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AUTOMATIC DEPENDENT SURVEILLANCE (ADS) AND AIR TRAFFIC SERVICES (ATS) DATA LINK APPLICATIONS

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FOREWORD

The ICAO Tenth Air Navigation Conference (1991) endorsed the communications, navigation and surveillance/air traffic management (CNS/ATM) systems and recognized that global implementation would be essential to derive the full benefits of those systems. Among the different technologies being developed, automatic dependent surveillance (ADS) was recognized as playing an important role in air traffic management enhancements which will improve airspace capacity.

In November 1994, the Air Navigation Commission considered the operational requirements and guidance material for ADS and air traffic services (ATS) data link applications developed by the third meeting of the Automatic Dependent Surveillance Panel (ADSP/3). The Commission agreed that the guidance material should be made available for use in the design of equipment, facilities and services for ADS and data links as envisioned by ICAO as part of the global CNS/ATM systems. Furthermore, the Commission recognized that the guidance material contains valuable information of interest to the international aviation community and agreed to the publication of the material as an ICAO circular.

The circular contains guidance material comprising long-term requirements and system performance requirements for ADS and ATS data link applications. Part I provides operational requirements, functional descriptions and performance characteristics for implementation of the ADS technique in an ADS-based air traffic control (ATC) system. Part II contains technical information on direct controller-pilot communications and air traffic services interfacility communications via data link. Part II is not yet complete with regard to the description and operational requirements for data link applications. This part will be finalized for inclusion in a future ICAO manual on ADS and ATS data link applications. At that time, the units of measurement shown in the circular will be aligned as necessary with the international Standards and Recommended Practices for dimensional units to be used in air and ground operations, contained in Annex 5 to the *Convention on International Civil Aviation* (Doc 7300).

The defined operational requirements are considered adequate for ADS and data link applications. However, in order to reach the objective of using ADS for tactical control, additional operational and functional requirements are expected to be identified. For example, the performance characteristics, documented for each operational requirement and each system element will develop in light of experience with implementation and operation in an ADS environment. Also, the end-to-end communications network and data processing time need refinement in order to achieve the required responsiveness for real-time ATC surveillance systems.

The operational requirements as contained in the guidance material should be implemented selectively and in accordance with regional planning to meet traffic demand and regional requirements. The importance of human factors issues in relation to ATC, communications and data display need to be treated as an integral part of the development of the ADS-based ATC system. It is expected that the contents of this ICAO circular will be used as guidance for the harmonized development of a global ADS system, and thus will contribute to the enhancement of safety, regularity and efficiency of international civil aviation.

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INTRODUCTION

1. HISTORICAL BACKGROUND

1.1 In the early 1980's, the International Civil Aviation Organization (ICAO) recognized the increasing limitations of the present air navigation systems and the improvements needed to take civil aviation into the 21st century. In 1983, ICAO established the Special Committee on Future Air Navigation Systems (FANS) with the task of studying, identifying and assessing new concepts and new technology and making recommendations for the co-ordinated evolutionary development of air navigation over a time scale of the order of 25 years.

1.2 FANS recognized that the limitations of the present systems were intrinsic to the systems themselves and the problems could not be overcome on a global scale except by new concepts and new communications, navigation and surveillance (CNS) systems to support future enhancements to air traffic management (ATM). FANS proposed a new system concept, one which would evolve over a period of years, and which recognized that the pace of change cannot be the same everywhere on the globe.

1.3 ICAO recognized that implementation of the concept would require global co-ordination and planning on an unprecedented scale, and established a follow-on committee to help ensure a coherent, cost-beneficial, global implementation of the new system concept.

1.4 The Tenth Air Navigation Conference (1991) endorsed the global concept proposed by the Special Committee for the Monitoring and Co-ordination of Development and Transition Planning for the Future Air Navigation System (FANS Phase II). The concept, which is contained in the Global Co-ordinated Plan for Transition to the ICAO CNS/ATM Systems (Doc 9623, FANS (II)/4 refers), included a variety of satellite-based systems along with a judicious selection of ground-based systems. A brief extract is given below.

2. THE ICAO CNS/ATM SYSTEMS CONCEPT

2.1 Communications

2.1.1 In the future CNS/ATM system, air-ground communications with aircraft will increasingly be by means of digital data link. This will allow efficient linkages between ground and cockpit systems. ICAO has developed a communication systems architecture that provides a range of capabilities to suit the needs of air traffic services providers and their users, from basic low-speed data to high-speed digital voice, including the aeronautical mobile-satellite service (AMSS). Various communications media, e.g. AMSS, very high frequency (VHF), data link and secondary surveillance radar (SSR) Mode S data link, will be integrated through an aeronautical telecommunications network (ATN) based on an open systems interconnection (OSI) architecture.

2.1.2 Potential benefits from air-ground communications are:

a) efficient linkages between ground and airborne systems;

b) improved handling and transfer of data;

c) reduced channel congestion;

d) reduced communications errors;

e) inter-operable communication media; and

f) reduced workload.

2.2 Navigation

2.2.1 Required navigation performance (RNP), conceived by the FANS Committee and developed by the Review of the General Concept of Separation Panel (RGCSP), defines navigation performance accuracy required for operation within a defined airspace. The concept, in principle, allows the aircraft operator to select the type of navigation equipment to use. It is anticipated that RNP requirements could be met by the global navigation satellite system (GNSS), currently being deployed. It is expected that GNSS will be able to provide a high-integrity, highly accurate navigation service, suitable for sole-means navigation, at least for en-route applications.

2.2.2 Potential benefits from GNSS are:

a) improved four-dimensional navigational accuracy;

b) high-integrity, high accuracy, worldwide navigation service;

c) worldwide navigation using a single set of navigation avionics;

d) costs savings from phase-out of ground-based navigational aids; and

e) improved air transport services using non-precision approaches and landing operations.

2.3 Surveillance

2.3.1 The ADS-based ATC system will use a data link to provide surveillance information for ATS, as well as direct two-way controller-pilot data communications.

2.3.2 Potential benefits from the enhanced surveillance system are:

a) enhanced flight safety;

b) improved surveillance of aircraft in non-radar areas;

c) facilitated reduction of separation minima in non-radar airspace;

d) reduced delays;

e) the accommodation of user-preferred flight profiles;

f) increased ATC capacity; and

g) more efficient and economic aircraft operations.

2.4 **Air traffic management (ATM)**

2.4.1 The future ATM system will make maximum use of automation to reduce or eliminate constraints imposed on ATM operations by current systems, and to derive the benefits made possible by implementation of the new CNS systems. The flexibility facilitated by the new CNS systems will allow the introduction of automation capabilities from the simplest to the most advanced, as required by the individual States, and in a globally harmonious fashion. It is expected that the use of ATM automation will be most visible in flow and tactical management.

2.4.2 ATM automation will make it possible to formulate real-time flow management strategies and allow for negotiation between ATS and aircraft to enhance tactical management. Data link and voice channels, enhanced by automation aids, will be used for aircraft not capable of automated negotiation with ground systems.

2.4.3 Future ATM systems will significantly benefit the rapidly growing international air traffic operations. The goal is to develop flexible operations by accommodating users' preferred trajectories to the optimum extent possible. The future ATM systems will use automatic dependent surveillance, other data link applications, satellite communications, the global navigation satellite system and aviation weather system improvements to integrate ground-based automation and airborne flight management systems.

2.4.4 Potential benefits from improvements in ATM are:

a) enhanced safety, reduced delays and increased airport capacity;

b) more flexible ATM operations;

c) enhanced surveillance capability;

d) reduced congestion;

e) more efficient use of airspace, including more flexibility and reduced separations;

f) better accommodation of user-preferred profiles;

g) enhanced weather information; and

h) reduced controller workload.

3. Purpose of the document

3.1 The purpose of this document is to describe the concept of an automatic dependent surveillance-based air traffic control (ADS-ATC) system and its application on a world-wide basis. The document provides guidance material for aviation authorities, airspace users and service providers in establishing an ADS-ATC service in their airspace according to regional and national plans. In addition, the document provides guidance and information on air traffic services (ATS) data link applications and identifies how such systems will enhance existing air traffic services.

4. Structure of the document

4.1 The main body of this document contains two major parts, covering automatic dependent surveillance and ATS data link applications. Each part contains detailed technical appendices which will be kept separate from the main body for purposes of updating. The guidance material in this document should be used as an amplification of the ICAO Standards and Recommended Practices (SARPs) and procedures already developed for the use of ADS and data link communications, as contained in Annexes 2 and 11 and the *Procedures for Air Navigation Services — Rules of the Air and Air Traffic Services* (PANS-RAC, Doc 4444).

PART I

AUTOMATIC DEPENDENT SURVEILLANCE

PART I – AUTOMATIC DEPENDENT SURVEILLANCE

CHAPTER 1. INTRODUCTION

1.1 GENERAL

1.1.1 The surveillance system, as envisaged by the communications, navigation and surveillance/air traffic management (CNS/ATM) systems, will be characterized by the use of automatic dependent surveillance (ADS), initially for application in areas outside radar coverage. ADS will be used to automatically transmit aircraft positions derived from on-board navigation systems, via satellite or other suitable data link communications system, to an air traffic services unit. This will provide a surveillance capability in areas where procedural air traffic control services are available today, particularly in oceanic and remote land areas.

1.2 PURPOSE OF PART I

1.2.1 Part I provides guidance material and information from an operational standpoint in support of technical developments relating to ADS. In this context, the guidance material represents a basic set of world-wide agreed operational principles and procedures for the efficient use of ADS in ATS. One of the essential purposes of the guidance material is to serve as the basis for the formulation of advanced ATC operational concepts and ATC system functional specifications, and to delineate the performance requirements of the different ADS system components. The future ADS-based ATC system will be responsive to the operational requirements for ADS and will be capable of satisfying all ATC functions. States concerned with the development of ADS should ensure that the technical media to be provided fulfil the operational needs.

1.2.2 ADS systems are being developed on a regional basis. Integration of these developments into a global implementation is envisaged within the context of the future CNS/ATM systems. Individual States and aeronautical industry are progressing the technical specifications for ADS avionics and other system components. Equipment for related data link communications is also being developed. Consequently, and in the general interest of developing harmonized and compatible ADS systems, this guidance material should be taken into account in those developments, as well as in the design and implementation of ADS.

1.2.3 This guidance material has been developed to:

a) explain the concept of an ADS based ATC system and associated data link communications requirements to support the automatic aircraft reporting and direct two-way controller-pilot communications for the digital interchange of ATS messages;

b) identify how an ADS-ATC system will enhance existing air traffic services;

c) provide guidance material for aviation authorities, airspace users and service providers in an ADS-ATC service, including system concept and description, operational requirements, air traffic services, procedures, and implementation and transition strategies; and

d) provide guidance material on ATC automation.

1.2.4 This guidance material is considered part of the evolutionary process for the implementation of ADS and related technology. ICAO will continue its effort in support of the timely development of all necessary material to ensure a global harmonization and standardization of future ADS-based ATC systems.

1.3 EXPLANATION OF TERMS

Automatic dependent surveillance (ADS). A surveillance technique in which aircraft automatically provide, via a data link, data derived from on-board navigation and position-fixing systems, including aircraft identification, four-dimensional position, and additional data as appropriate.

ADS-based ATC system (ADS-ATC). An ATC system with appropriate automation and communications facilities, relying on ADS updates to provide surveillance.

ADS-ATC service. An ATC service provided by an ATC unit based on an ADS-ATC system.

Definitions of other terms are provided in the Glossary.

PART I – AUTOMATIC DEPENDENT SURVEILLANCE

CHAPTER 2. ADS AND ASSOCIATED DATA LINK REQUIREMENTS

2.1 GENERAL

2.1.1 The CNS/ATM systems will build on existing systems and technologies in an evolutionary manner. One of their objectives is to harmonize the different air traffic control systems among the regions, irrespective of the surveillance, navigation and communications systems in use. Data link communications will allow direct controller-pilot data link communications and the transfer of automatic dependent surveillance data.

2.2 ADS AND ASSOCIATED DATA LINK REQUIREMENTS

2.2.1 The CNS/ATM systems will overcome the shortcomings of the current systems by providing for global communications, navigation and surveillance coverage from (very) low to (very) high altitudes, for digital data interchange between the air-ground systems to fully exploit the automation capabilities of both, and for the development of a fully integrated CNS end-system which will operate in a normalized manner throughout the world.

2.2.2 The ADS-ATC system will improve the handling and transfer of information between operators, aircraft and ATS units, provide extended surveillance capabilities by using ADS and advance ground-based data processing and display systems to the controller, thus allowing advantage to be taken of the improved navigation accuracy in four dimensions and accommodating the flight's preferred profile in all phases of flight, based on the operator's objectives. The future ADS-ATC system will also improve conflict detection and resolution, as well as the automated generation and transmission of conflict-free clearances and rapid adaptation to changing traffic conditions.

2.2.3 In oceanic areas and remote land airspaces with limited ground-based air navigation facilities, surveillance of air traffic is envisioned to be provided by ADS reporting and satellite communications. Surveillance of low-altitude traffic operations will be conducted in a similar manner. In continental airspaces, surveillance of air traffic may be achieved by ADS reports integrated with ground-based radar systems. Controller-pilot data link communications and the interchange of ATS messages will be carried out by satellite, SSR Mode S, VHF or other suitable data link available, e.g. high frequency (HF) data link.

2.2.4 Implementation of ADS will overcome limitations found today in procedural ATC systems based on pilot-reported position reports. The introduction of air-ground data links through which the ADS reports and associated messages will be transmitted, together with accurate and reliable aircraft navigation systems, presents the opportunity to improve surveillance of aircraft in those airspaces.

2.2.5 The implementation of ADS offers the potential for increasing flight safety and airspace utilization by reducing ATC loop errors in air-ground communications and by providing ATC with accurate aircraft position information. The exchange of ATS messages by digital data link will alleviate the overloading of ATC radio frequencies and support ATC automation, as well as the implementation of other ATS data link applications.

2.2.6 The processing of automated position reports will result in improved monitoring of aircraft operations. Automatic flight plan data validation will facilitate the early detection by ATC of on-board system flight and route data insertion errors. Conflict prediction and resolution will support the use of preferred route profiles. The display of the traffic situation as derived from ADS reports and the automated processing of ATS safety messages will significantly improve the ability of the controller to respond to pilot requests and to resolve traffic situations.

2.2.7 With a combination of improved ATC automation, reliable communications and accurate navigation and surveillance, it should be possible to increase the level of tactical control and to reduce separation minima on the basis of controller intervention capability and other ATM improvements, thereby further increasing airspace capacity.

PART I – AUTOMATIC DEPENDENT SURVEILLANCE

CHAPTER 3. GENERAL PROVISIONS

3.1 GENERAL

3.1.1 ADS is a surveillance technique for use by air traffic services in which aircraft automatically provide, via a data link, data derived from on-board navigation and position-fixing systems. The data includes, as a minimum, aircraft identification and four-dimensional position.

3.1.2 Although the application of ADS does not specifically encompass ATC communications, automation or procedures, all of these elements must be tailored to support the ADS function and to make meaningful use of the data. Thus, it is critical to consider the ATC automation and communications systems as the foundation upon which the ADS-based ATC system is built.

3.1.3 The ADS-ATC service is an air traffic control system provided by an ATC unit based on an ADS-ATC system. Figure 3-1 depicts a general overview of several components of an ADS system (see also paragraph 3.2.3).

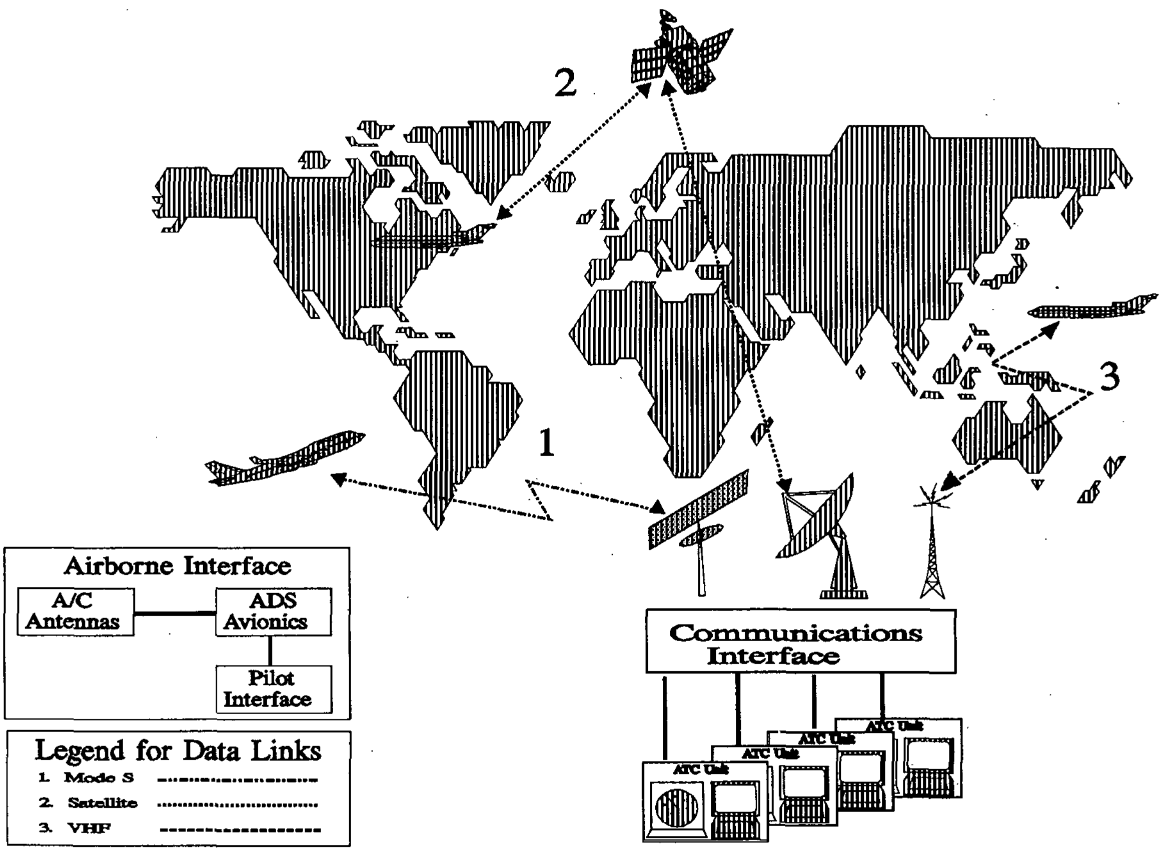

Figure 3-1. ADS systems concept

3.1.4 The ADS function, which is provided through avionics software, obtains navigational, meteorological and flight data from other avionics equipment and processes some or all of the information into reports for ADS applications. The implementation of ADS applications into the air traffic system will be an evolving process.

3.1.5 Outside the range of radar, the ADS reports will be used by air traffic services applications to improve position determination, resulting in improvements in safety, efficient utilization of airspace and improved controller efficiency. This is expected to increase airspace capacity and allow more economical routing and spacing of aircraft. ADS will be beneficial in other areas, where ADS may serve as a supplement to and/or back-up for secondary surveillance radar (SSR), thereby reducing the need for primary surveillance radar (PSR).

3.1.6 In oceanic and other areas which are beyond the coverage of land-based radar, ADS will significantly change the way air traffic control services are provided. The accurate and timely indication of an aircraft's position and reliable communications are keys to the operation of a safe, responsive and effective ATC system. Outside radar coverage, ADS capabilities enable the air traffic controller to monitor flight progress, ensure safe separation of aircraft and respond in a timely manner to user requests. There will be a gradual transition from procedurally-oriented strategic air traffic control towards a more tactical control environment with the introduction of an ADS-based ATC system.

3.2 OPERATIONAL CONCEPT

3.2.1 **Background**

3.2.1.1 The implementation of ADS, through reliable data link communications and accurate aircraft navigation systems, will provide surveillance services in oceanic airspaces and other areas where procedural air traffic control services are currently provided. The implementation of ADS was also envisaged to provide benefits in en-route continental, terminal areas and on the airport surface. The automatic transmission of the aircraft position through ADS will replace present pilot position reports. The content and frequency of reporting will be determined by the controlling ATC unit. In non-radar airspace, the effective use of ADS in air traffic services will facilitate the reduction of separation minima, enhance flight safety and better accommodate user-preferred profiles. To this end, ADS reports and associated communications will have to be supported by advanced airborne and ground facilities and data link communications with proven end-to-end integrity, reliability and availability.

3.2.1.2 The ADS Panel decided that, from an operational point of view, ADS should be considered as a service rather than as a function. The future air-ground data link communications systems will be used for both ADS and other ATS data link messages and, where necessary, data elements for controller-pilot data link communications.

3.2.1.3 As with current surveillance systems, the benefit of ADS for ATC purposes requires supporting complementary two-way pilot/controller data and/or voice communication (voice for at least emergency and non-routine communication). Where VHF coverage exists, the communication requirement is envisaged to be met by VHF voice. In areas where high frequency (HF) is currently used for communication (e.g. oceanic areas), regular controller-pilot data link communications are envisaged to be used to support the ADS-ATC service in the en-route phase of flight.

3.2.1.4 The original FANS definition of ADS and the ADS report format have been expanded to their present formats and configurations documented in Part II of the PANS-RAC (Doc 4444). Eight data blocks have been configured for the content of ADS reports, the composition of which shall be established by the controlling ATC unit on the basis of aircraft reporting capability, traffic workload and operational conditions. Full details of the format and contents of the ADS report message and data blocks are included in Chapter 4 and Appendix C to Part I, Chapter 5.

3.2.1.5 An ADS-ATC system must include the capability to exchange messages between the pilot and the controller. A voice capability must be available for (at least) emergency and urgent, non-routine safety-related communications.

3.2.1.6 In the context of the future CNS/ATM systems, ADS is envisaged to be one of the possible applications supported by the ATN.

