AERONAUTICAL TELECOMMUNICATIONS NETWORK PANEL

WORKING GROUP 3 MEETING

Munich, 24-28 June 1996

Agenda Item 6: Air-Ground Applications SARPs

PROPOSED ATNP/2 WP -

'OVERVIEW OF CMA APPLICATION SARPS AND GUIDANCE MATERIAL'

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SUMMARY

This paper briefly outlines the development of the CMA SARPs since ATNP/1. It recommends that the attached SARPs be baselined as Version N.0

1. INTRODUCTION

1.1 The concept of using data link as a major medium for ATS communications arose from the deliberations of the two phases of the ICAO Special Committee for Future Air Navigation Systems which met between 1985 and 1992. The Context Management Application (CMA) is one of the four early applications of an air/ground Air Traffic Management (ATM) data link system envisaged by the Automatic Dependent Surveillance Panel (ADSP), the others being Controller Pilot Data Link Communication (CPDLC), Automatic Dependent Surveillance (ADS) itself, and Flight Information Services (FIS).

1.2 The ADSP is one of the ICAO operational Panels. It is charged with developing Operational Requirements for ATM data link applications, both air/ground and ground/ground, but it is not required to develop the necessary technical Standards and Recommended Practices (SARPS) - this responsibility has been delegated by ICAO to the Aeronautical Telecommunications Network Panel (ATNP), in some instances using material developed earlier by the Secondary Radar and Collision Avoidance Systems Panel (SICASP).

1.3 The ATNP established a number of Working Groups, of which Working Group 3 was responsible for developing, inter alia, SARPS and Guidance Material (GM) for the four air/ground applications noted in paragraph 1.1 above. WG 3 convened a Subgroup specifically for the purpose of developing SARPS material for the four air/ground applications, taking into account a limited set of the funtionalities identified by the ADSP, constrained by the need to achieve early implementation of the applications by 1998, this timescale being established by the requirements of the Industry.

1.4 The proposed CMA Standards and Recommended Practices are attached at Appendix A to this paper.

2. OPERATIONAL CONCEPT

2.1 In an ATS data link environment, the CM application provides the data link initiation capability to establish a connection ('log-on') between Air Traffic System (ATS) ground and aircraft systems, and between ATS peer ground systems,. Once an appropriate connection has been established CM provides data link application information for any application the aircraft wishes to use (whether or not the ground system can support it), the capability to log-on to another ground system, and the capability to update log-on information.

2.2 In establishing an air-ground link, CM is always aircraft initiated, but may be ground terminated.

2.3 The airborne system provides information on each application (e.g. ADS, CPDLC, FIS) for which it requires a data link service. Where ground initiated data link application services are requested, additional information may be provided to allow unambiguous association of the aircraft with flight plan information stored on the ground. The ground system responds indicating whether or not the data link initiation was successful, and indicates whether or not it will maintain or terminate the CM dialogue. If initiation is successful, the ground system will respond with information on each data link application it can support.

2.4 The CM log-on function will provide the capability for the ground system to accept any log-on request. However, if the ground system does not have a flight plan for the aircraft, or the flight plan information from the aircraft does not correlate with the ground flight plan information appropriate to that aircraft, the ground system may not be capable of supplying information for a requested application.

2.5 Since the CM is the data link initiation function, version negotiation is carried out in this application. This means that there has to be total backward compatibility, in that the ground system has to be able to recognise a request from any aircraft CM version, provided that it is ICAO compliant, if only to report that it cannot support the version of the application requested.

3. DEVELOPMENT OF THE CMA SARPS.

3.1 The main document from which the SARPs have been developed is the Draft ICAO Manual of ATS Data Link Applications, submitted to the 2nd Meeting of the ADS Panel in September 1996. Some additional information was obtained from the RTCA Document 219, Minimum Operating Performance Standards for ATC Two-way Data Link Communications, initially published in August 1993, and recently updated to bring it into line with the SARPs material. In addition, ICAO had specified that CMA should conform to the ATN protocols for its data link operations.

3.2 The initial development of the SARPs was conceptually relatively uncomplicated. After an initial log-on message was sent by the aircraft requesting support for specific services, the ground system would reply, passing the necessary address information. Within the same uplinked message, the ground would terminate the dialogue, leaving the aircraft with a list of application addresses, which the aircraft could use at its convenience.

3.3 In the course of the development of these SARPs, the concept has become more complicated. In particular, the ADSP identified a need for ground to maintain the dialogue after the initial contact had been made. The requirement for this facility applied particularly, but not exclusively, to aircraft in the European Region, where Flight Information Regions can be small, and consequently the establishment of contact with relevant data authorities (which takes a finite time) can be frequent.

