation community consensus regarding the principles for the provision of Air Traffic Services (ATS) via an Aeronautical Data Link System (ADLS) data communications utilizing the Aeronautical Telecommunication Network (ATN) in the United States (U.S.) National Airspace System (NAS). Hereafter, for ease of reading this will be referred to as "ATS over ATN". These 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 implementation are planned with each phase accommodating or replacing legacy functions of the previous phases.

This is a living document that will ultimately describe the end-state data communication system for all flight domains. The principles will define the applications and services required to support Free Flight. This version intends to highlight the role that the initial phases of the FAA program, Builds I and IA, will play in achieving the larger goal of a seamless ATN-compliant Communications, Navigation, Surveillance/Air Traffic Management (CNS/ATM) system.

Future versions of this document will address the phased implementation process of the ADLS in all operational domains and phases of flight, address accommodation and transition issues and the development of new operational services using data link.

A companion document, DO-251, *U.S. National Airspace System Plan for Air Traffic Services Data Link (Phase 1, En Route CONUS Implementation)*, describes the aviation community consensus regarding the evolution and implementation path for the provision of ATS over ATN in the U.S. NAS.

1.2. Background

Aeronautical data link has been used for over a decade by the airline dispatch offices for Aeronautical Operational Control (AOC) functions. These include safety of flight related functions such as flight plan uplinks, wind/altitude profiles, essential flight management initiation data, and take off speeds. The Aircraft Communications Addressing and Reporting System[1] (ACARS) is the data link network employed by multiple communications service providers worldwide.

In early 1990's, the Federal Aviation Administration (FAA) approved the use of standard ACARS data link for Pre Departure Clearances (PDC) and Digital Automated Terminal Information Services (D-ATIS). PDC and D-ATIS over standard ACARS are now available at 57 domestic U.S. airports.

Elsewhere in the world, ATS providers have implemented other services using ACARS.[2] These services include Departure Clearance (DC), Oceanic Clearance Message (OCM), and Waypoint Position Reports (WPR).

The FAA facilitated coordination with industry for the continued development of ATS using data link through its Communications/Surveillance Operational Implementation Team (C/SOIT). The C/SOIT defined four packages of ATS data link functions and one package of ATS satellite voice communication function:

> Package A. A joint FAA/United Airlines effort that resulted in operational approval of a limited message set for controller/pilot communications using standard ACARS for oceanic operations. Package A has been superceded by Package B.
>
> Package B. A joint FAA, South Pacific ATS, Boeing, and airline integrated CNS/ATM system, which is identified as Future Air Navigation Systems (FANS) 1/A. It includes a

© RTCA, Inc 2000