3.2.1.7 The ADS-ATC service must permit introduction of ADS without interruption of existing operational ATC services. The system should also be sufficiently flexible and expandable to achieve the following:

a) capability to incorporate the SARPs as they are developed;

b) capability to adapt to local regulations and special ATS requirements, and flexibility to accommodate future changes in functional needs and technological advances;

c) ability to revert safely to other forms of operational ATC services in case of degradation or failure of the system;

d) provision of a minimum service capability to all appropriately-equipped aircraft;

e) provision of an ATS infrastructure capable of taking full advantage of ADS; and

f) capability to be introduced without increasing the workload of the controller.

3.2.2 **Functional description**

3.2.2.1 ADS functional objectives include:

a) the enhancement of flight safety through the ability to provide a means of surveillance of aircraft operating outside radar coverage areas;

b) timely detection of way-point insertion errors/ATC loop errors;

c) current flight plan (CPL) conformance monitoring and timely detection of deviations from the cleared track;

d) corrective action associated with b) and c);

e) reduction in separation minima made possible by the improved surveillance, communications, ATC data processing and display capability which must be associated with automatic dependent surveillance to obtain full benefits (in association with appropriate navigational performance);

f) an increased level of tactical control enabling a more flexible use of airspace;

g) enhancing conflict detection and resolution; and

h) timely notification and enhanced position accuracy during emergency situations.

3.2.2.2 The functional elements needed for the evolutionary implementation of ADS must include requirements for avionics, communications and ATC automation. The implementation of ADS will be a major contribution to the ICAO CNS/ATM systems and will provide significant benefits to users and providers. Although ADS will find its prime application in ATS, the function would also be useful in air traffic flow management (ATFM) and airspace management (ASM).

3.2.2.3 The ADS system architecture will consist of three physical components of the ATN: the avionics data network, air-ground data link communications and the ground network. The ADS avionics will be either a stand-alone ADS unit (ADSU) or an ADS function (ADSF) developed and installed within the on-board equipment. The air-ground media will use a choice of satellite, VHF and/or Mode S data links. HF data link may be incorporated in the future. The ground-based system will use the ATN routers and the appropriate data link devices available to forward ADS reports and associated messages to/from the ground end-system. Figure 3-2 shows ADS implementation alternatives.

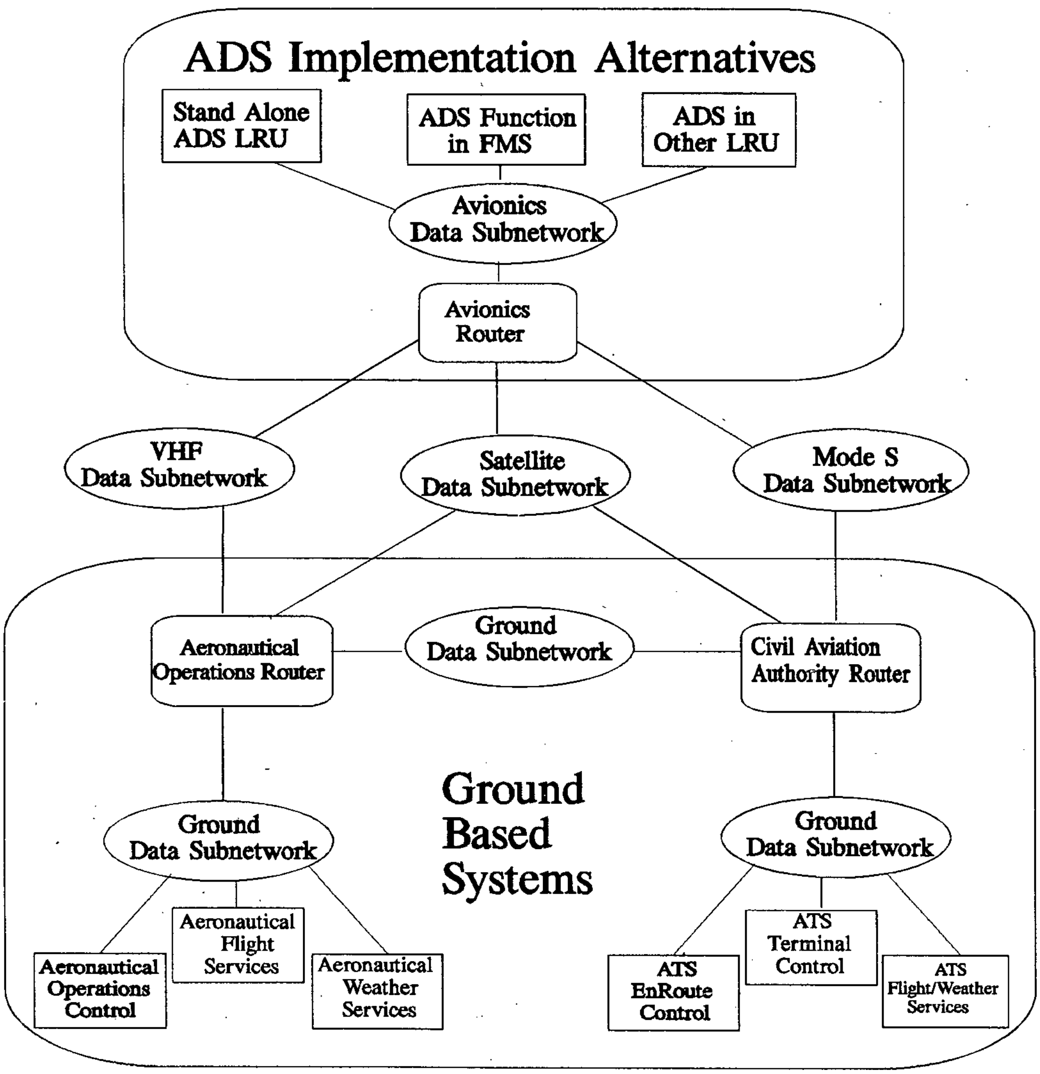

Figure 3-2. ADS communications network overview within the ATN

3.2.3 Components of an ADS-ATC system

3.2.3.1 There are six major components which are combined to form an integrated ADS-based ATC system. Each of these components is being developed independently, and will evolve according to the needs of the users. The design of the system provides for these enhancements to be made without any disruption to operations. The six components of an ADS-based ATC system are:

a) pilot interface;

b) avionics;

c) data link;

d) communication interface;

e) ATC automation; and

f) controller interface.

3.2.3.2 Pilot interface

3.2.3.2.1 Most of the air-ground communication will be conducted by data link. The pilot interface to the data link system must be efficient and easy to operate. Routine messages, which form the vast majority of communications, will require some rapid entry mechanism. Use of data link will result in changes to the cockpit environment, since the messages which are currently transmitted by voice, using HF radio, will be transmitted by data link.

3.2.3.2.2 Digital voice will gradually replace HF communications for emergency and non-routine situations. For VHF communications, voice and/or data will be used, depending on the situation.

3.2.3.2.3 Generally, the transmission of ADS data is done without the need for pilot intervention. Most operations involved in establishing and maintaining a surveillance link will be performed automatically. However, the pilot must be able to monitor system operations. The pilot will also have the capability to increase the ADS reporting rate during emergency and non-routine situations.

3.2.3.2.4 Direct controller-pilot voice capability should be available for emergency and non-routine messages. In order to cater to these types of emergency situations, the system will also provide for a pilot-initiated communication which would indicate the state of emergency and include a basic ADS report and aircraft identification.

3.2.3.3 Airborne avionics

3.2.3.3.1 The ADS function must be supported by avionics equipment which is able to gather aircraft data from on-board systems, format the data and direct the data to the relevant air-ground link. The avionics should make maximum use of equipment already in place on most commercial air carriers. This on-board equipment should also have the capability to receive messages, originated by the controlling ATS unit, which establish the ADS reporting plan (periodic and event-driven), and the data fields to be included in the ADS reports.

3.2.3.3.2 The principal elements comprising the avionics data link subsystem are: an ADS unit (ADSU), an aircraft router and a data link processor. The ADSU collects ADS-related information from the aircraft navigation and flight management systems, reformats the data as required and transfers it to the communications system. The ADSU will also accept up-link messages that set the reporting rate, select the fields to be transmitted and provide other functions related to establishing, maintaining, updating and terminating a communications connection. The data link processor supports all data communications, including automatic reporting and direct two-way controller-pilot communications.

3.2.3.3.3 In the ADS system, the required air-ground data link could be either satellite data link, VHF data link, Mode S data link or any other medium which meets the operational requirements.

3.2.3.3.4 The avionics portion of the ADS system will require a minimum configuration of one ADSU and a communications management unit (CMU), or equivalent, containing an ATN router and one or more avionics data link devices. The ADS function will forward ADS position reports to a CMU. The CMU will, in turn, route and forward the reports to an appropriate air-ground data link communications device.

3.2.3.3.6 It is noted that complementary industry standards, such as those being developed by RTCA Special Committee 170 (SC 170), will, when ICAO compliant, provide avionics manufacturers with the means of ensuring that the above equipment will perform its intended functions satisfactorily under all conditions normally encountered in routine aeronautical operations.

3.2.3.3.7 The implementation of the ADS function assumes the following:

a) position data is supplied from the on-board navigational equipment currently navigating the aircraft;

b) a message time stamp is provided to the automatic dependent surveillance function (ADSF) and that it varies no more than 1 (one) second from Co-ordinated Universal Time (UTC) time;

c) an ATN-compliant link is the data communications network used for ADS; and

d) the ADS function may be a stand-alone ADSU or may be embedded in other on-board avionics equipment.

3.2.3.4 Data link

3.2.3.4.1 The ADS-based ATC system may utilize one of several data links based on the ATN concept. These include the satellite communication (SATCOM), VHF digital data link (VDL) and SSR Mode S.

3.2.3.4.2 A standard application interface will be provided, independent of the link employed. The network and on-board avionics will select the most suitable path, based on time-varying considerations such as geographic location, cost, delay, throughput and link availability. For example, in oceanic airspace, satellite data links will most likely be employed, while, in domestic airspace, VHF or SSR Mode S data links could be used. From the user's perspective, the resulting system will appear seamless (i.e. independent of the communications system).

3.2.3.5 Communication interface

3.2.3.5.1 The ADS-based ATC end-system will be connected to the air-ground data link through a terrestrial communications network. The network will conform to the protocol suite defined as part of the aeronautical telecommunications network concept. For messages from the ground (ADS contract commands), the ground ATN routers must choose the most suitable data link device available and route the message to that transmitting station. ATN routers must receive reports from the aircraft and forward reports to the addressed ground end-system.

3.2.3.6 ATC automation

3.2.3.6.1 The following functions, based on data link and ADS, have been identified for implementation into the ATC automation system:

a) *Position monitoring*. The automation system processes incoming ADS messages to verify their validity and match them to the appropriate flight plan.

b) *Conformance monitoring*. The ADS-reported position is compared to the expected aircraft position, which is based on the current flight plan. Longitudinal variations – which exceed a pre-defined tolerance limit – will be used to adjust expected arrival times at subsequent fixes. Horizontal and vertical deviations which exceed a pre-defined tolerance limit will cause an out-of-conformance alert to be issued to the controller.

c) *Conflict prediction*. This function identifies to the controller potential violations of separation standards, based on the ADS reports and the current flight plan.

d) *Data presentation*. Data presented to the controller, which include traffic information and conflict and out-of-conformance lists.

e) *Clearance validation*. Way-point data contained in the navigation system are down-linked and compared with the current flight plan. Any discrepancies are reported immediately to the controller.

f) *Tracking*. The tracking function is intended to extrapolate the current position of the aircraft based on ADS reports.

g) *Conflict resolution*. This function provides the controller with possible solutions to potential conflicts when they are detected.

h) *Wind grid estimation*. Real-time reports of wind data, available from ADS reports, may be used to update the expected arrival times at way-points, and will also be used by the meteorology (MET) offices to improve the upper air forecasts for aviation.

i) *Flight management*. Aircraft with four-dimensional (4-D) navigation capabilities will be capable of flying an optimum profile to a specified point in space and arriving at that point at a specified time. ATC automation may be used to generate optimum conflict-free clearances to support fuel-saving techniques such as cruise climbs. Aircraft performance characteristics must be considered when generating the clearances.

3.2.3.6.2 For systems where ADS is used as a complement to radar, provisions are required which integrate ADS and radar position information.

3.2.3.7 Controller interface

3.2.3.7.1 Air traffic services providers will define and develop specific controller interfaces tailored to their particular needs. The human-machine interface will be left to the individual service provider. However, all such interfaces should be developed and integrated into existing systems, with the objective of reducing controller workload. The following functionalities should be considered:

a) display traffic situation information in a relevant manner;

b) alert the controller to potential and actual violations of separation standards;

c) provide tools for the composition of ground-air (up link) data link messages;

d) display air-ground messages; and

e) provide an air-ground voice channel for two-way emergency and non-routine communications.

3.2.3.7.2 An enhanced controller interface which should permit data link communications with pilots as follows:

a) the message template mode will provide templates for commonly used messages, such as clearances, and will allow rapid and standard message creation and transmission; and

b) the free text mode will allow the controller to enter any desired text and send it to the selected aircraft.

3.2.4 **Use of ADS in ATC**

3.2.4.1 The implementation of ADS will provide surveillance services in oceanic airspaces and other areas where procedural air traffic control is currently in operation. The implementation of ADS will provide benefits in en-route continental airspace, terminal areas and even on the airport surface. The automatic transmission of the aircraft position through ADS will replace present pilot position reports. The content and frequency of reporting will be determined by the controlling ATC unit except for emergencies.

3.2.4.2 Aircraft shall be under the control of only one ATC unit, whether or not ADS is being used. ADS reports will be made available to facilities, other than the controlling ATC unit, on the basis of mutual agreement.

3.2.4.3 A performance check for validity of the accuracy of the aircraft position obtained through ADS reports should be carried out before using ADS for the provision of air traffic control services.

3.2.4.4 The ADS-ATC unit controlling the aircraft should establish the composition and requirements for the transmission of ADS reports through an ADS agreement with the aircraft. This agreement can be considered to be an ADS reporting plan which will be fulfilled by one or more contracts (see paragraph 3.3.1.5).

3.2.4.5 The effective use of ADS in the provision of air traffic services in non-radar airspace should facilitate the reduction of separation minima, enhance flight safety and better accommodate user-preferred profiles. To this end, ADS reports and associated communications will have to be supported by advanced airborne and ground facilities and data link communications with proven end-to-end integrity, reliability and availability.

3.2.4.6 In view of the safety benefits that will be derived from implementation of ADS, the ultimate objective is to achieve world-wide coverage. The introduction of ADS in non-radar airspace will better enable controllers to identify potential losses of separation or non-conformance with the CPL and to take the appropriate action.

3.3 OPERATIONS

3.3.1 Principles of operation

3.3.1.1 The ADS concept is based on the use of aircraft-derived position information, transmitted over data link, for use in providing air traffic services. It can be used in remote areas where radar is impractical, or as a low-cost alternative to a long-range radar system. Early operational use of the system will be primarily for oceanic position reporting, but future applications may include domestic reporting, terminal area and ground movement surveillance.

3.3.1.2 The initial airspace environment may contain special routes reserved for ADS-equipped users. These routes will take advantage of ADS and data link capabilities to provide reduced separation between aircraft.

3.3.1.4 ADS reports are generated in response to commands called contract requests issued by the ground ATC system. The contract identifies the types of information and the conditions under which reports are to be transmitted from the aircraft.

3.3.1.5 Three types of reporting have been identified:

a) periodic contract;

b) event contract; and

c) on-demand reports.

3.3.1.6 In response to a periodic contract request, the aircraft assembles and transmits a message containing the fields at the interval specified in the contract request. The aircraft may also initiate an emergency reporting, which is a special case of periodic reporting. Event contracts define certain events, such as altitude change, which will cause ADS reports to be sent, independent of any periodic contracts in effect. One on-demand report is sent each time it is commanded from the ground.

3.3.1.7 An ATS facility may issue several contracts to a single aircraft at one time, including one periodic and one event contract, which may be supplemented by any number of on-demand reports. Up to four separate ground facilities may initiate ADS contracts simultaneously with a single aircraft. This is to support simultaneous, but possibly different, requirements for ADS data by releasing and receiving ADS-ATC units and units whose area of control are close to the aircraft's flight path. ATS facilities have priority and preemptive access to the communications system over other users for the provision of ATC services, including ADS.

3.3.2 High reporting rates

3.3.2.1 High reporting rates are required under the following circumstances:

a) on routes where there is a high traffic density, particularly if the route structure is complex; and

b) when an aircraft's altitude or velocity vectors are changing rapidly, which would occur at turning points and during climb and descent. The magnitude of the parameter changes that would initiate an aircraft report could include:

  i) speed change greater than 40 km/h (20 kts);

  ii) heading change greater than 10 degrees; or

  iii) altitude change greater than 50 m (150 ft); and

c) in emergency situations.

3.3.2.2 The ATC system is the best determinant of the optimum reporting rate for a) above, and the aircraft navigation systems for b) above.

3.3.2.3 The address for reports should be assumed from any existing periodic contract with the aircraft. When there is no existing periodic contract, the address of any existing event contract should be used.

3.3.3 Emergency

3.3.3.1 Emergency mode provides ADS reports at a high fixed rate to support ATC alerting procedures and to assist search and rescue operations. The basic position data should be in every report, with flight identification and ground vector group included in every fifth report.

3.3.3.2 The emergency mode should be established by a simple pilot action. It would also be permissible for avionics to automatically establish the emergency mode. There should be no provision for ground activation.

3.3.3.3 The emergency reporting period should be a system parameter, normally a number of seconds. The parameter should be alterable during maintenance procedures. A default value of 64 seconds was recommended initially. However, the emergency report period should be shorter than the normal report period.

3.3.3.4 When an emergency report mode is declared, any existing periodic contract with that aircraft should be modified to a default emergency period contract. While there is an emergency mode in effect, other requests for a periodic contract should be ignored. An emergency mode should not affect an event contract. The periodic contract in effect when emergency mode is declared would be reinstated when the emergency ends.

3.3.4 ADS operations

3.3.4.2 The purpose of ADS data interchange is to support automatic surveillance of equipped aircraft, with complete transparency to the controller and pilot regarding the communications medium. A standard is required to provide worldwide interoperability and uniformity for interfaces between the ADS application processes of aircraft and those of ground end-systems. The specific requirements which that standard must satisfy are documented in the appendices to Part I, Chapter 5.

3.3.5 Avionics

3.3.5.1 The ADS service is intended for use with aircraft equipped with data link capabilities. The ADS position reports will be automatically forwarded to a communications management unit on the aircraft. The communications management unit will route and forward the reports to an appropriate air-ground data link communications device.

3.3.6 Air-ground data link(s)

3.3.6.1 For uplink messages, the ground ATN routers must choose the best data link device available and route the message to the transmitting ground station. For messages from the aircraft, the ground ATN routers must receive reports from the receiving ground station and forward reports to the addressed ground end-system.

3.3.7 Operational description

3.3.7.1 The ADS service provides the aircraft with the capability of transmitting various types of information either periodically or aperiodically, as requested from the appropriate ground facility or facilities.

3.3.8 ADS ground transactions

3.3.8.1 There are three contract modes of operation for the ADS system: periodic contract mode, event contract mode and demand contract mode. Each of these modes may be active simultaneously. See Part II for the functional requirements for ADS contracts.

3.3.8.2 In the periodic contract mode, ADS reports are requested by a flight data processing system (FDPS) at a specific reporting rate. The reporting rate and message content can be requested, modified or cancelled as needed.

3.3.8.3 Another contract mode of operation will be the event contract mode, in which ADS reports are generated based on the occurrence of a specified event. Some examples of specified events include change of next and/or next + one way-point, variance of speed, heading and/or altitude.

3.3.8.4 The ground-based processor will also be capable of requesting a single report. This constitutes the demand contract mode. This feature may be used, for example, when a contract mode ADS report is not received within its expected time frame.

3.3.8.5 Aircraft-initiated reports are unsolicited reports which are received unexpectedly by an FDPS. These unsolicited reports need not be acknowledged by the FDPS.

3.3.8.6 When an FDPS requests ADS report(s) from the ADS function on-board the aircraft, it assembles and sends a request, which contains the desired contents and reporting criteria of the requested ADS report(s). If, however, an acknowledgment is not received in response to the request after some time-out period, then the request may be sent out again.

3.3.8.7 A new contract request from an FDPS will replace or modify the prior contract between the FDPS and the ADS function. The FDPS may also at any time request that a contract be cancelled. If the ADS function continues to send ADS reports, then another request to cancel a contract will be sent.

3.3.9 **ADS aircraft transactions**

3.3.9.1 ADS reports will be sent in response to requests from an FDPS.

3.3.9.2 When an ADS function receives a demand mode contract request, it assembles and sends an acknowledgment and the desired ADS report, and the transaction is complete.

3.3.9.3 When an ADS function receives a periodic contract request, it assembles and sends an acknowledgment and the desired ADS report. As long as the contract is not terminated, the ADS function sends fresh ADS reports at assigned time intervals, starting when the initial contract request was received. When a new event contract request is received, any previous event contract associated with the same FDPS is replaced.

3.3.9.4 When an ADS function receives an event contract request, it assembles and sends an acknowledgment. When the event occurs, an ADS report is sent. When a new event contract request is received, any previous event contract associated with the same FDPS is replaced.

3.4 PROCEDURES

3.4.1 **General provisions**

3.4.1.1 ADS service

3.4.1.1.1 ADS-ATC service shall be provided by an ADS-ATC unit having appropriate automation and communication facilities, and which relies on ADS to provide aircraft position information. The ADS service should be supported by direct two-way controller-pilot data link and/or voice communication.

3.4.1.2 Use of ADS

3.4.1.2.1 The use of ADS in air traffic services shall be subject to limitations as may be specified by the appropriate ATS authority or by Regional Air Navigation Agreement. Adequate information on the operating methods used, as well as operating practices and/or equipment limitations having direct effects on the operations of the air traffic services, shall be published in aeronautical information publications.