3.4 There was also an explicit requirement in the ADSP material for the ATSU which had received information from the CM log-on function to be able to pass aircraft address information to an adjacent ATSU. ATNP WG 3 considered that, within the timescale available, it would be unable to develop a suitable set of Inter Centre Communications SARPs to enable this functionality. It therefore decided to include an element of ground/ground message forwarding in the CPDLC functionality.

3.5 Both the maintenance of a dialogue and the ground/ground functionality were seen by some WG 3 members as having a limited applicability. States would not be willing to incur the costs of implementing a complete system if they only ever intended to use certain elements of the application. In addition, they would want to be involved in a validation programme for parts of SARPs for which they would have no future need. On the basis of these arguments, therefore, the WG agreed to try to separate out the functionalities to enable part implementation and part validation, whilst still retaining the interoperability required by the ICAO Standards. This has led to the development of subsetting rules, and the identification of conformant configurations.

3.6 The Subgroup of Working Group 3 which has been responsible for the production of the draft CMA SARPs material has worked very closely with the relevant Working Groups of the ADSP, to ensure that the development of both the operational concepts, and the technical means of achieving them keep in step with each other.

4. OVERVIEW OF THE CONTENTS OF THE MATERIAL

General

4.1 Due to the complexities of the documentation, and the repetitive nature of some of the material, none of the Air-Ground Applications SARPs are stand-alone documents. For example, there are no formal list of acronyms, definitions or references - these are all in Part 1. Likewise, conventions for expressing requirements, system performance parameters common to all air-ground applications, and the whole description of the Application Layer structure, with its finite and abstract concepts and its basis within ISO specifications, is also outwith this material.

4.2 Also, to the extent possible, the CMA SARPs are a Controlled Document. This means that, once they were initially baselined (at the WG 3/4 meeting in October 1995) all changes have been documented through defect reporting and a configuration control procedure. Some reports are little more than a one line entry, invoking near-global changes agreed by a meeting of WG 3, whereas others may be technically complex, raised by an organisation responsible for developing prototype implementations. All defect reports are reviewed by Subgroup 2, acting as a Configuration Control Board , the necessary remedial action put in place, and the results presented to WG 3 for acceptance and approval. Traceability of actions is provided by means of the Configuration Sheet at the front of the SARPs.

4.3 All the Air-Ground SARPs are produced to a standard format of eight chapters, and all chapter headings are the same. This has greatly helped the maintenance of document stability, commonality and presentation. CMA SARPs are no different in basic layout from all other air-ground applications SARPs.

Chapter 1 - Application overview

4.4 This introductory chapter gives a very brief, high level description of CPDLC, as an application allowing an addressing capability for data link applications.

4.5 This chapter also contains an outline description of the functions which the application provides, namely:

a. **The Logon Function**

This defines a method for the aircraft system to provide an application name and version number for each air-only initiated application, and an application name, address and version number the aircraft wishes to use that can be ground initiated, along with flight plan information as required by the ground system. In response, the ground provides an application name for each ground-only initiated requested application that can be air initiated and that the ground can support.

b. **The Update Function**

This function provides the capability for the ground system to update application information.

c. **The Contact Function**

This provides the capability for the ground system to request the aircraft to initiate the logon function with a designated ground system. It is expected that this function will only be used when ground connectivity is not available between respective ground systems.

d. **The Forwarding Function**

This provides the capability for a ground system to forward information received from the CM Logon function to another ground system. This function is initiated by a ground system, which supports ground-ground forwarding, having completed a successful logon that can then forward the aircraft CM Logon information to other ground systems.

e. The Registration Function

This provides a method for the air and ground CM applications to make available application name, address and version number for each application exchanged in the logon, update or forward functions to other applications or communication systems in the aircraft or on the ground.

4.6 Finally, chapter one contains a brief resume of the contents of the other chapters.

4.7 Since this chapter contains no information directly relation to the stipulation of specific Standards, it is written almost entirely as series of informative notes.

Chapter 2 - General requirements

4.8 This chapter contains information and high level requirements for the maintenance of Backward Compatibility and Error Processing. Throughout these SARPs great emphasis is placed on the end users being kept informed of the state of the system.

Chapter 3 - The Abstract Service

4.9 This chapter defines the abstract service interface for the CM application. The CPDLC-Application Service Element (CM-ASE) abstract service is described from the viewpoint of the CM-air-user (the pilot and the aircraft systems), the CM-ground-user (the ATSU ground system facilities) and the CM-service-provider (the providers of the communications media, routing and switching facilities).

4.10 In this chapter the static behaviour, (i.e. the format) of the CM abstract service is described. Its dynamic behaviour (i.e. how it is used) is described in chapter 7. In order to clarify some of the concepts inherent in the abstract service, an outline diagram and informative notes are provided as an introduction. There is of course no requirement to implement the CM-ASE abstract service in a CM product: however, it is necessary to implement the ground based and air based system in such a way that it will be impossible to detect (from the peer system) whether or not an interface has been built. This emphasises the implementation impartiality of the SARPs, which retaining the need for the provision of interoperability.

4.11 The CM-ASE abstract service shall consist of a subset of the following services (permissible subsets are described in chapter 8), the rules and requirements of which are described in detail:

a. CM-logon service

b. CM-update service

c. CM-contact service

d. CM-end service

e. CM-forward service

f. CM-user-abort service, and

g. CM-provider-abort service

4.12 Each service contains a number of primitives and parameters - parameter values, where required, conforming to the Abstract Syntax Notation .One (ASN.1) syntax as given in Chapter 4.

Chapter 4 - Formal Definition of Messages

4.13 This chapter describes the contents of all permissible CM messages through definition of the CM ASN.1 abstract syntax. All possible combinations of message parameters and their range of values are detailed.

Chapter 5 - Protocol Definition

4.14 This chapter is effective split up into three parts - sequence diagrams for the services given in chapter 3, protocol descriptions and error handling for the CM-Air- and Ground-ASEs, and State Tables.

4.15 The sequence diagrams define the valid sequence of primitives that are possible to be invoked during the operation of the CM application. They show the relationship in time between the service request and the resulting indication, and, if applicable, the subsequent response and resulting confirmation. With the exception of the abort primitives, only the sequence of primitives described in the diagrams shall be permitted. (Abort primitives may interrupt and terminate any of the normal message sequences.)

4.16 In order to guarantee message sequencing in normal operations, the CM-air-ASE and the CM-ground-ASE shall process primitives in the order in which they are received.

4.17 The protocol descriptions and error handling part of the chapter presents requirements for the CM-air and ground-ASEs in specific states. If no actions are described for a CM service primitive when the ASE is in a specific state, then the invocation of that primitive shall be prohibited while the ASE is in that state. Likewise, should the unexpected happen when an ASE is in a specific state, then exception handling procedures shall apply.

4.18 The state tables are a tabular description of the protocol rules earlier in the chapter. However, if the state tables conflict with any textual statements made elsewhere in the SARPs, the textual statements take precedence.

4.19 In the state tables, the statement ‘cannot occur' means that if the implementation conforms to the SARPs, it is impossible for this event to occur. If the event does occur, this implies that there is an error in the implementation. If such a situation is detected, it is suggested that the ASE aborts , giving an indication of an unrecoverable system error. The statement 'not permitted' means that the implementation must prevent this event from occurring through some local means. If the event does occur, this implies that there is likewise an error in the implementation. However, if such a situation is detected in this case, it is suggested that the ASE performs a local rejection of the request, rather than aborting the dialogue.

Chapter 6 - Communication Requirements

4.20 This short chapter specifies the use of Packed Encoding Rules (PER) to encode/decode the ASN.1 message structure, Dialogue Service requirements, including Quality of Service (QOS), and stipulates the IA5 character string used as the Application Entity qualifier for the CM application.

4.21 In this initial version of the CM application, there are only limited QOS requirements - these will be expected to become more strongly defined in later versions.

Chapter 7 - User Requirements

4.22 This chapter contains requirements imposed on the CM-user concerning CM messages and interfacing with the CM-ASEs. This chapter is also written in slightly less formal language.

4.23 Since the only human input into the system is likely to be the initial pilot activity calling on the service, recommendations have been made as to the performance of the system - system turn round times of 0.5 seconds are recommended.

Chapter 8 - Subsetting Rules

4.24 This chapter specifies conformance requirements which all implementations of the CM protocol obey. The protocol options are tabulated, and indication is given as to whether mandatory, optional or conditional support is required to ensure conformance to the SARPs.

4.25 There is just one CM-air-ASE conformant configuration, namely supporting the full air/ ground functionality. The ground user has 28 permissible combinations.

4.26 These subsetting rules will permit applications to be tailored to suit individual ground implementations, commensurate with the underlying task, while still maintaining an acceptable level of interoperability.

5. RECOMMENDATION

5.1 The Panel is recommended to approve the attached CM material for inclusion in the ATN Standards and Recommended Practices.