3.4.1.2.2 The number of aircraft simultaneously provided with ADS-ATC services shall not exceed that which can be safely handled under the prevailing circumstances, taking into account:

a) the degree of technical reliability and the back-up facilities of the voice and data link communication systems in use;

b) the level of automation of the ADS-ATC system;

c) the capabilities and skill of the air traffic controller;

d) the complexity of the traffic situation and associated workload within the sector or area of responsibility of the controller; and

e) the effect of loss of communication.

3.4.1.2.3 ATS standard message sets and ADS report messages shall be used, and message routing systems and services shall be ensured, at all times.

3.4.1.3 Performance checks

3.4.1.3.1 The air traffic controller shall be responsible for adjusting his situation display(s), and for carrying out adequate checks on the accuracy thereof, in accordance with the technical instructions prescribed by the appropriate authority for the ADS-ATC equipment concerned.

3.4.1.3.2 The air traffic controller shall satisfy himself that the ADS-related information presented on his situation display(s) is adequate for the functions to be performed.

3.4.1.3.3 The air traffic controller shall report any fault in the equipment, any incident requiring investigation or any circumstances which make it difficult or impractical to provide ADS-ATC services.

3.4.1.4 ADS procedures

3.4.1.4.1 An ADS agreement shall be established between an aircraft and the ATC system prior to the provision of the ADS-ATC services. This agreement will contain information on the data required by the ATC system and the frequency of ADS reports.

3.4.1.4.2 Identification procedures

3.4.1.4.2.1 The ATC system should use the 24-bit aircraft address and the aircraft identification to perform identification of aircraft.

3.4.1.4.3 Termination of the ADS agreement

3.4.1.4.3.1 Termination of an ADS agreement shall be achieved automatically by the FDPS based on bilateral agreements for aircraft crossing flight information regions (FIRs). Normally, landing or arrival shall initiate the cancellation of existing ADS agreements.

3.4.1.4.5 Transfer of ADS control

3.4.1.4.3.2 Transfer of control in an ADS environment will follow existing ATC practices.

3.4.1.4.3.2.1 Where the transfer of control is between ATC units servicing airspaces where ADS-ATC service is available, provision must be made to forward the ATC registration data from the transferring unit to the receiving unit.

3.4.1.4.3.2.2 To satisfy the requirements of both the transferring and receiving ADS-ATC units, ADS report messages will need to be sent to multiple ATC units. This need will exist for a period of time before and after the aircraft crosses the common boundary.

3.4.1.4.3.2.3 When the control of an aircraft is to be transferred from an ADS-ATC service to a non-ADS-ATC service, the ADS controller shall ensure that appropriate separation is effected before that transfer takes place.

3.4.1.4.3.3 Once transfer of control has been accomplished, the pilot will be notified.

3.4.1.5 Emergencies

3.4.1.5.1 In the event of an aircraft in, or appearing to be in, any form of emergency, every assistance should be provided by the controller. The procedures prescribed herein may be varied according to the situation.

3.4.1.5.2 The progress of an identified aircraft in emergency shall be monitored and (whenever possible) delineated on the situation display until the aircraft position reports are no longer received; that position information shall be provided to all air traffic services units which may be able to give assistance to the aircraft. Communication and ADS agreement transfer to adjacent sectors shall also be effected when appropriate.

3.4.2 **Use of ADS in air traffic control service**

(Note.— The guidance material in this section provides general implementation guidelines for the application of ADS in the provision of air traffic control services.)

3.4.2.1 Functions

3.4.2.1.1 The information presented on a situation display may be used to perform the following functions in the provision of air traffic control service:

a) maintain a watch on the progress of air traffic in order to provide the air traffic control unit concerned with:

   i) improved position information regarding aircraft under its control;

   ii) supplementary information regarding other traffic, including separation;

   iii) the application of separation of the aircraft under its control; and

   iv) information regarding any significant deviations by aircraft from the terms of their respective air traffic control clearances, including their cleared routes;

b) provide instructions and clearances to aircraft for the purpose of:

   i) resolving potential conflicts;

   ii) assisting aircraft in adverse weather avoidance: and

   iii) accommodating user-preferred flight trajectories.

3.4.2.2 Co-ordination of traffic

3.4.2.2.1 Appropriate arrangements shall be made in any air traffic control unit using ADS position data to ensure the co-ordination of traffic being provided ADS-ATC service with non-ADS traffic, and to ensure the provision of adequate separation between all controlled aircraft.

3.4.2.2.2 No significant change shall be made by a controller using ADS to a clearance issued by a controller not using ADS without the prior approval of the latter, except when special procedures are in effect or when circumstances necessitate immediate action. In such cases, the non-ADS controller concerned shall be informed as soon as practicable of the effected change in clearance.

3.4.2.3 Interruption or termination of ADS-ATC service

3.4.2.3.1 An aircraft which has been informed that it is provided with an ADS-ATC service should be informed immediately when, for any reason, that service is terminated or interrupted.

3.4.2.4 Failure of equipment

3.4.2.4.1 When ADS-ATC service is interrupted due to the failure of any component of the ADS-ATC system, the controller shall take the necessary action to establish the appropriate separation minimum between aircraft as soon as possible.

3.5 IMPLEMENTATION

3.5.1 General

3.5.1.1 The transition to an ADS-ATC system needs careful consideration and should be based on safety, cost-benefit and feasibility studies. The transition plan should consider the time required for acquisition of ATC and communication systems, the number of aircraft suitably equipped and the time for operators to equip, and the timeframes of implementation in neighbouring FIRs.

3.5.1.2 In order to achieve a globally co-ordinated plan for the implementation of ADS, it was considered desirable to harmonize not only the implementation timescales for the flight information regions within ICAO regions, but also the level of capability of the ADS-ATC system serving neighboring FIRs.

3.5.1.3 Implementation of ADS should be considered in the framework of implementation of the ICAO CNS/ATM systems. General guidance can be found in the "Global Co-ordinated Plan for Transition to the ICAO CNS/ATM Systems", as developed by the ICAO FANS (II) Committee.

3.5.2 Transition principles and guidelines

3.5.2.1 General principles

3.5.2.1.1 The phased implementation of an ADS/ATC system will take place within an environment which places constraints and conditions on the process, namely:

a) a future system can only be implemented by means of an evolutionary process;

b) the impact on the pilots and air traffic controllers of human factors issues must be resolved;

c) the new system must be capable of working with a wide variety of traffic densities, aircraft types, avionics sophistication, etc;

d) the system should not be overly sensitive to random disturbances, such as outage emergencies, etc;

e) the system should be able to accommodate increased demands and future growth; and

f) evolving systems should be able to accommodate expected variations in the quality standards and performance characteristics represented in the operational requirements, due to the evolving state of the art of the various communication sub-networks (see table of communications medium capability in Appendix A).

3.5.2.1.2 The implementation plan for a specific area will also be based on the specific requirements in that area. The benefits to be gained from the use of ADS are not the same in all areas, and use will be based on cost-benefit considerations and the need for overall coverage and compatibility with neighbouring areas.

3.5.2.1.3 Not all operational requirements for an ADS-ATC system would need to be implemented at the same time. However, an incremental level of capability, implemented in phases, would occur in many cases and would be in keeping with the established transition guidelines. For example, the simplest implementation of ADS, providing position reporting only, could be used in combination with existing communications facilities. The mere availability of a surveillance capability would provide significant safety benefits, as it would permit the detection by the controller of deviations from the cleared flight path, and thus prevent gross navigation errors.

3.5.2.1.4 In some cases, ADS will be first introduced for specific operations in limited areas to enhance safety and efficiency, for example, for low level helicopter operations below radar coverage. In order to be compatible with more extensive ADS-ATC systems and to gain experience with the standardized system, these early implementations should as much as possible meet the operational requirements as set out in this document.

3.5.2.1.5 Meeting the future requirements of a full ADS/ATS operational system necessitates the development of automation for the ATM functions. In order to derive maximum benefits for controllers, the design of the ATM system for ADS-ATS service should pay close attention to the work stations of the controllers, as well as the validation methods used in the development of automated functions.

3.5.2.1.6 It is impossible to provide a uniform environment for all users in all States and regions in the same time frame. However, certain criteria must be established and a phased implementation must be developed to maximize the benefits as quickly as possible, with the least disruption.

3.5.2.2 Implementation principles

3.5.2.2.1 The global ADS system should be developed in balance with other parts of the overall air navigation infrastructure. The necessary changes should be introduced in an evolutionary fashion. There should be little disparity in the level of service given to differently-equipped aircraft in order to provide an expeditious flow of air traffic. System development must be harmonized to enable future technologies to be accommodated in a consistent manner throughout the globe.

3.5.2.2.2 Guidelines for transition to the future surveillance system should be such as to encourage early equipage by users through the earliest possible accrual of the system benefits. Although a transition period during which dual equipage, both airborne and ground, will be necessary in order to ensure the reliability and availability of the new system, the guidelines should be aimed at minimizing this period to the extent practicable.

3.5.2.2.3 The following transition guidelines have been developed by the ICAO FANS (II) Committee and are quoted from the "Global Co-ordinated Plan for Transition to the ICAO CNS/ATM Systems".

a) States should begin to develop operational procedures, in accordance with ICAO SARPs and guidelines, for the implementation of ADS within airspace under their control.

   This will ensure early implementation of ADS and the most efficient use of global airspace.

b) Transition to ADS should initially begin in oceanic airspace and in continental en-route airspace with low-density traffic.

   In oceanic and some continental areas, position reporting is the only available means of surveillance, and ADS could provide a significant early benefit. In some oceanic areas where HF communication congestion occurs, ADS will provide relief.

c) States and/or regions should co-ordinate to ensure that, where ADS is to be introduced, it is introduced approximately simultaneously in each FIR where major traffic flows occur.

   This will help ensure seamless transitions through FIR boundaries, and that the benefits of ADS service will be available to suitably-equipped aircraft.

d) Where differing surveillance methods are employed in adjacent States or FIRs, commonality or compatibility of systems should be developed to enable a service which is transparent to the user.

   This will help ensure seamless transition through State and FIR boundaries.

e) During the transition period, after ADS position reporting is introduced, the current levels of integrity, reliability and availability of existing position reporting systems must be maintained.

This is necessary to back-up ADS and to accommodate non-ADS-equipped airspace users.

f) States and/or regions should take actions within the ICAO frame work to ensure that implementation of procedural changes due to ADS and other systems results in more efficient use of airspace.

Procedural changes may include reduction of horizontal separation standards in oceanic airspace.

g) During the transition to ADS, suitably equipped aircraft should be given precedence over non-ADS-equipped aircraft for preferred routes and airspace.

For the longer term, when aircraft and ATC capabilities permit, organized track system should be eliminated in favor of user-preferred flight plans with ADS surveillance and conflict probing.

h) ADS should be introduced in phases.

This will facilitate rapid introduction of ADS. The first phase can introduce ADS position reporting, conflict probing and flight plan conformance monitoring by ATC, and two-way satellite communications with an initial set of pre-defined message formats. Later stages can introduce a more complete set of pre-defined message formats and further ATC automation.

i) ADS equipment, standards and procedures should be developed in such a way as to permit the use of ADS as a back-up for other surveillance methods.

This is in accordance with the ICAO CNS/ATM systems for back-up of surveillance systems.

3.5.3 Planning for implementation

3.5.3.1 Planning for the new over-all CNS system is underway on global and regional bases. ICAO has developed a global plan for transition, which provides over-all guidance to States and regions for their planning activities. Several States and regions are actively progressing their planning towards implementation of the CNS/ATM systems, within the framework of the global plan, to realize the anticipated benefits from safety enhancement and capacity improvements.

3.5.3.2 The transition to an ADS-ATC service should ideally be accompanied by improvements in ATM and should be through structural and procedural changes that will enhance the service and provide benefits to users. The structural changes involve airspace reorganization required to optimize the new service. Other areas that will need to be addressed are:

a) data link;

b) message formats;

c) separation;

d) automation; and

e) ATC procedures.

3.5.4 Validation and early implementation

3.5.4.1 The six component parts of the ADS/ATS system described in Part I, Chapter 3, paragraph 3.2.3.1, for the most part, have been adequately demonstrated as being viable. There is an urgent need for States and other organizations, in a position to do so, to undertake trials and implementation of pre-operational systems, as soon as practical, with a view to facilitating a timely implementation of a fully operational system.

3.5.4.2 Timely implementation of operational ADS systems in specific areas would enable early benefits to be derived and provide further incentive to airspace users to equip their aircraft with ADS. In addition, the experience gained in the early utilization of ADS would further ensure benefits to be more closely identified.

3.5.4.3 In continental airspace, the implementation of ADS as a back-up or complement to radar can have benefits in terms of surveillance availability and reduced need for overlapping radar coverage, but will also be an essential transition step in the process of evaluating and establishing operational requirements for using ADS as a primary means of surveillance in continental airspace.

3.5.4.4 The regional bodies most effected by the use of an ADS-ATS system should be co-ordinated with, and provided with, ADS material. This may then be used in giving consideration to the use of ADS, including phased implementation in their forward planning. For example, the North Atlantic Facilities and Services Implementation Document (FASID) outlines the progress from the current situation to a full ADS environment.

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APPENDIX A

TO PART I, CHAPTER 3

COMMUNICATIONS MEDIUM CAPABILITIES TABLE

	Proposed by ADSP		Present Communications Medium Capability			
Criteria	**ADS**	**CPDLC**	**Satellite**	**VHF**	**Mode S***	**HF**
Availability Essential (near term) (mid and long term) Service restoration time (near term) (mid and long term)	 $1 - 10^{-6}$ to $1 - 10^{-4}$ 6 s to 90 s		 $1 - 10^{-2}$ $1 - 10^{-3}$ 600 s 90 s	 $1 - 10^{-3}$ 10 s	 $1 - 10^{-4}$ $1 - 10^{-5}$ 30 s 5 s	
Quality standards (data) Residual message error rate	 1×10^{-7}		 1×10^{-7}	 1×10^{-6}	 1×10^{-9}	
Quality standards (voice) Voice quality Probability of blocking Probability of misrouting	 near toll- quality 10^{-6} 10^{-7}		 near toll- quality 10^{-2} 10^{-6}			
Performance (data) Uplink transit delay (flight safety priority) Downlink transit delay (flight safety priority) Uplink transit delay (urgency priority) Downlink transit delay (urgency priority)	 15 s 0.4 – 15 s 5 s	 10 s	 20 s 55 s 15 s 45 s	 0.8 s to 28 s 0.5 s to 5 s	 2.5 to 1 s (long term) 2.5 to 0.5 s (long term)	
Performance (voice) Call set-up delay New call initiate time Maximum transfer delay	 max 10 s max 1 s 600 ms		 mean 10 s mean 3 s 600 ms			

* Data still immature

DEFINITIONS OF THE CRITERIA

Service restoration time. For Mode S, it is the time to restore a broken switch virtual circuit (SVC) after an incident.

Residual message error rate. Probability that an attempt to transfer a single data packet is not entirely successful. It includes mis-delivery and non-delivery of packets, as well as undetected packet errors.

Probability of blocking. This is a grade of service (GOS) parameter. A blocked call attempt is a call attempt that is rejected owing to a lack of resources in the network. Various CCITT recommendations set design objectives for loss of GOS probability as less than 1 per cent.

Probability of misrouting. This is the probability that the telephone switching equipment associated with a GES misroutes a call owing to internal processing or signalling errors.

Transit delay. Standard speed of service parameter for the transfer of a single data packet. The standard reference length for the data packet is 128 octets, which will accommodate a 104-octet ADS message length. For Mode S, the figures are given for an antenna rotation of a turn every 4 seconds. For VHF, the values depend on the number of ground stations, the number of aircraft in the area of connectivity and the number of messages per second. This why a range of values is indicated for 5 messages/second.

Mean call set-up delay. The delay between the origination of a call request and the indication to the called party of an incoming call.

New call initiation time. Delay between terminating one call and being able to initiate the next one.

PART I – AUTOMATIC DEPENDENT SURVEILLANCE

CHAPTER 4. OPERATIONAL REQUIREMENTS

4.1 INTRODUCTION

4.1.1 Common operational requirements (O.R.s) are needed to provide a harmonized service to users across international flight information region boundaries. Such harmonized systems should include efficient facilities and procedures to ensure flight safety through continuity of air traffic services as the flight progresses across national boundaries.

4.1.2 While the operational requirements defined in this document were developed specifically for applicability in an ADS-ATC environment, they also apply in other circumstances. In certain cases, it is foreseen that aircraft which are not "ADS-equipped", operating in non-ADS airspace, could be required to provide similar information to ATC units in order to benefit from other ATS data link applications supporting CNS/ATM.

4.2 ADS REPORTS

4.2.1 The ADS reports will be composed of defined data blocks containing data elements which are automatically derived from the on-board navigation systems. These data blocks are selected on the basis of air traffic operational conditions and the aircraft's capability to provide specific information. The content of ADS reports is contained in Part II of the PANS-RAC (Doc 4444).

4.2.2 The current ADS report data blocks and corresponding data elements are detailed in Appendix C to Part I, Chapter 5 of this guidance material. Part II, Chapters 2 and 3 specify the ground-ground message set to support end-to-end connection management for both ADS and associated massages, as well as for controller-pilot data link communication (CPDLC) service. The appendices to those chapters also identify the ADS report as an additional ground-ground message, required to support sharing of ADS reports among ADS-ATS units concerned.

4.2.3 **Content of ADS reports**

4.2.3.1 ADS reports shall be composed of data blocks selected from the following:

a) Basic ADS
   - Latitude
   - Longitude
   - Altitude
   - Time
   - Figure of merit

b) Ground vector
   - Track
   - Ground speed
   - Rate of climb or descent

c) Air vector
  Heading
  Mach or IAS
  Rate of climb or descent

d) Projected profile
  Next way-point
  Estimated altitude at next way-point
  Estimated time at next way-point
  (Next + 1) way-point
  Estimated altitude at (next + 1) way-point
  Estimated time at (next + 1) way-point

e) Meteorological information
  Wind speed
  Wind direction
  Temperature
  Turbulence

f) Short-term intent
  Latitude at projected intent point
  Longitude at projected intent point
  Altitude at projected intent point
  Time of projection

  If an altitude, track or speed change is predicted to occur between the aircraft's current position and the projected intent point, additional information would be provided in an intermediate intent block as follows:

    Distance from current point to change point
    Track from current point to change point
    Altitude at change point
    Predicted time to change point

g) Extended projected profile (in response to an interrogation from the ground system)
  Next way-point
  Estimated altitude at next way-point
  Estimated time at next way-point
  (Next + 1) way-point
  Estimated altitude at (next + 1) way-point
  Estimated time at (next + 1) way-point
  (Next + 2) way-point
  Estimated altitude at (next + 2) way-point
  Estimated time at (next + 2) way-point
  [repeated for up to (next + 20) way-points]

4.2.4 In addition to those data blocks, other information shall be transmitted by the aircraft, including a block identifier, aircraft identification and the 24-bit aircraft address. These separate data, which will be used mainly during the initial log-on procedures between the aircraft and the ATS unit concerned, will be available and transmitted by the aircraft upon request from the ground system both as a complement to the basic ADS report and as additional data blocks required for the surveillance function of ADS. The block identifier will be used by the system as a tag address, for the identification of data blocks in the composition of the ADS reports. The aircraft identification, together with the 24-bit aircraft address inherent in each subsequent downlinked message, will be used to establish correlation between in-coming ADS reports and the reporting aircraft and its related flight plan data. As the flight progresses following the log-on procedures, the aircraft identification should be retained in the ground system to avoid transmitting repetitive information by the aircraft.

4.2.5 Full technical details of the format and contents of the above set of ADS message blocks are included in the appendices to Part I, Chapter 5.

4.2.6 All the ADS report data blocks should be available from all ADS-equipped aircraft. It is recognized, however, that, in the evolutionary and incremental implementation of ADS, initial applications in some areas may be restricted due to limitations of avionics and/or flight data processing systems (FDPS). Additionally, and as experience is gained with the operation of ADS-ATC systems, it may be necessary to add to or delete from the present configuration of ADS message blocks.

4.2.7 All the ADS data blocks should be available from all ADS-equipped aircraft. It is recognized, however, that the initial application in some areas may be restricted, due to limitations of avionics and/or flight data processing systems (FDPS).

4.3 OPERATIONAL REQUIREMENTS

4.3.1 In addition to the operational requirements, several significant functional requirements have been identified concerning the overall level of sophistication required to permit effective implementation of a full ADS-ATC environment, as envisaged by FANS.

4.3.2 Air traffic control facilities providing an ADS-ATC service must be capable of receiving, storing, processing, displaying and disseminating specific flight information relating to flights equipped for and operating within ADS-ATC environments where ADS-ATC service is provided.

4.3.3 Aircraft intending to fly within airspace where an ADS-ATC service is available and wishing to take advantage of the service must be equipped with data link capabilities to permit the exchange of ADS messages between the aircraft and the ATC facilities providing the service.

4.3.4 Effective human-machine interfaces must exist on the ground and in the air to permit inter-activity between the pilot and controller.

4.3.5 Design of appropriate digital data interchange communications systems between ATC facilities is also significant to the effective implementation of ADS-ATC service. Effective digital data interchange communication systems, techniques and procedures should be developed in parallel with the ADS-specific requirements.

4.3.6 Certain basic operational requirements need to be fulfilled to permit the effective provision of ADS-ATC service. In context, an operational requirement is defined as:

> "A statement of the operational attributes of a system needed for the effective and/or efficient provision of air traffic services to users."

4.3.7 Additional operational requirements may be developed to increase the efficiency and effectiveness of the systems as the systems evolve. Neither should the currently defined requirements be considered as being immediately needed to permit an initial level of ADS-ATC service. In the transition towards a fully developed ADS-ATC system, limited conformance could still provide benefits to the users and to ATC. This will ensure that implementation of ADS-ATC service can proceed on an evolutionary basis.

4.3.8 An operational requirement is not a description of "how" the requirement is to be met, nor should it be assumed that the solution will always be technical in nature. It may be that the requirement will be met by appropriate procedural training or staffing actions. However, when technical solutions are required, their definition remains the responsibility of the technical and engineering specialists who must ensure that the needs of the ATC system are met. Close co-ordination between operational and technical authorities is essential if the optimum solution is to be found.

4.3.9 An ADS-ATC system must include the capability to exchange messages between the pilot and the controller. A direct voice communication capability should be available for at least emergency and non-routine, safety-related communications.

4.3.10 The ADS agreement necessary for the initiation of such data link communications will be established with each aircraft by the ATC system, for portions of the aircraft flight. The agreement will include the basic ADS block and, optionally, one or more additional data blocks. The agreement will also provide for ADS reports at geographically-defined points such as way-points and intermediate points, in addition to other specific event-driven reports.

4.3.11 A set of specific operational requirements has been identified to define the global ADS-ATC environment. Each requirement was analyzed to ensure that the functionality required to fulfil the operational requirement was identified and documented.

4.4 DERIVATION OF OPERATIONAL REQUIREMENTS

4.4.1 In deriving the operational requirements necessary for the provision of an ADS-ATC service, the various information needs of the pilot, avionics, FDPS and controller were considered. Appropriate processes were stated and the performance of the various subsystems, including the air-ground communications system (AGCS), were documented.

4.4.2 Thus, each of the following operational requirements is expressed in terms of:

a) a functional statement;

b) a diagram and description of the actions required of the various system components;

c) a set of parameters to control the output of these actions; and

d) specific performance needs.

4.5 Specific operational requirements

4.5.1 The specific requirements are that the ADS-ATC system must support the following:

a) identification of the aircraft's data link and ADS capabilities from the filed flight plan;

b) establishment of data link between aircraft avionics and the FDPS;

c) registration of the communications and surveillance capabilities of an aircraft with the receiving ADS-ATC unit's flight data processing system;

d) comparison of the 4-D profile stored in the aircraft system with flight data stored in the FDPS;

e) identification and allocation of the appropriate ADS agreement;

f) monitoring of the flight of the aircraft before entering the subject airspace;

g) approval for flight to enter ADS-ATC airspace;

h) recognition that the aircraft has entered the ADS-ATC airspace;

i) confirmation that the aircraft's projected profile coincides with that stored in the FDPS;

j) verification by the FDPS that the aircraft is proceeding in accordance with the ATC clearance;

k) provision to the controller of the most up-to-date traffic situation available using ADS-derived information;

l) provision of automatic position reporting in accordance with ADS agreements allocated by the ATC ground system;

m) automatic transfer of control and communications between ADS-ATC airspaces using digital data interchange;

n) automatic transfer of control and communications from ADS-ATC airspace to non-ADS-ATC airspace using digital data interchange;

o) provision of controller-pilot data link communications (CPDLC);

p) provision of direct pilot/controller voice communications;

q) self-monitoring and automatic reporting by aircraft of significant flight variances;

r) aircraft notification of changes to position determination capability; and

s) provision of an emergency mode of ADS operation to support ATC alerting procedures and to assist search and rescue operations.

4.5.2 It is emphasized that there is a critical need for a common understanding of the operational requirements which have to be met for the efficient and effective implementation of the various subsystems which will together comprise the ADS-ATC system.

4.5.3 In the operational requirements that follow, the numbers in the square brackets refer to the data flow between the various subsystem "blocks", e.g. [4.2, 3] refers to functional thread number 4, data paths 2 and 3. This cross-reference scheme is carried forward into the appendices which collate the performance requirement parameters for the O.R.s and the system performance requirements for the various subsystem components.

Note.— Throughout the document, the terms "aircraft-unique identifier" and "airframe identification block" should be interpreted as referring to the term "24-bit aircraft address".

O.R. 1 IDENTIFICATION OF AN AIRCRAFT'S DATA LINK AND ADS CAPABILITIES FROM THE FILED FLIGHT PLAN

Functional statement

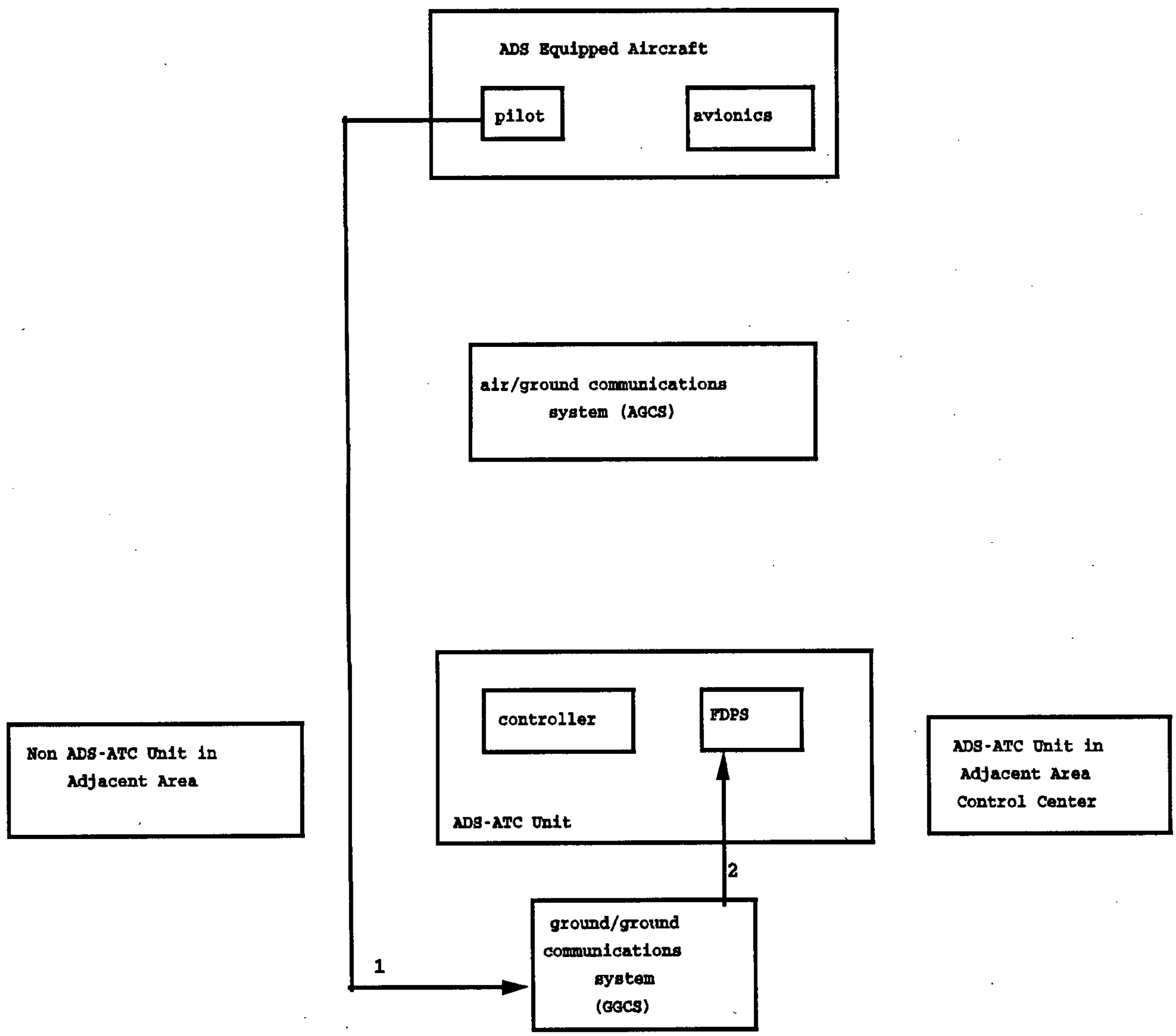
ADS-ATC units need advance notification of aircraft equipage in order to assign appropriate ADS agreements.

Prior to the aircraft entering ADS-ATC airspace, the ADS-ATC unit's FDPS database will be updated to reflect the aircraft equipage from data included in the received flight plan.

Functional thread description

The pilot shall include details about data link and ADS capability in the flight plan. [1.1, 2]

O.R. 1 Functional thread diagram: Identification of an aircraft's data link and ADS capabilities from the filed flight plan



O.R. 2 ESTABLISHMENT OF DATA LINK BETWEEN AIRCRAFT AVIONICS AND THE FDPS

Functional statement

Before entering an airspace where the ADS service is provided by the ATC automation system, a data link connection will need to be established between the avionics and the FDPS in order to register the aircraft and start the ADS dialogue when necessary. Normally, this will be initiated from the aircraft, either by the avionics or, possibly, by pilot intervention. However, it is foreseen that, in exceptional circumstances, establishment of the link could be initiated by the controller or the FDPS.

Functional thread description

Data link establishment procedure

Method A: Airborne initiation [normal procedure]

A time parameter (t2A.1) before an ADS-equipped aircraft enters ADS-ATC airspace, the pilot or the avionics will need to initiate the log-on procedure. [2A.1, 2]

The avionics will then generate and transmit the log-on request message which contains the aircraft-unique identifier and the aircraft's current position. [2A.3, 4]

The FDPS will correlate the aircraft-unique identifier with the aircraft identification stored in the FDPS database. [2A.5a]

The FDPS will enter the correlated information into its database. [2A.5b]

The FDPS will then respond to the aircraft's log-on request. [2A.6, 7]

The avionics will acknowledge that the log-on has been effected. [2A.8, 9]

Method B: Ground initiation [exception – where Method A cannot be implemented]

A time parameter (t2B.1) before the FDPS estimates that an ADS-equipped aircraft will enter its ADS-ATC airspace, it will identify the need to establish a data link connection with that aircraft. [2B.1]

The FDPS will then generate and send the log-on request message to the aircraft, using the aircraft-unique identifier, and the aircraft identification stored in the FDPS database. [2B.2, 3]

The aircraft will respond to the log-on request and transmit its current position. [2B.4, 5]

The FDPS will confirm the correlation of the aircraft-unique identifier with the aircraft identification stored in the FDPS database. [2B.6a]

The FDPS will update its database using the transmitted position data and other information. [2B.6b]

The FDPS will acknowledge that the log-on has been effected. [2B.7, 8]

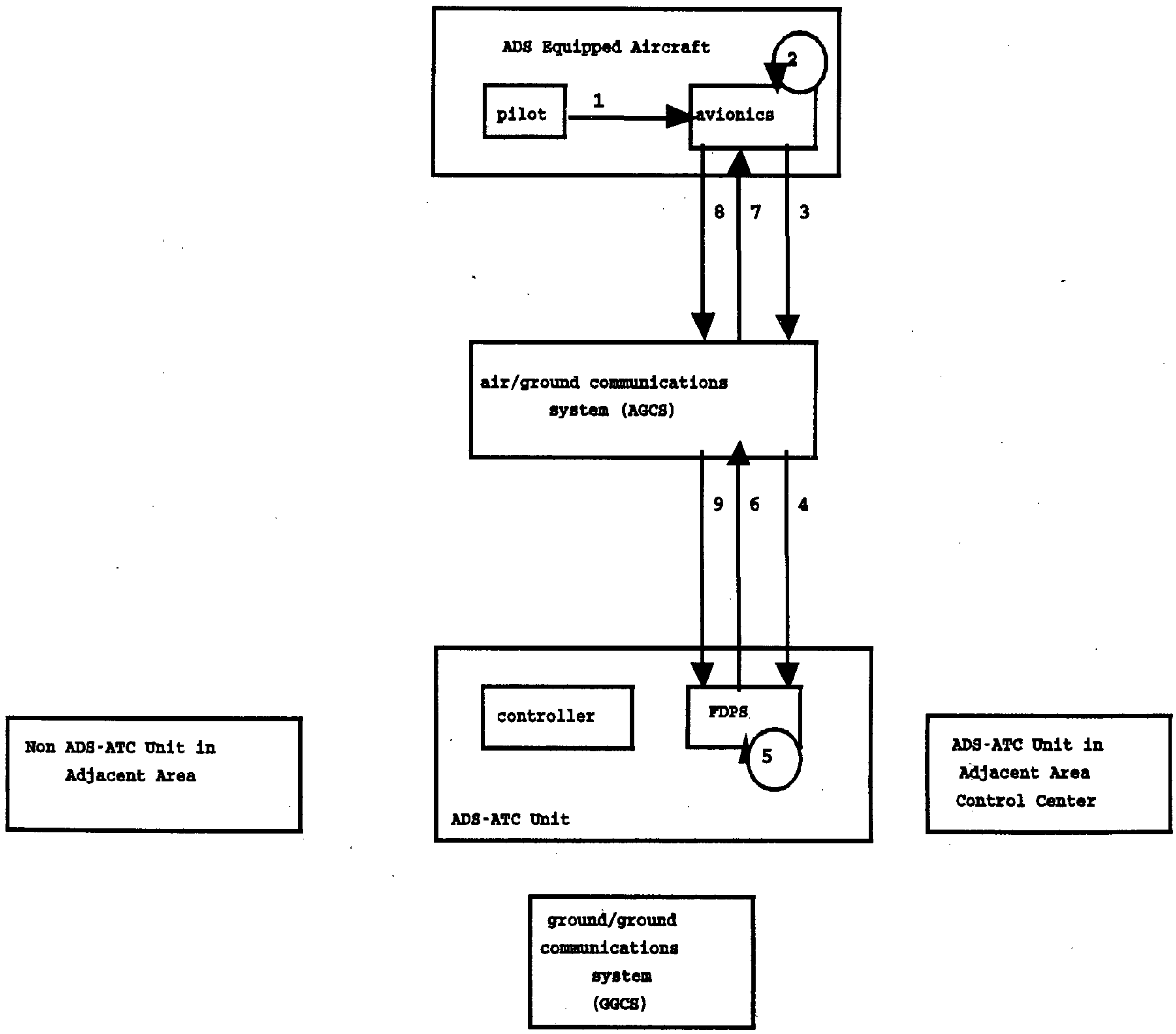
Typical parameters

t2A.1 = 10 – 120 minutes (local procedures)
t2B.1 = 10 – 120 minutes (local procedures)

System performance requirements

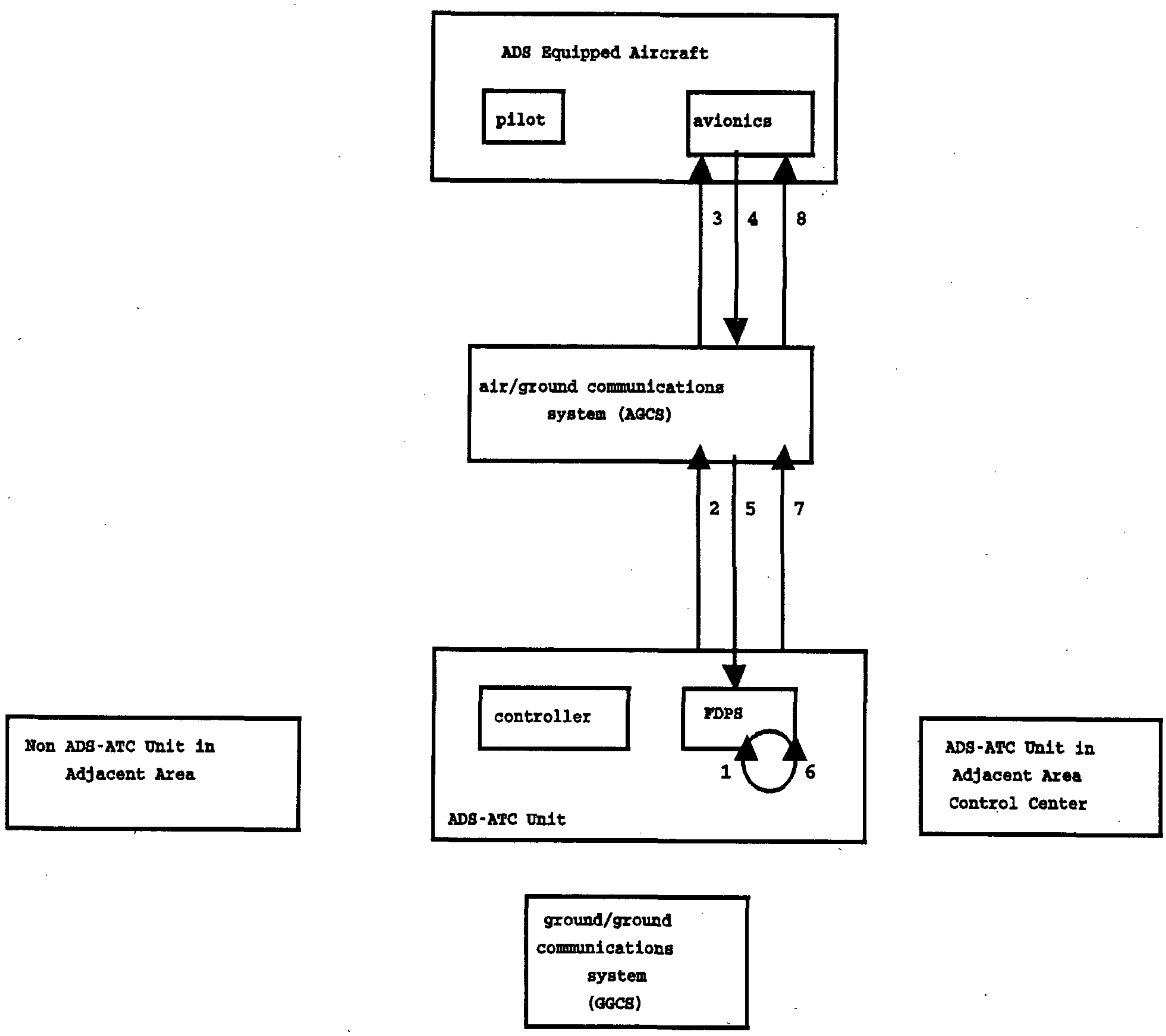
Although not critical from a system viewpoint, it is anticipated that, from initiation to establishment of the data link, the time should not exceed 45 seconds.

O.R. 2 Functional thread diagram: Establishment of data link between aircraft avionics and the FDPS



Method A: Airborne Initiation

O.R. 2 Functional thread diagram: Establishment of data link between aircraft avionics and the FDPS



Method B: Ground Initiation

O.R. 3 REGISTRATION OF THE COMMUNICATIONS AND SURVEILLANCE CAPABILITIES OF AN AIRCRAFT WITH THE RECEIVING ADS-ATC UNIT'S FDPS

Functional statement

The FDPS will identify the communications and surveillance capabilities of aircraft in order to establish appropriate ADS-ATC agreements.

Functional thread description

For each flight, the FDPS will identify the following aircraft capabilities [3.1]:

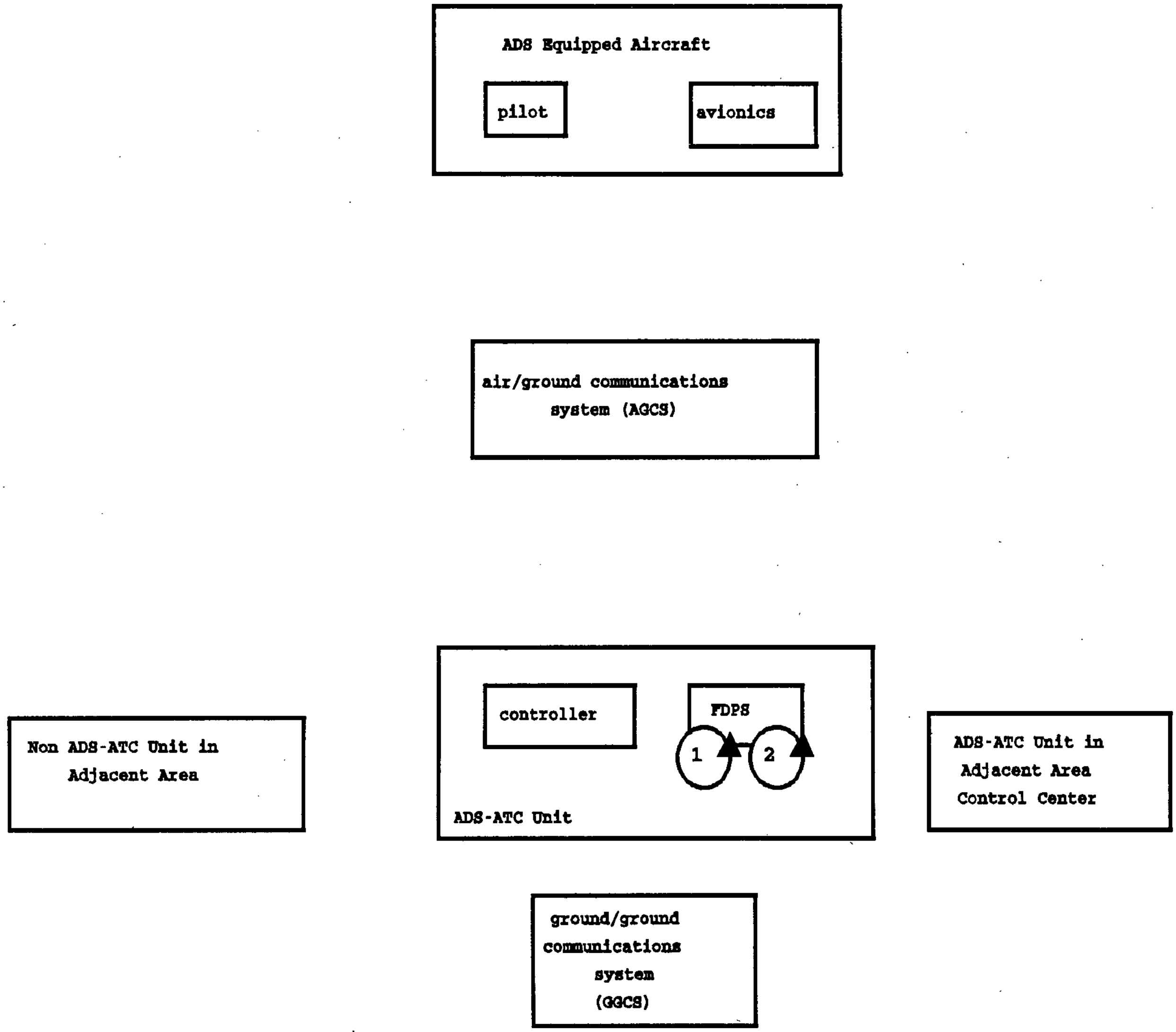
- aircraft ADS capability;
- data link capability;
- voice communications capability; and
- the aircraft's unique address.

The FDPS will maintain a list of participating aircraft, and their current capability, on a real-time basis. [3.2]

System performance requirements

The probability that the registration process is in error shall not exceed 10^{-6}.

O.R. 3 Functional thread diagram: Registration of the communications and surveillance capabilities of an aircraft with the receiving ADS-ATC unit's FDPS



O.R. 4 COMPARISON OF FOUR-DIMENSIONAL (4-D) PROFILE STORED IN THE AIRCRAFT SYSTEM WITH FLIGHT DATA STORED IN THE FDPS

Functional statement

Many operational errors today in non-radar airspace are due to way-point insertion errors in aircraft flight management systems. To minimize the possibility of such blunders and to permit advanced strategic planning in an ADS-ATC system, the FDPS will verify that the aircraft's planned four-dimensional profile is the same as the profile that ATC is expecting the aircraft to follow.

Functional thread description

A parameter time (t4.1) before an ADS-equipped aircraft enters ADS-ATC airspace, the FDPS will need to compare the aircraft's current planned 4-D profile with the flight data for that aircraft, stored in the FDPS database. [4.1]

At such time, the FDPS will request the projected 4-D flight profile (extended projected profile block) from the ADS-equipped aircraft's avionics. [4.2, 3]

The FDPS will acquire the projected 4-D flight profile from the ADS-equipped aircraft's avionics. [4.4, 5]

The FDPS will compare the 4-D projected profile from the aircraft with flight data stored in the FDPS database. An alert to the controller will be generated if any difference exceeds the specified parameter delta(lat), delta(long), delta(alt), delta(time). [4.6]

Typical parameters

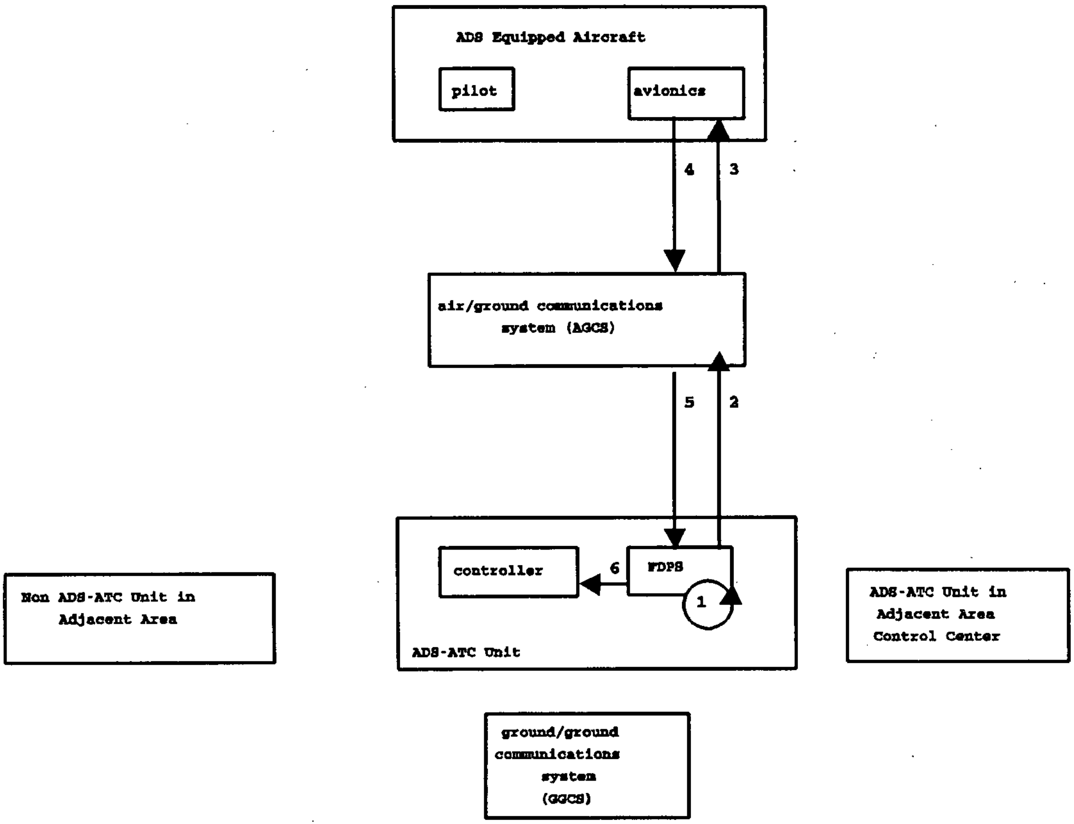
t4.1 = 10 – 120 minutes (local procedures)

delta(lat) = equivalent to 1 NM
delta(long) = equivalent to 1 NM
delta(alt) = 150 ft or 50 m
delta(time) = 1 – 5 minutes (local procedures)

System performance requirements

The time between the initial request for profile data and the completion of the comparison should not exceed 45 seconds.

O.R. 4 Functional thread diagram: Comparison of four-dimensional (4-D) profile stored in the aircraft system with flight data stored in the FDPS



O.R. 5 IDENTIFICATION AND ALLOCATION OF THE APPROPRIATE ADS AGREEMENT

Functional statement

Based on the current flight plan, information obtained from the aircraft, the ADS capability of the aircraft and ATM requirements, an appropriate ADS agreement will be identified and transmitted to the aircraft for acceptance.

Functional thread description

At a parameter time (t5.1) or distance (d5.1) prior to the boundary, the FDPS will generate and allocate an appropriate ADS agreement for the aircraft, based on the current flight plan, information obtained from the aircraft, and the ATM requirements in effect. [5.1]

The FDPS will send the ADS agreement to the aircraft's avionics. [5.2, 3]

The avionics will confirm acceptance of the ADS agreement to the FDPS. [5.4, 5]

Typical parameters

t5.1 = 5 – 45 minutes

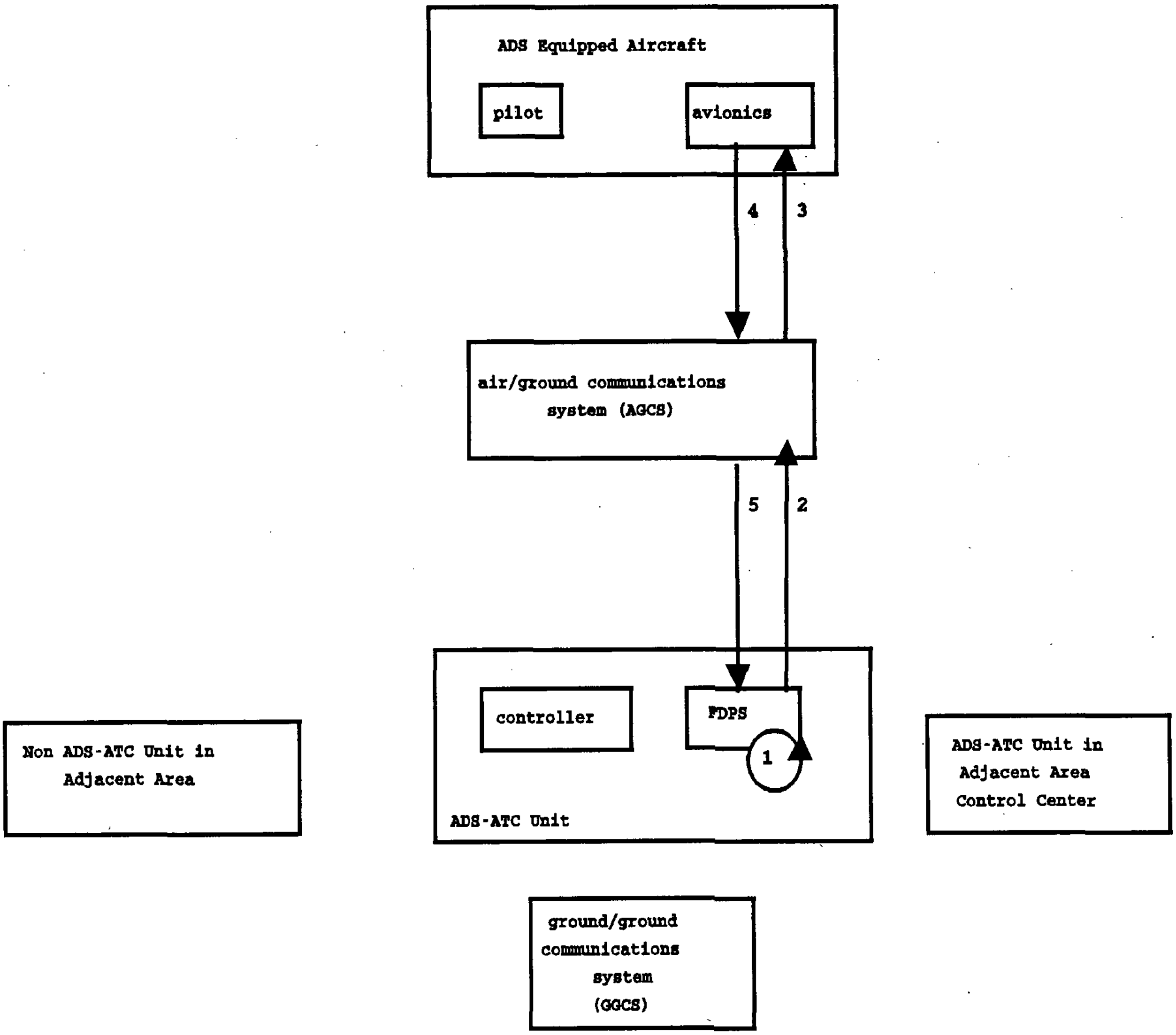
d5.1 = 50 – 500 NM

System performance requirements

The probability that an incorrect ADS agreement is allocated shall not exceed 10^{-6}.

The time between uplink of the ADS agreement and receipt of an acknowledgment from the avionics shall not exceed 45 seconds.

O.R. 5 Functional thread diagram: Identification and allocation of the appropriate ADS agreement



O.R. 6 MONITORING THE FLIGHT OF THE AIRCRAFT BEFORE ENTERING THE SUBJECT AIRSPACE

Functional statement

Based on the ADS agreement accepted by the aircraft, the aircraft avionics will begin to send ADS reports to the appropriate ATC unit to initiate flight-following for planning purposes.

Functional thread description

The avionics will recognize the triggering event contained in the ADS agreement, to start sending ADS reports. [6.1]

The avionics will generate and transmit ADS reports to the appropriate ATC unit's FDPS, in accordance with the ADS agreement. [6.2, 3]

The FDPS will use ADS information to update its database, and initiate a probe to ensure entry conditions into the airspace remain acceptable. [6.4]

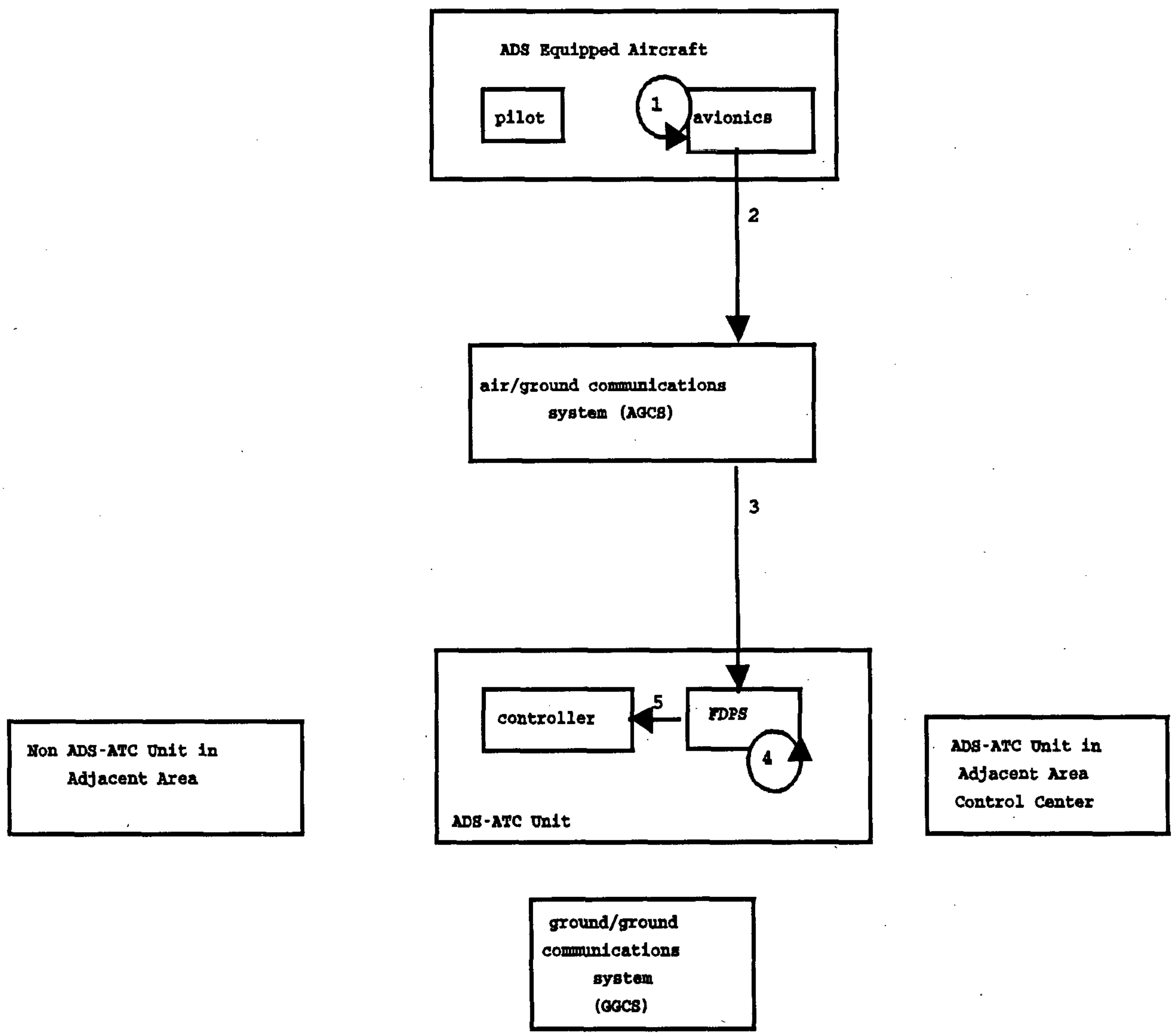
Display of the position information of the aircraft will be made available to the controller. [6.5]

System performance requirements

The probability that entry conditions are wrongly deemed to be acceptable shall not exceed 10^{-6}.

The time between the receipt of an initial ADS report and the assessment of the acceptability of entry conditions by the FDPS shall not exceed 45 seconds.

O.R. 6 Functional thread diagram: Monitoring the flight of the aircraft before entering subject airspace using ADS reports



O.R. 7 APPROVAL FOR FLIGHT TO ENTER ADS-ATC AIRSPACE

Functional statement

The approval for a flight to enter ADS-ATC airspace will be subject to conformance by the aircraft to the entry conditions.

Functional thread description

A time parameter (t7.1) before an ADS-equipped aircraft enters ADS-ATC airspace, the FDPS will display the current updated flight details of the aircraft, including figure of merit, to the appropriate controller. [7.1]

The controller will confirm acceptance of the aircraft. [7.2]

The FDPS database will be updated to reflect the acceptance of the aircraft. [7.3]

The FDPS will update the appropriate display(s) to indicate the new status of the flight within the database. [7.4]

The FDPS will generate either an acceptance message to the offering agency or a clearance to the aircraft. [7.5]

The FDPS will transmit the acceptance message to the offering agency [7.6, 7]; or

The FDPS will transmit the appropriate clearance to the aircraft. [7.8, 9]

The aircraft's avionics will display the clearance to the pilot. [7.10]

Typical parameters

t7.1 = 2 − 15 minutes (local procedures)

System performance requirements

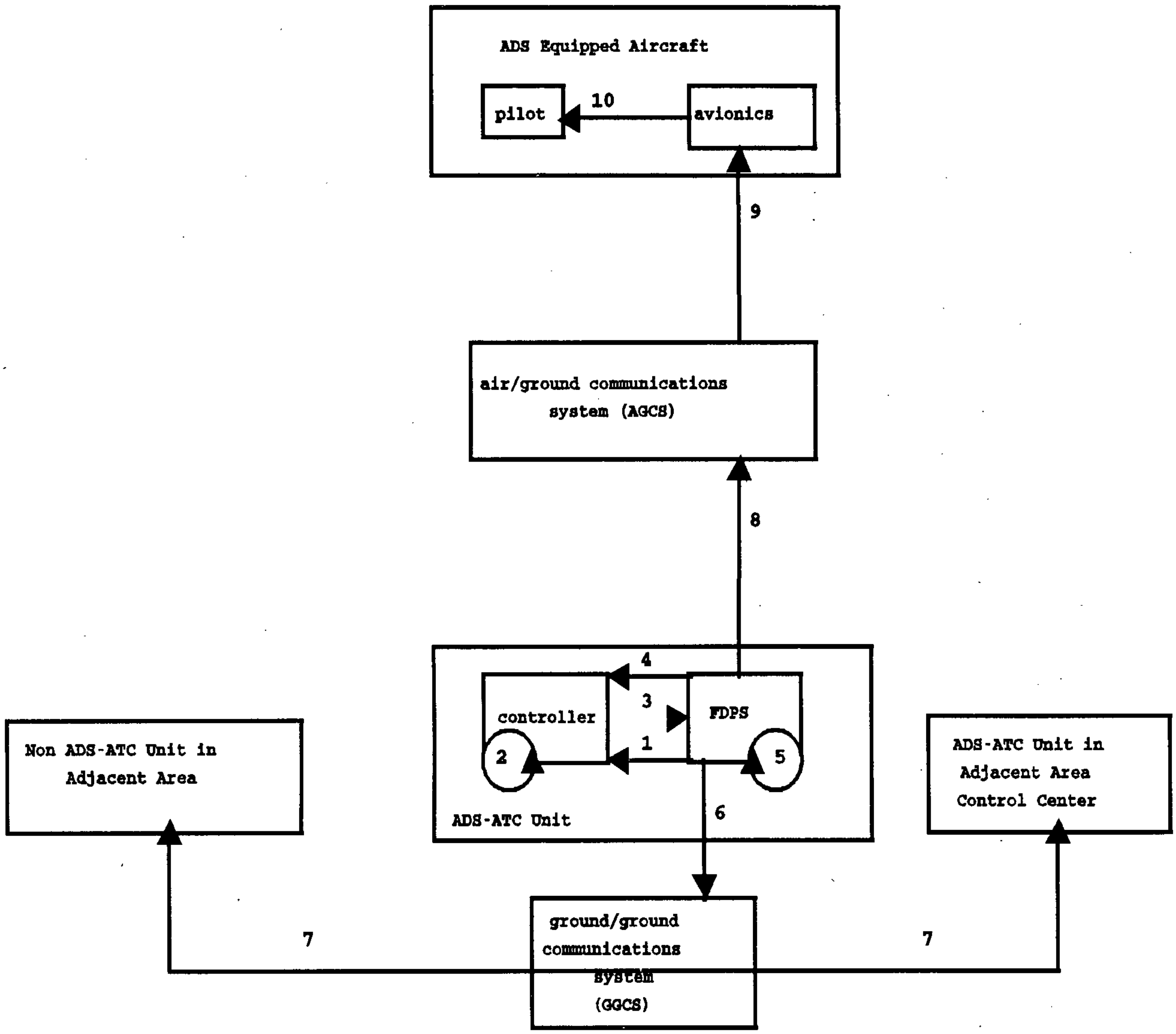
The time between acceptance or clearance action by the controller and:

a) the completion of the database and display update shall not exceed 3 seconds;

b) the arrival of an acceptance message at the transferring authority shall not exceed 45 seconds;

c) the arrival of a clearance at the aircraft shall not exceed 45 seconds.

O.R. 7 Functional thread diagram: Approval for flight to enter ADS-ATC airspace



O.R. 8 RECOGNITION THAT THE AIRCRAFT HAS ENTERED THE ADS-ATC AIRSPACE

Functional statement

In a non-radar airspace, especially when transiting from an uncontrolled airspace to an ADS-ATC airspace, the FDPS of the controlling ADS-ATC unit must recognize that the flight has entered the ADS-ATC airspace. A set of data as specified by the ADS agreement shall then be sent by the avionics to the FDPS.

Functional thread description

The FDPS will recognize that the aircraft is entering the ADS-ATC airspace. [8.1]

The ADS-equipped aircraft will send ADS reports as required by the current ADS agreement with the accepting unit. [8.2, 3]

The FDPS will modify the ADS agreement of the entering aircraft as required, once the aircraft is within its jurisdiction. [8.4, 5]

The ADS-equipped aircraft will confirm acceptance and respond to any new ADS agreement. [8.6, 7]

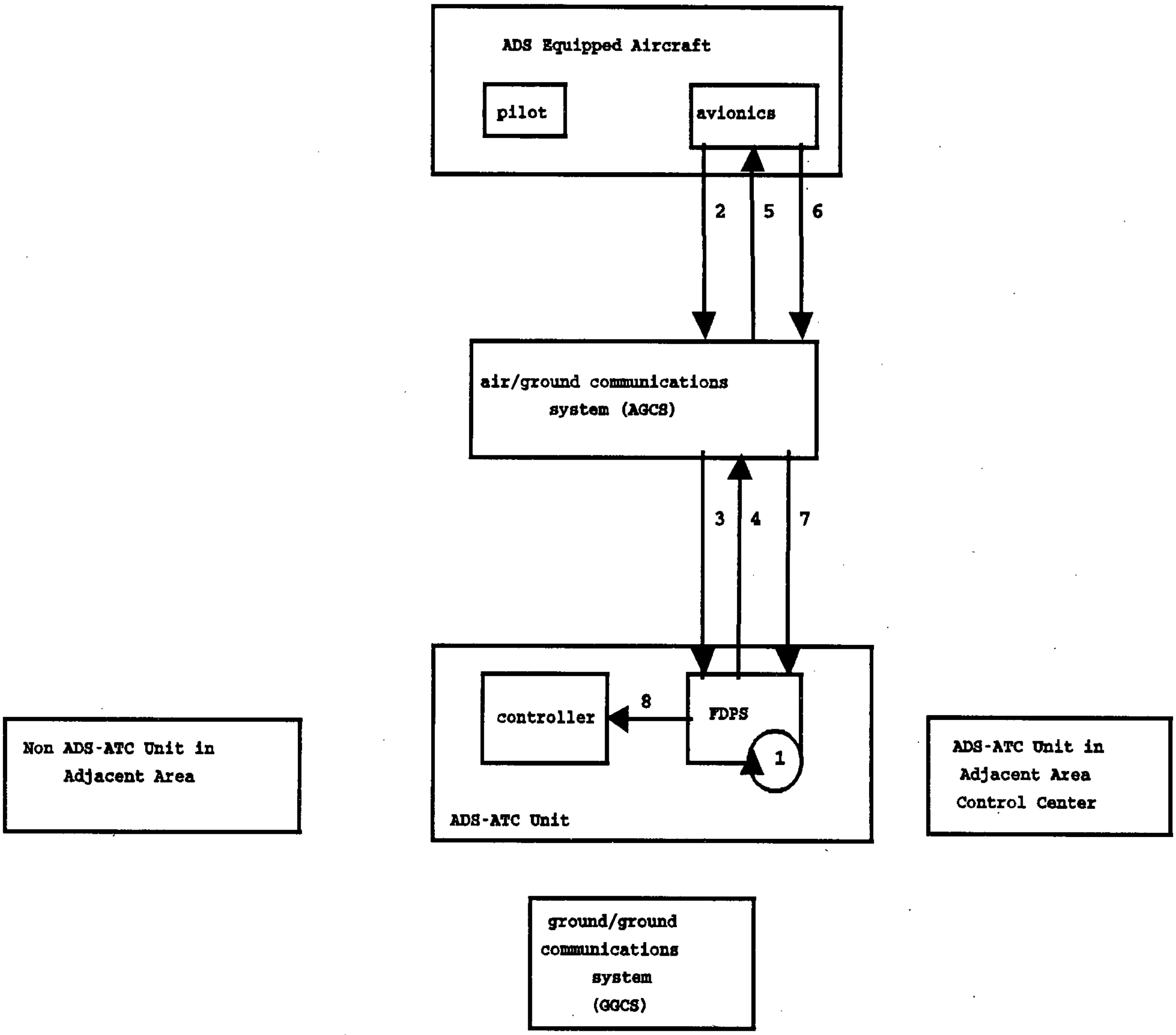
The FDPS will update the controller's display. [8.8]

System performance requirements

The probability of the FDPS not recognizing entry of the aircraft into its airspace shall not exceed 10^{-6}.

The time between the FDPS' recognition of an aircraft's entry into its airspace and the update of the controller display shall not exceed 3 seconds.

O.R. 8 Functional thread diagram: Recognition that the aircraft has entered the ADS-ATC airspace



O.R. 9 CONFIRMATION THAT THE AIRCRAFT'S PROJECTED PROFILE COINCIDES WITH THAT STORED IN THE FDPS

Functional statement

Whenever the FDPS receives an aircraft's projected profile information, the FDPS will check and verify that it is consistent with that already held.

Functional thread description

The avionics will recognize the triggering event to include projected profile information in the ADS report, according to the ADS agreement. [9.1]

The avionics will generate and transmit projected profile information in an ADS report to the ADS-ATC unit's FDPS. [9.2, 3]

The FDPS will compare the projected profile information from the ADS report with the stored profile for the aircraft. [9.4]

The FDPS will generate and display an appropriate alert to the controller if any difference exceeds the specified parameter delta(lat), delta(long), delta(alt), delta(time). [9.5]

Typical parameters

delta(lat) = equivalent to 1 NM

delta(long) = equivalent to 1 NM

delta(alt) = 150 ft or 50 m

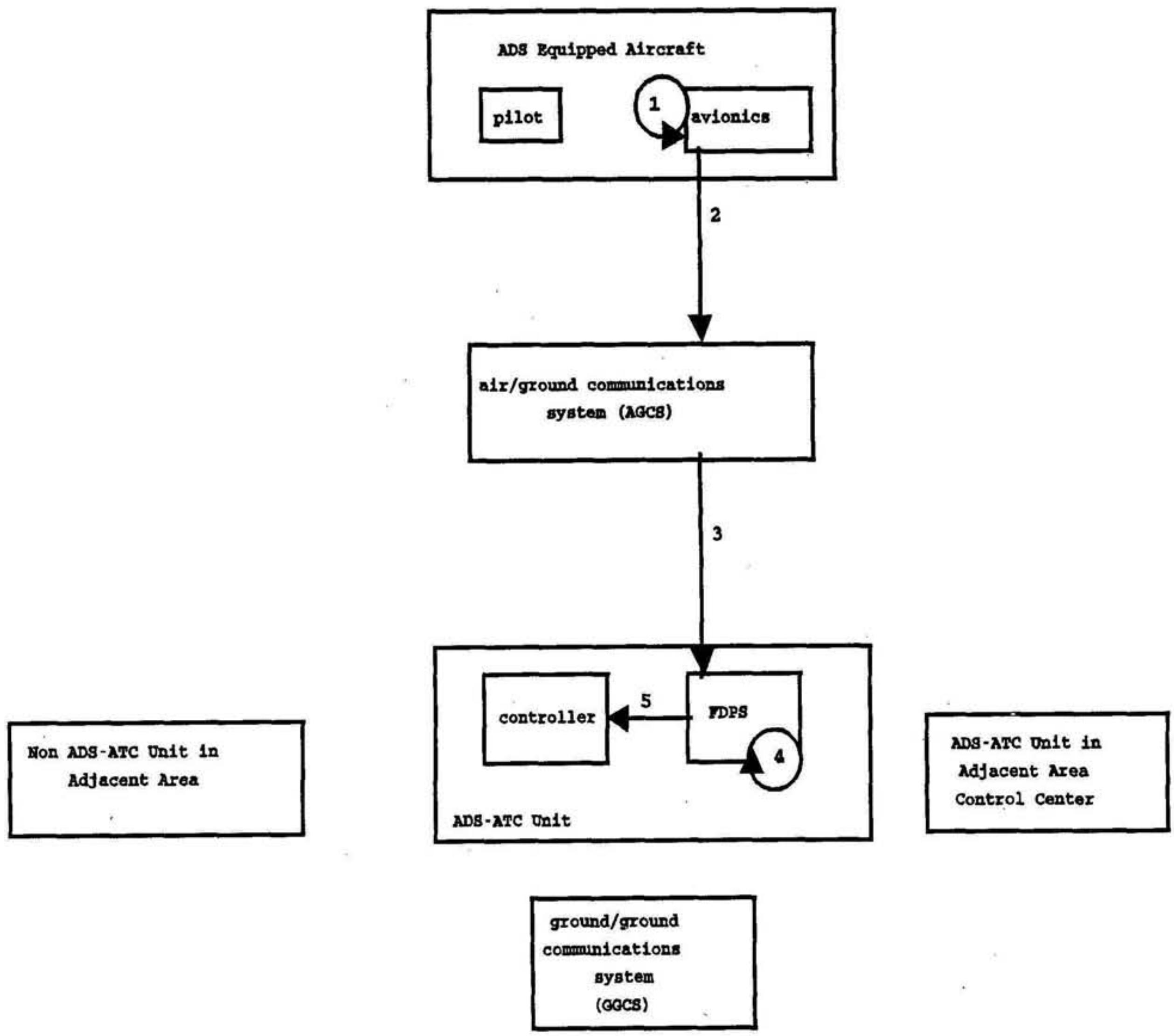
delta(time) = 1 – 5 minute(s) (local procedures)

System performance requirements

The probability of an erroneous indication being provided to the controller shall not exceed 10^{-6}.

The time between the receipt of the message by the FDPS and an alert to the controller of an inconsistency shall not exceed 3 seconds.

O.R. 9 Functional thread diagram: Confirmation that the aircraft's projected profile coincides with that stored in the FDPS



O.R. 10 VERIFICATION BY THE FDPS THAT THE AIRCRAFT IS PROCEEDING IN ACCORDANCE WITH THE ATC CLEARANCE

Functional statement

In the ADS-ATC system, the FDPS will use the ADS position reports and other ADS message group data to provide automated flight-following and conformance-monitoring.

Functional thread description

The avionics will recognize the trigger to transmit ADS data according to the ADS agreement. [10.1]

The avionics will generate and transmit ADS data to the appropriate ADS-ATC unit's FDPS. [10.2, 3]

The FDPS will compare the aircraft's position with the position predicted by the FDPS. [10.4]

The FDPS will generate and display appropriate messages to the controller if the ADS position report does not conform, within the given parameters, to the position predicted by the FDPS. [10.5]

Typical parameters

delta(lat) = equivalent to 1 NM

delta(long) = equivalent to 1 NM

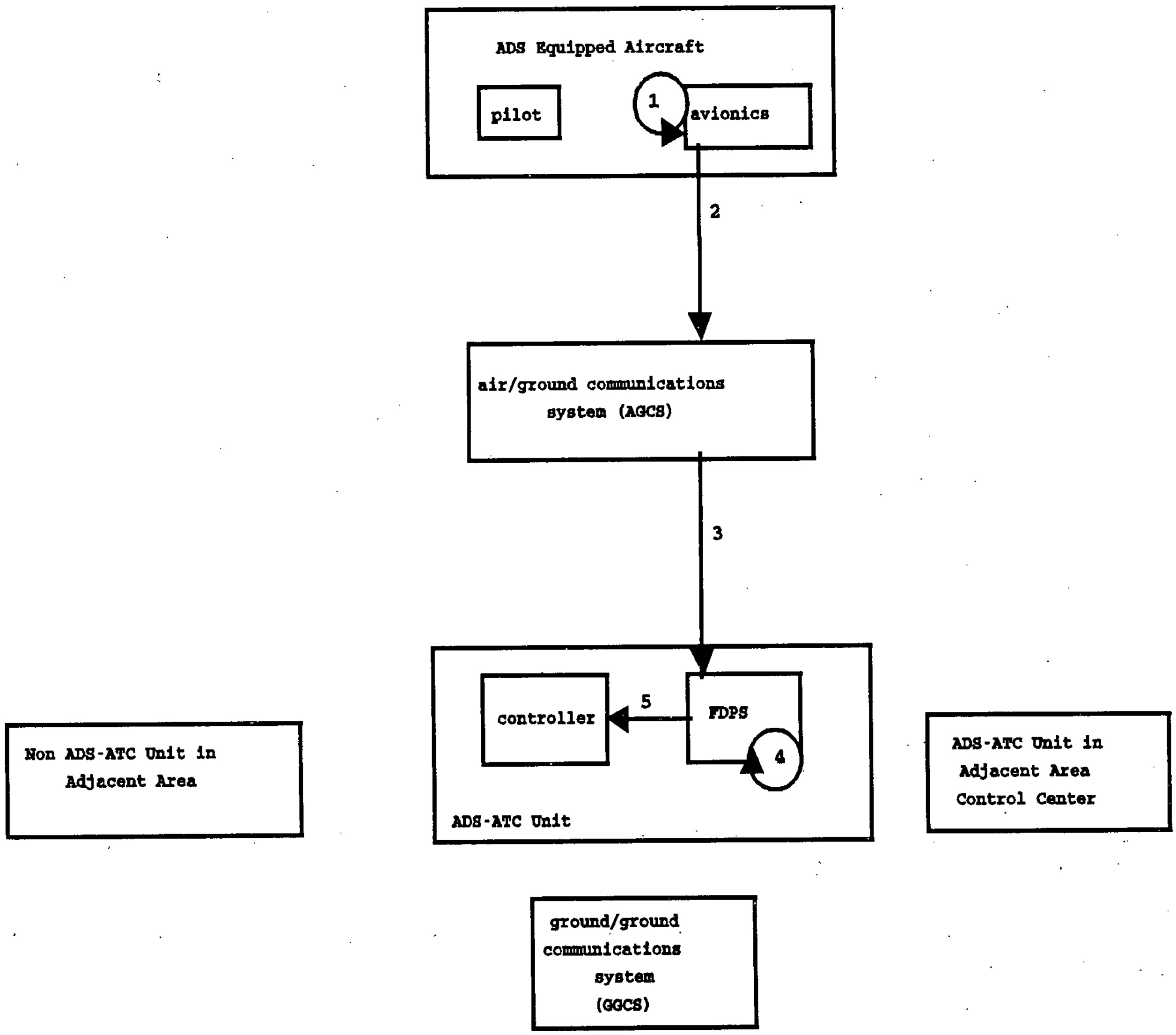
delta(alt) = 150 ft or 50 m

System performance requirements

The probability that an out-of-conformance situation is not notified to the controller shall not exceed 10^{-7}.

The time between the detection of an out-of-conformance condition and the notification to the controller shall not exceed 3 seconds.

O.R. 10 Functional thread diagram: Verification by the FDPS that the aircraft is proceeding in accordance with the ATC clearance between way-points



O.R. 11 PROVISION TO THE CONTROLLER OF THE MOST UP-TO-DATE TRAFFIC SITUATION AVAILABLE USING ADS-DERIVED INFORMATION

Functional statement

In an ADS-ATC environment, the controller must be provided with the most up-to-date ADS-derived information to permit the provision of effective air traffic control.

Functional thread description

The FDPS will acquire the ADS position information sent by ADS-equipped aircraft. [11.1.a]

The FDPS will process the ADS position information sent by ADS-equipped aircraft. [11.1.b]

The FDPS will extrapolate the ADS-equipped aircraft's position based on previously received ADS position reports, and in accordance with the algorithms and weather models incorporated within the system. [11.1.c]

The FDPS will carry out conflict probes on each ADS-equipped aircraft against known traffic in, and entering, the ADS-ATC airspace. [11.1d]

The FDPS will update the controller's display(s) using information derived from the ADS reports, together with appropriate internal processing. The time between display updates will be a system parameter (t11.2) seconds. [11.2a]

The FDPS will generate warnings (and alternative clearances, where conflict resolution algorithms are incorporated) to the controller when the conflict probe identifies a potential conflict between two or more aircraft. [11.2b]

The controller may request the display of the ADS-equipped aircraft's figure of merit. [11.3]

The FDPS will display the ADS-equipped aircraft's figure of merit if requested by the controller. [11.4]

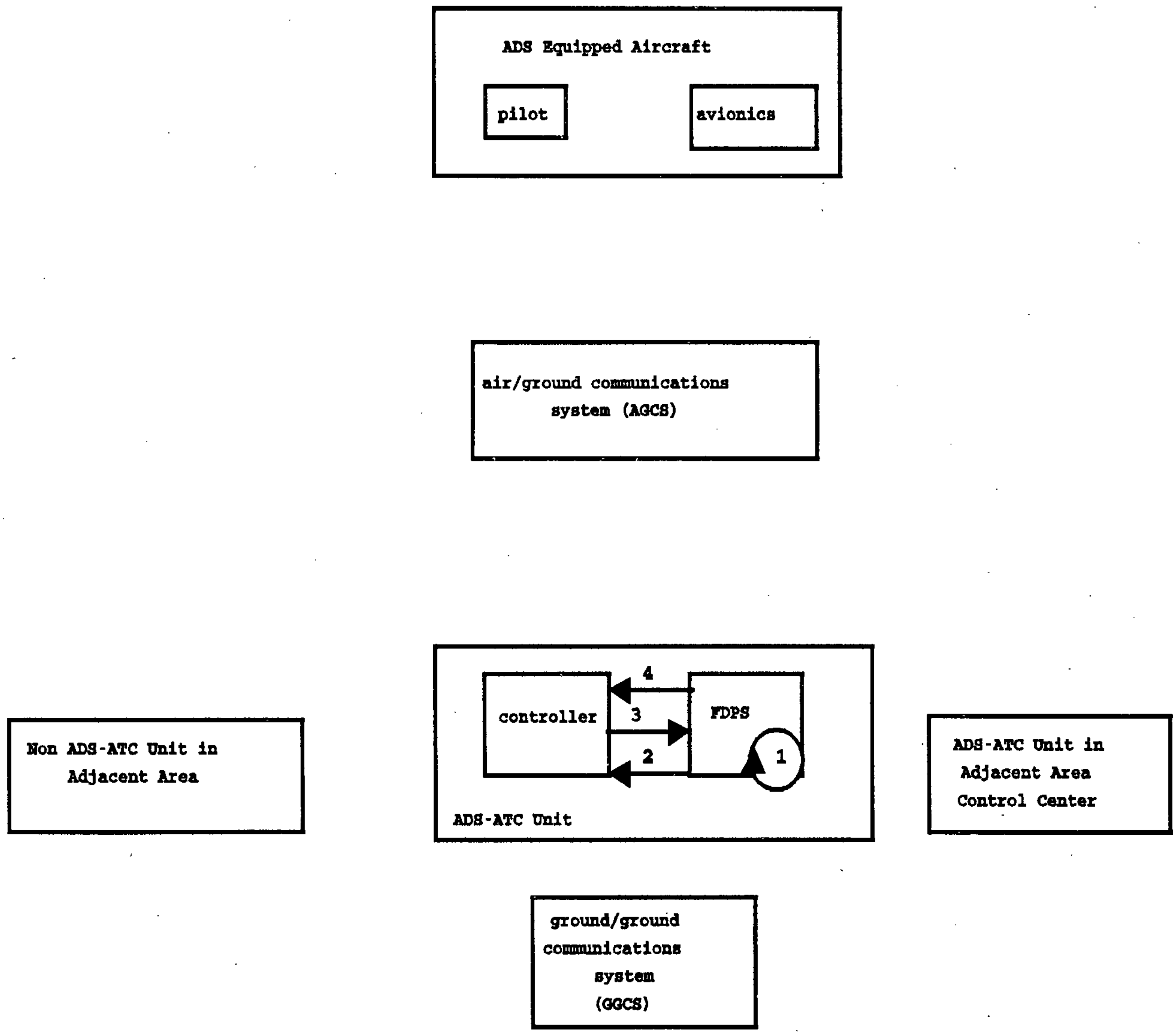
Typical parameters

t(11.2) = 1 − 15 seconds (local procedure)

System performance requirements

The time between the receipt of the ADS report and the output from the tracking software driving the controller display shall not exceed 1 second.

O.R. 11 Functional thread diagram: Provision to the controller of the most up-to-date traffic situation available using ADS-derived information



O.R. 12 PROVISION OF AUTOMATIC POSITION-REPORTING IN ACCORDANCE WITH ADS AGREEMENTS ALLOCATED BY THE ATC GROUND SYSTEM

Functional statement

Aircraft with ADS capabilities will provide ADS reports in accordance with the current ADS agreement.

Functional thread description

The avionics will recognize the trigger to generate the ADS report. [12.1]

The avionics will generate and transmit ADS reports to the appropriate ADS-ATC unit's FDPS in accordance with the ADS agreement. [12.2, 3]

The FDPS will process ADS reports based on the following priority [12.4]:

1) emergency;

2) "out-of-conformance"* reports;

3) other ADS reports.

The controller will be capable of modifying the ADS agreement as required by circumstances. [12.5]

The FDPS will generate appropriate messages to the aircraft to initiate such modifications to existing ADS agreements. [12.6, 7]

System performance requirements

The probability that an aircraft will fail to make a report according to the ADS agreement in force shall not exceed 10^{-6}.

The time between the composition of the ADS report and its receipt by the FDPS shall not exceed 10 per cent of the reporting interval, to a maximum of 15 seconds. Similarly, the time between the creation of an ADS management message and its receipt by the avionics shall not exceed 15 seconds.

The aircraft time stamp shall be within 1 (one) second of UTC.

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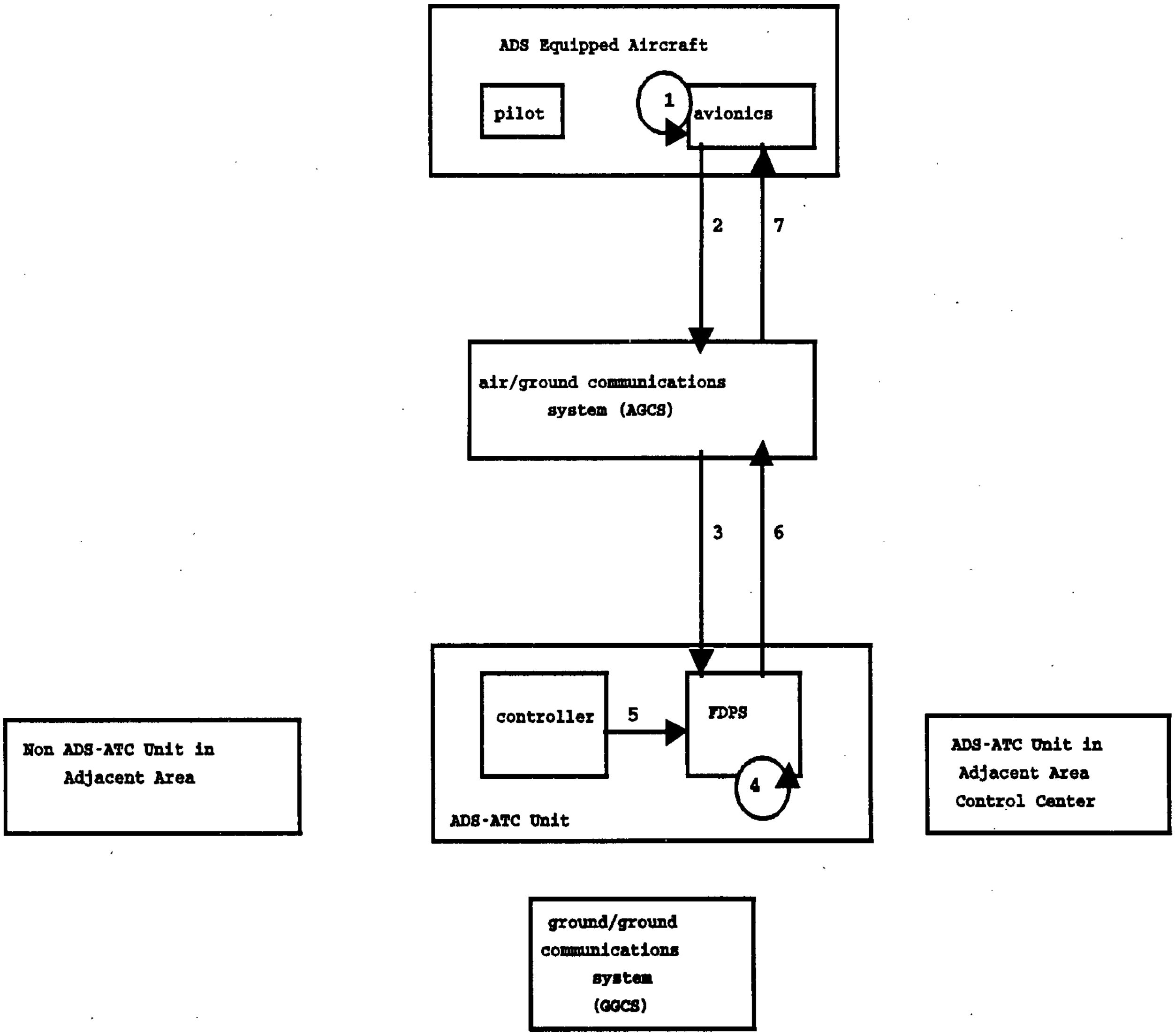
*Out-of-conformance variance parameters are defined under Operational Requirement 17.

O.R. 12 Functional thread diagram: Provision of automatic position-reporting in accordance with ADS agreements allocated by the ATC ground system



O.R. 13 AUTOMATIC TRANSFER OF CONTROL AND COMMUNICATIONS BETWEEN ADS-ATC AIRSPACES USING DIGITAL DATA INTERCHANGE

Functional statement

Two scenarios exist.

Scenario A portrays the situation where the receiving unit establishes its own ADS agreement prior to the boundary, with transfer of control being effected according to the inter-unit procedural agreement. This is the recommended procedure.

Scenario B illustrates the case where ADS data are transferred from the releasing unit to the accepting unit by ground/ground communications, prior to transfer of control. This is an extension of current inter-facility procedures.

Functional thread description

Scenario A: *Full use of air/ground communications* [this is the recommended procedure]

A time parameter (t13a.1) before an ADS-equipped aircraft reaches the transfer point or area, the releasing FDPS will extract appropriate boundary agreements from the FDPS database. [13A.1.a]

The releasing FDPS will select the boundary agreement appropriate to the route/level of the ADS-equipped aircraft, taking account of the ATM requirements currently in force. [13A.1.b]

The releasing FDPS will send the receiving ADS-ATC unit's FDPS a co-ordination message concerning the aircraft to be transferred. [13A.2, 3]

The releasing FDPS will instruct the aircraft to establish communications with the accepting ADS-ATC unit. [13A.4, 5]

The releasing FDPS will display to the releasing controller the information pertaining to the approach of the ADS-equipped aircraft to the transfer point. [13A.6]

The accepting FDPS will display to the accepting controller the information pertaining to the approach of the ADS-equipped aircraft to the transfer point. [13A.7]

A data link will be established between the aircraft and the accepting FDPS. [13A.8, 9a]

The accepting FDPS will establish an ADS agreement with the aircraft. [13A.8, 9b]

The releasing and accepting controllers effect the transfer of control and communications. This may be manual, automated or totally procedural, dependent on the letters of agreement between the ATS units. [13A.10, 11]

The pilot will be advised of the change of control authority. [13A.12, 13, 14, 15]

The releasing FDPS will terminate its ADS agreement(s) with the transferred aircraft at the appropriate time or place, as designated in the ADS agreement. [13A.16, 17]

Scenario B: *Limited air/ground exchanges*

A time parameter (t13b.1) before an ADS-equipped aircraft reaches the transfer point or area, the releasing FDPS will extract appropriate boundary agreements from the FDPS database. [13B.1a]

The releasing FDPS will select the boundary agreement appropriate to the route/level of the ADS-equipped aircraft, dependent on current ATM requirements. [13B.1b]

The releasing FDPS will send the receiving ADS-ATC unit's FDPS the co-ordination message, followed by ADS data concerning the aircraft to be transferred. [13B.2, 3]

The releasing FDPS will display to the releasing controller the information pertaining to the approach of the ADS-equipped aircraft to the transfer point. [13B.4]

The accepting FDPS will display to the accepting controller the information pertaining to the approach of the ADS-equipped aircraft to the transfer point. [13B.5]

A data link is established between the aircraft and the accepting FDPS. [13B.6, 7a]

The accepting FDPS will establish an ADS agreement with the aircraft. [13B.6, 7b]

The releasing and accepting controllers effect the transfer of control and communications. This may be manual, automated or totally procedural, dependent on the letters of agreement between the ATS units. [13B.8, 9]

The pilot is informed of the change of control authority. [13B.10, 11, 12, 13]

The releasing FDPS will terminate its ADS agreement(s) with the transferred aircraft at the appropriate time or place, as designated in the ADS agreement. [13B.14, 15]

The accepting FDPS will send to the releasing ADS-ATC unit's FDPS, ADS data concerning the aircraft until no longer required by the boundary agreement. [13B.16, 17]

Typical parameters

t13a.1 = 10 – 60 minutes (local procedures)

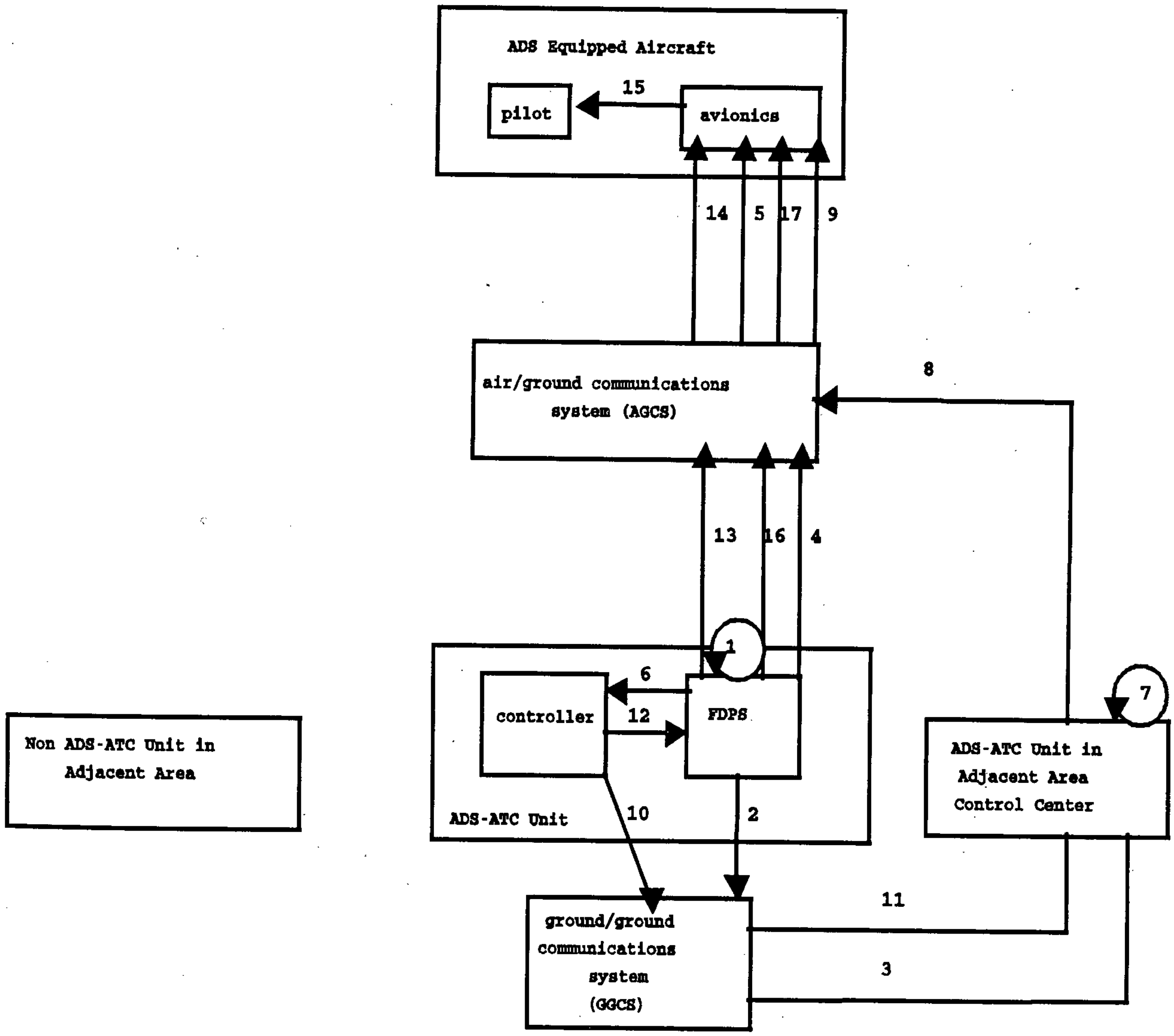
t13b.1 = 10 – 60 minutes (local procedures)

System performance requirements

The probability of failure to achieve automatic transfer of control and communications shall not exceed 10^{-6}.

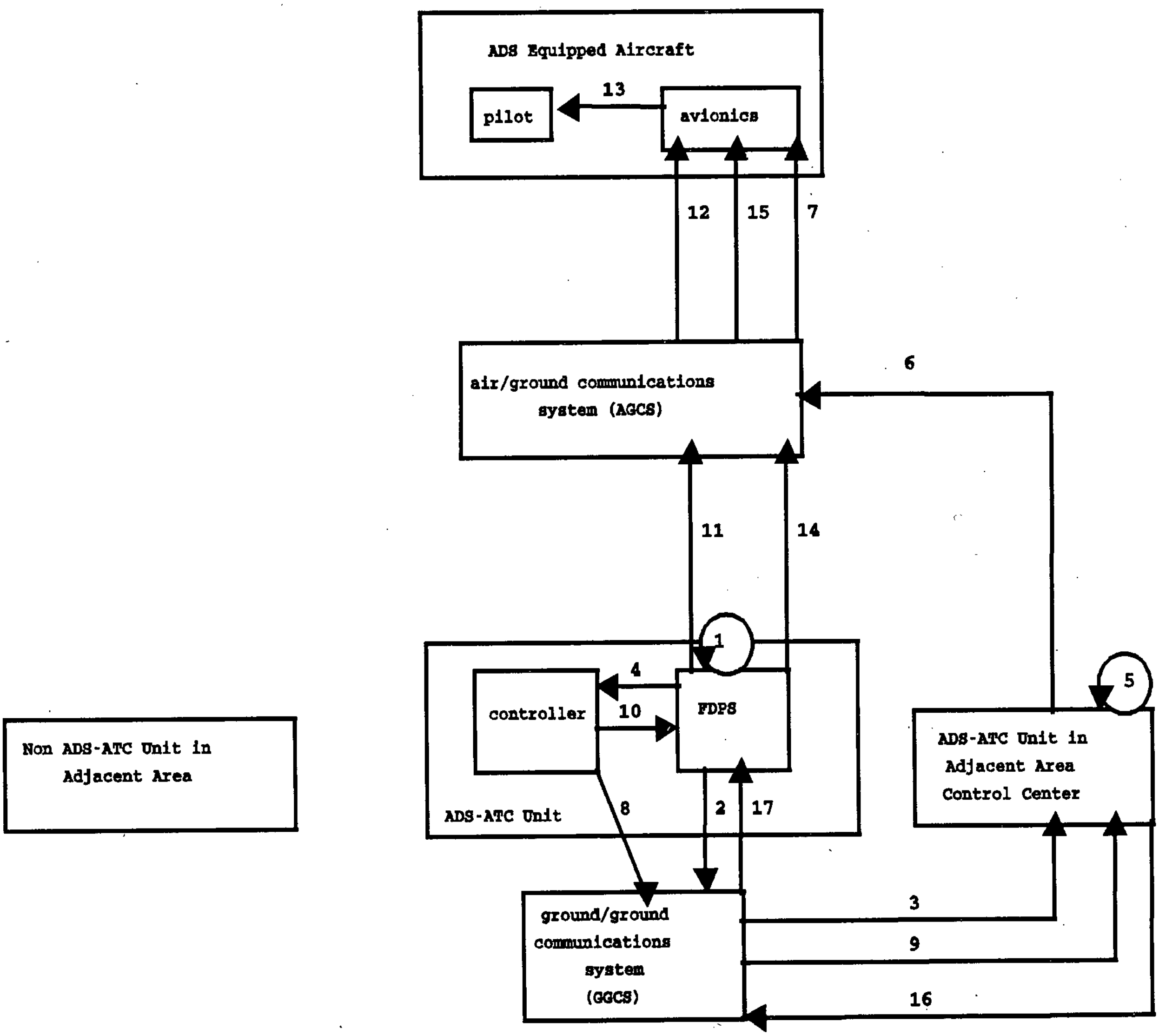
The time between the transfer of control and communications and the update of the avionics shall not exceed 5 seconds.

O.R. 13 Functional thread diagram: Automatic transfer of control and communications between ADS-ATC airspaces using digital data interchange



Scenario A: Air/Ground Communications

O.R. 13 Functional thread diagram: Automatic transfer of control and communications between ADS-ATC airspaces using digital data interchange



Scenario B: Limited Air/Ground Exchanges

O.R. 14 AUTOMATIC TRANSFER OF CONTROL AND COMMUNICATIONS FROM ADS-ATC AIRSPACE TO NON-ADS-ATC AIRSPACE USING DIGITAL DATA INTERCHANGE

Functional statement

A specific ATC procedure for the transfer of control and communications is needed when the receiving airspace is non-ADS-ATC airspace.

Functional thread description

A time parameter (t14.1) before an ADS-equipped aircraft reaches the transfer point or area, the FDPS will identify the appropriate boundary agreement between the releasing ADS-ATC airspace and the subsequent one. [14.1.a]

The FDPS will select the boundary agreement appropriate to the route/level of the ADS-equipped aircraft and the ATM requirements currently in force. [14.1.b]

The FDPS will send to the receiving non-ADS-ATC unit a co-ordination message concerning the ADS-equipped aircraft to be transferred in accordance with the appropriate boundary agreement. [14.2, 3]

The releasing FDPS will advise the releasing controller of the approach of the ADS-equipped aircraft to the transfer point or area. [14.4]

The releasing controller will initiate the transfer of control and communications, in accordance with current letters of agreement between the units. [14.5]

The releasing FDPS will advise the pilot of the ADS-equipped aircraft of the change of control authority. [14.6, 7, 8]

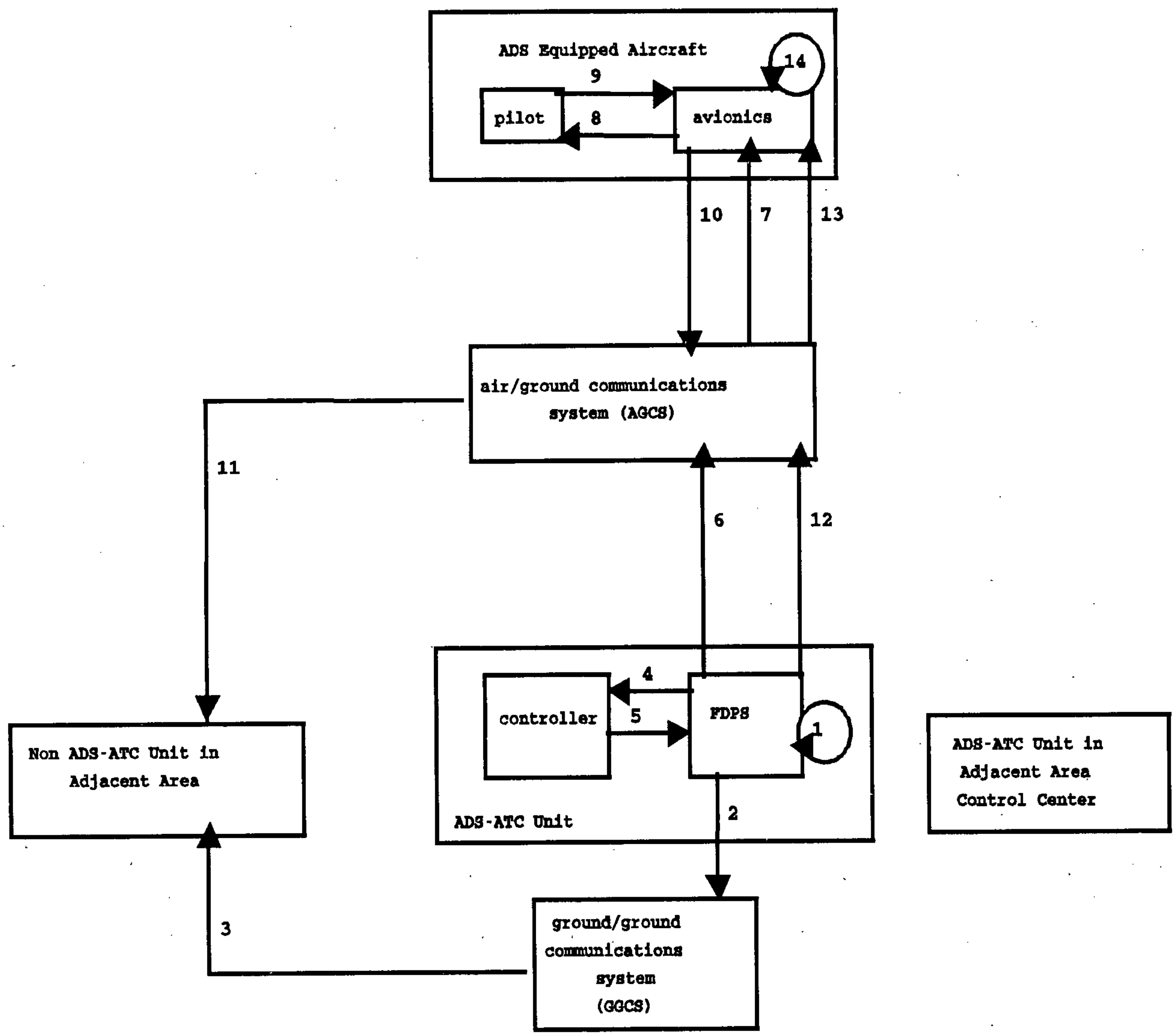
The pilot will establish contact with the accepting ATC unit, using normal communications procedures. [14.9, 10, 11]

The releasing FDPS will terminate all ADS agreements currently in place with the transferred ADS-equipped aircraft. [14.12, 13, 14]

Typical parameters

t14.1 = 10 – 60 minutes (local procedures)

O.R. 14 Functional thread diagram: Automatic transfer of control and communications from ADS-ATC airspace to non-ADS-ATC airspace using digital data interchange



O.R. 15 PROVISION OF CONTROLLER-PILOT DATA LINK COMMUNICATIONS (CPDLC)

Functional statement

When required by the ATM system in force, the system shall support the interchange of data link messages between the pilot and controller to support the effective provision of the ADS-ATC service.

Functional thread description

Downlink: Pilot to controller (Method A: Airborne initation)

The pilot will identify a situation requiring a data link message to the controller. [15A.1]

The pilot will initiate a data link message using either the defined message set or a free-text message or a combination of both. [15A.2]

The avionics will transmit the data link message to the controlling ADS-ATC unit's FDPS. [15.A.3, 4]

The FDPS will display the message to the appropriate controller. [15.A.5]

Uplink: Controller to pilot (Method B: Ground initiation)

The controller will identify a situation requiring a data link message to the pilot. [15B.1]

The controller will initiate a data link message using either the defined message set or a free-text message or a combination of both. [15.B.2]

The FDPS will transmit the data link message to the appropriate aircraft's avionics. [15.B.3, 4]

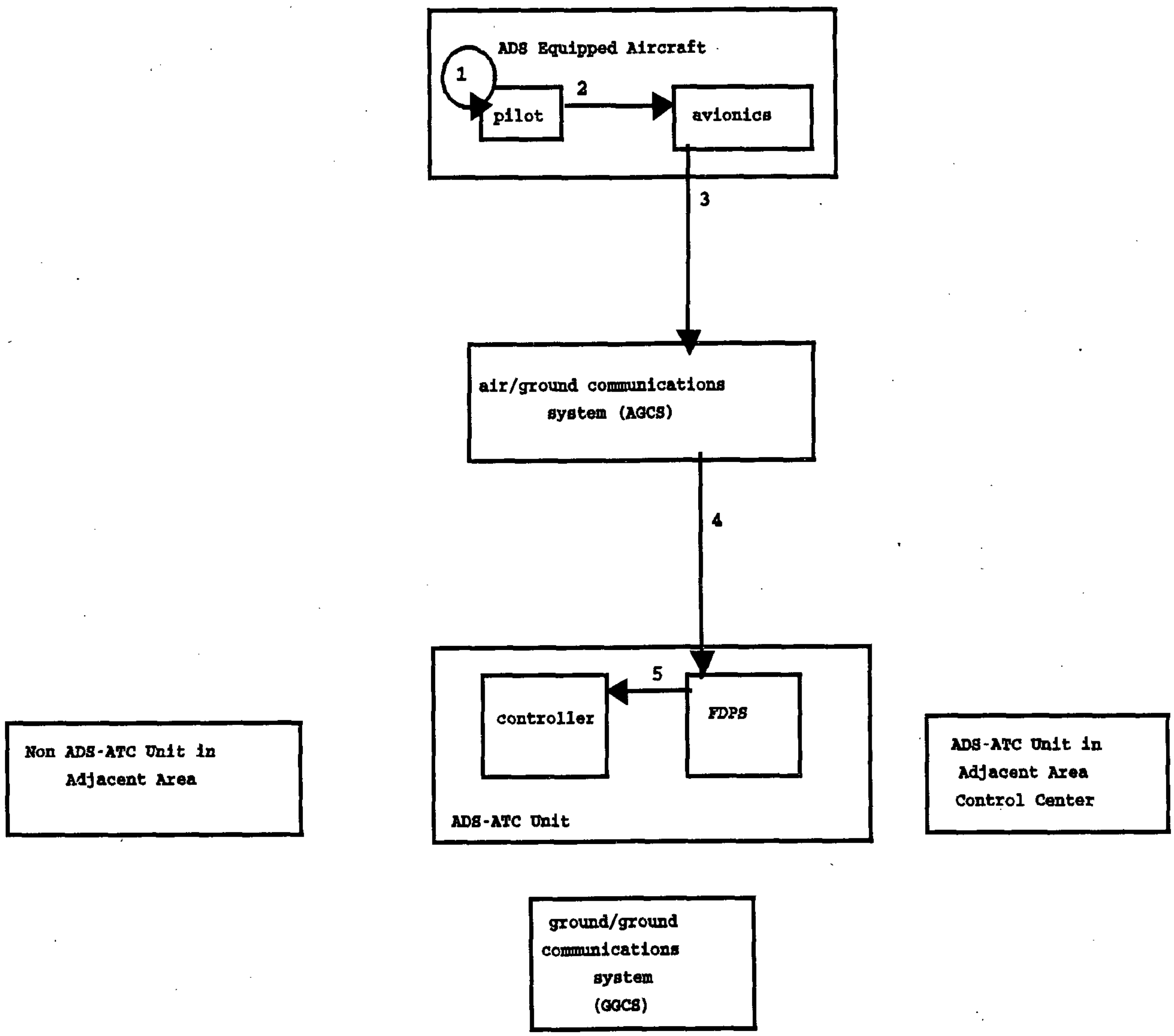
The avionics will display the message to the pilot. [15.B.5]

System performance requirements

The probability of establishing an erroneous link shall not exceed 10^{-7}.

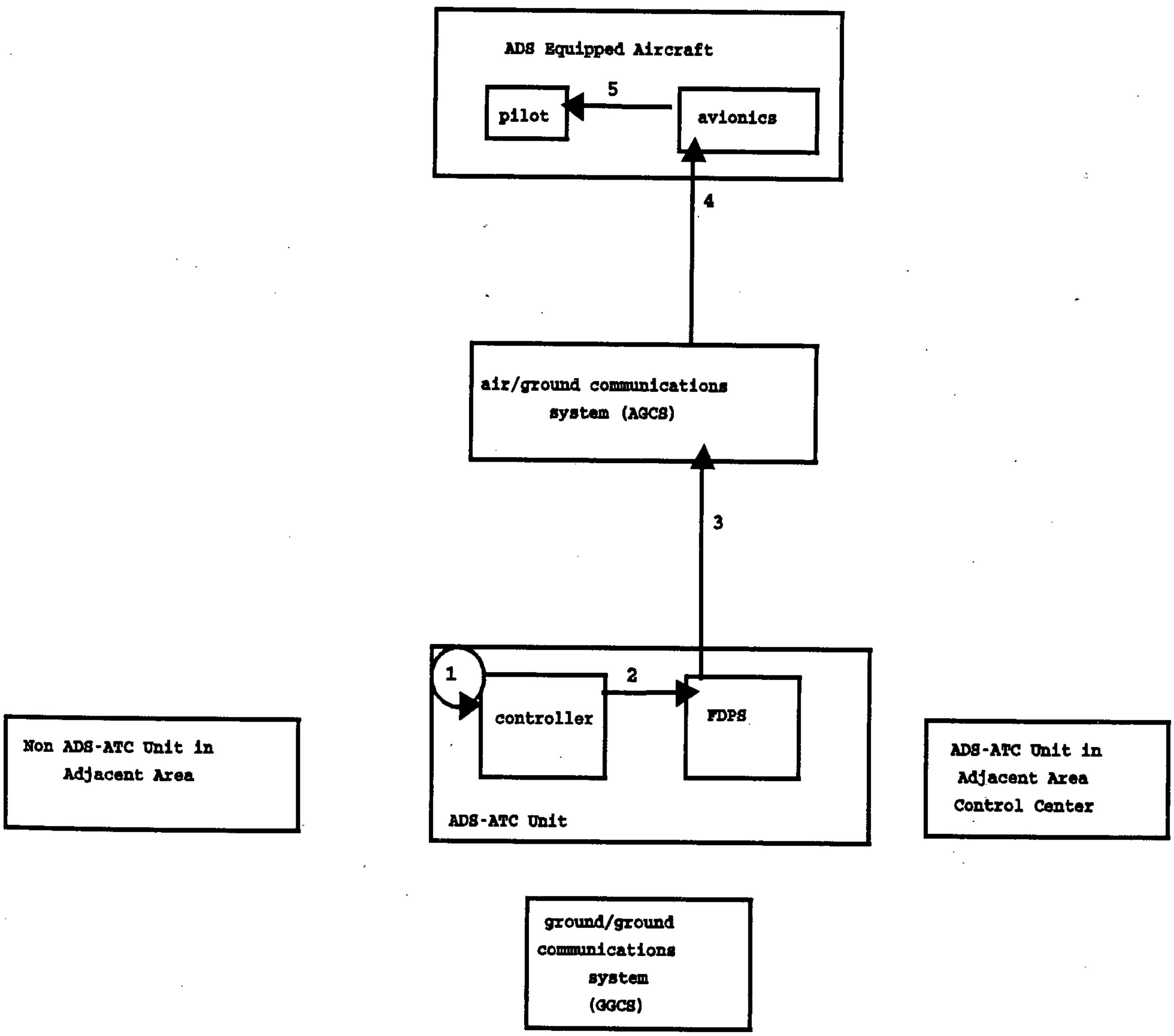
The time between a message being sent and its display to the recipient shall not exceed 10 seconds.

O.R. 15 Functional thread diagram: Provision of direct controller-pilot data link communications



Method A: Airborne Initiation

O.R. 15 Functional thread diagram: Provision of direct controller-pilot data link communications



Method B: Ground Initiation

O.R. 16 PROVISION OF DIRECT PILOT-CONTROLLER VOICE COMMUNICATIONS

Functional statement

The pilot and controller will be capable of initiating direct pilot-controller communication by voice in emergency or urgent, non-routine, safety-related situations.

Functional thread description

Pilot to controller (Method A: Airborne intitation)

The pilot will identify an emergency or urgent, non-routine, safety-related situation requiring voice communication with the controller. [16A.1]

The pilot will use simple actions to initiate voice communications. [16A.2]

Voice communications will be established between the aircraft and the controller controlling the aircraft. [16A.3, 4, 5]

The availability of voice will be made apparent to the pilot. [16A.6]

Controller to pilot (Method B: Ground initiation)

The controller will identify an emergency or urgent, non-routine, safety-related situation requiring voice communication with the pilot. [16B.1]

The controller will use simple actions to initiate voice communications. [16B.2]

Voice communications will be established between the controller and the pilot. [16.B.3, 4]

The pilot shall be alerted that a direct voice communication has been initiated by the controller. [16B.5]

The availability of voice will be made apparent to the controller. [16B.6]

System performance requirements

[*Note. – These performance requirements specifically address* satellite *voice communications.*]

Near toll-quality intelligibility. Passenger telephone quality is seen as meeting this ATC requirement.

Voice audio delay shall not exceed 600 ms.

The call set-up should not exceed 10 seconds.

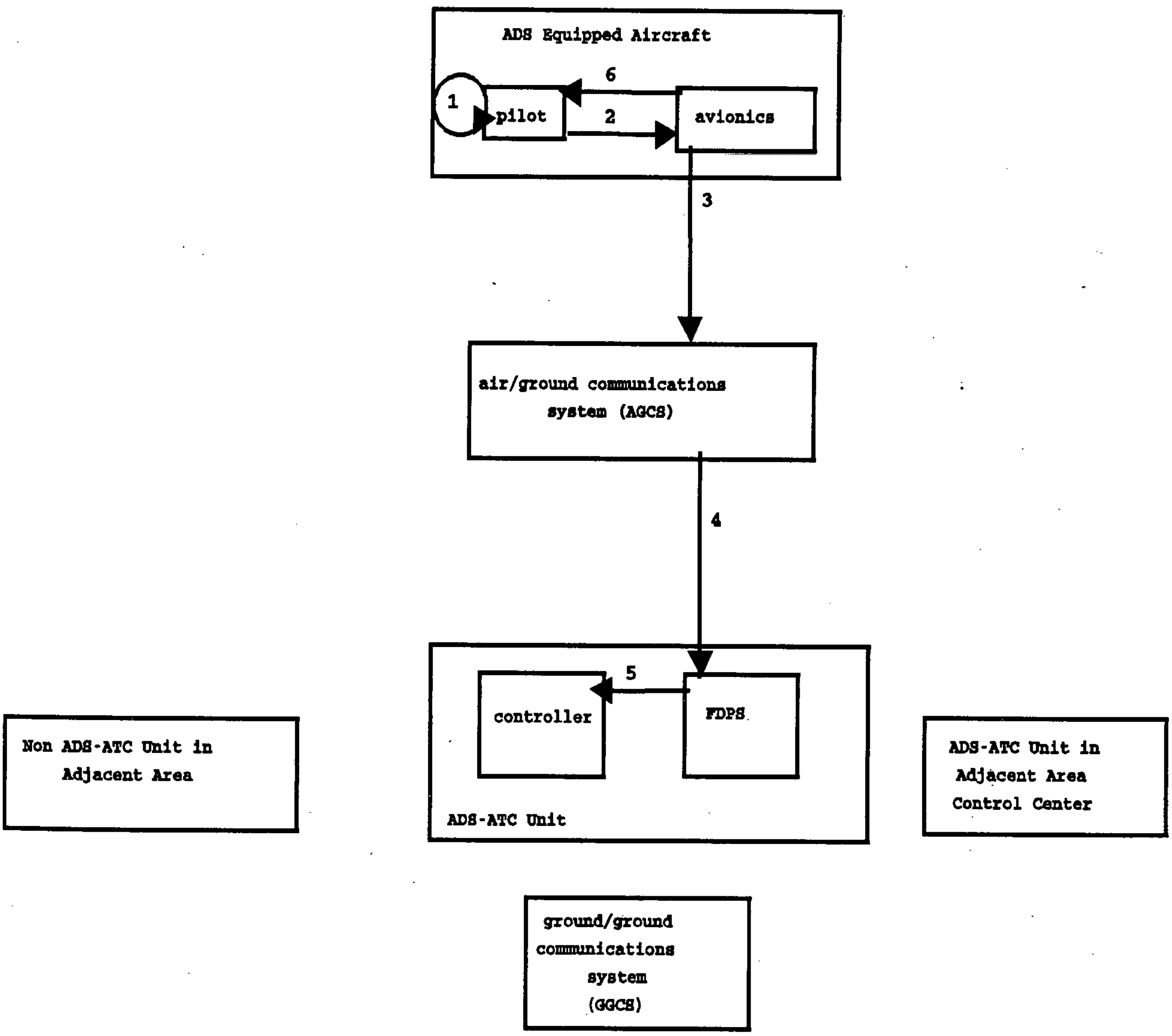
An emergency call shall ruthlessly preempt a lower-priority call.

The link shall be full duplex.

A new call shall be able to be accepted or initiated within 1 second of termination of the preceding call.

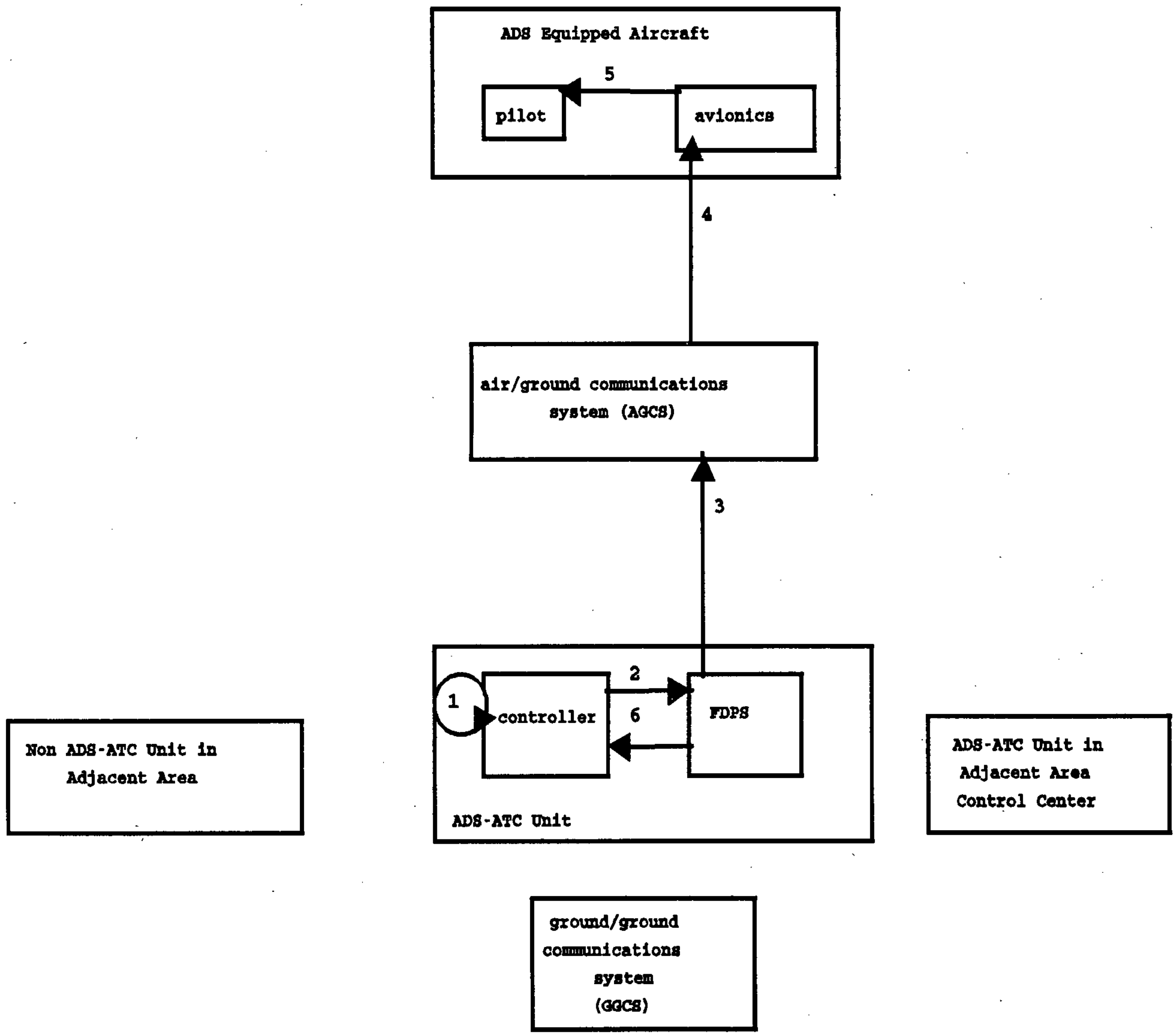
The probability that a desired connection is not made shall not exceed 10^{-6}.

O.R. 16 Functional thread diagram: Provision of direct pilot-controller voice communications



Method A: Airborne Initiation

O.R. 16 Functional thread diagram: Provision of direct pilot-controller voice communications



Method A: Ground Initiation

O.R. 17 SELF-MONITORING AND AUTOMATIC REPORTING BY THE AIRCRAFT OF SIGNIFICANT FLIGHT VARIANCES

Functional statement

Based on parameters established in the ADS agreement, the avionics will automatically report to the appropriate ADS-ATC unit's FDPS when flight variances relating to either speed, heading or altitude are fulfilled or exceeded, or when the aircraft's flight profile data changes.

Functional thread description

The FDPS will determine the flight conformance criteria applicable to the airspace and phase of flight. [17.1]

The FDPS will include within the ADS agreement the values that trigger these reports. [17.2, 3]

The avionics will recognize when one of the reporting criteria is satisfied or exceeded. [17.4]

The avionics will generate and transmit an appropriate ADS report for the specific flight variance. [17.5, 6, 7]

The FDPS will generate an alert to the controller if any parameter is exceeded. [17.7]

Typical parameters

Typical variance values are as follows:

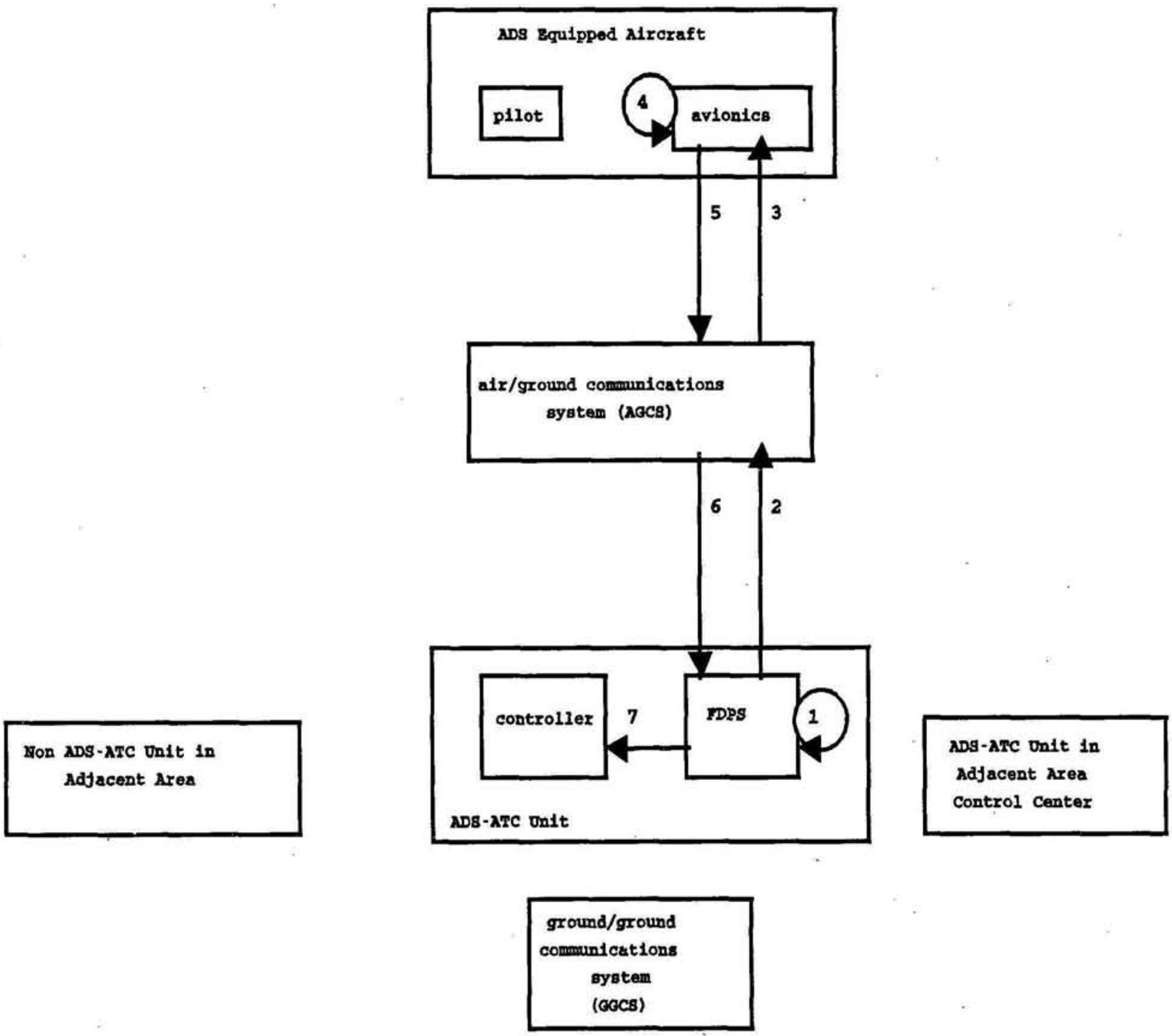
Speed 20 kt
Track/Heading 10°
Altitude 150 ft or 50 m

when compared to their value in the last ADS report which contained the data element in question.

An off-track distance of 1 NM
Any change to the aircraft's flight profile data

If a variance parameter is exceeded, the report will comprise an indication of which parameter has triggered the report, the basic plus the air or ground vector block as appropriate, based on the current ADS agreement.

O.R. 17 Functional thread diagram: Self-monitoring and automatic reporting by the aircraft of significant flight variances



O.R. 18 AIRCRAFT NOTIFICATION OF CHANGES TO POSITION DETERMINATION CAPABILITY

Functional statement

Based on parameters established in the ADS agreement, the avionics will automatically report to the ADS-ATC unit's FDPS when the aircraft's navigation capability (figure of merit) has changed.

Functional thread description

The avionics will recognize when the aircraft's navigation capability (figure of merit) has changed. [18.1]

The avionics will generate and transmit the basic ADS report. [18.2, 3]

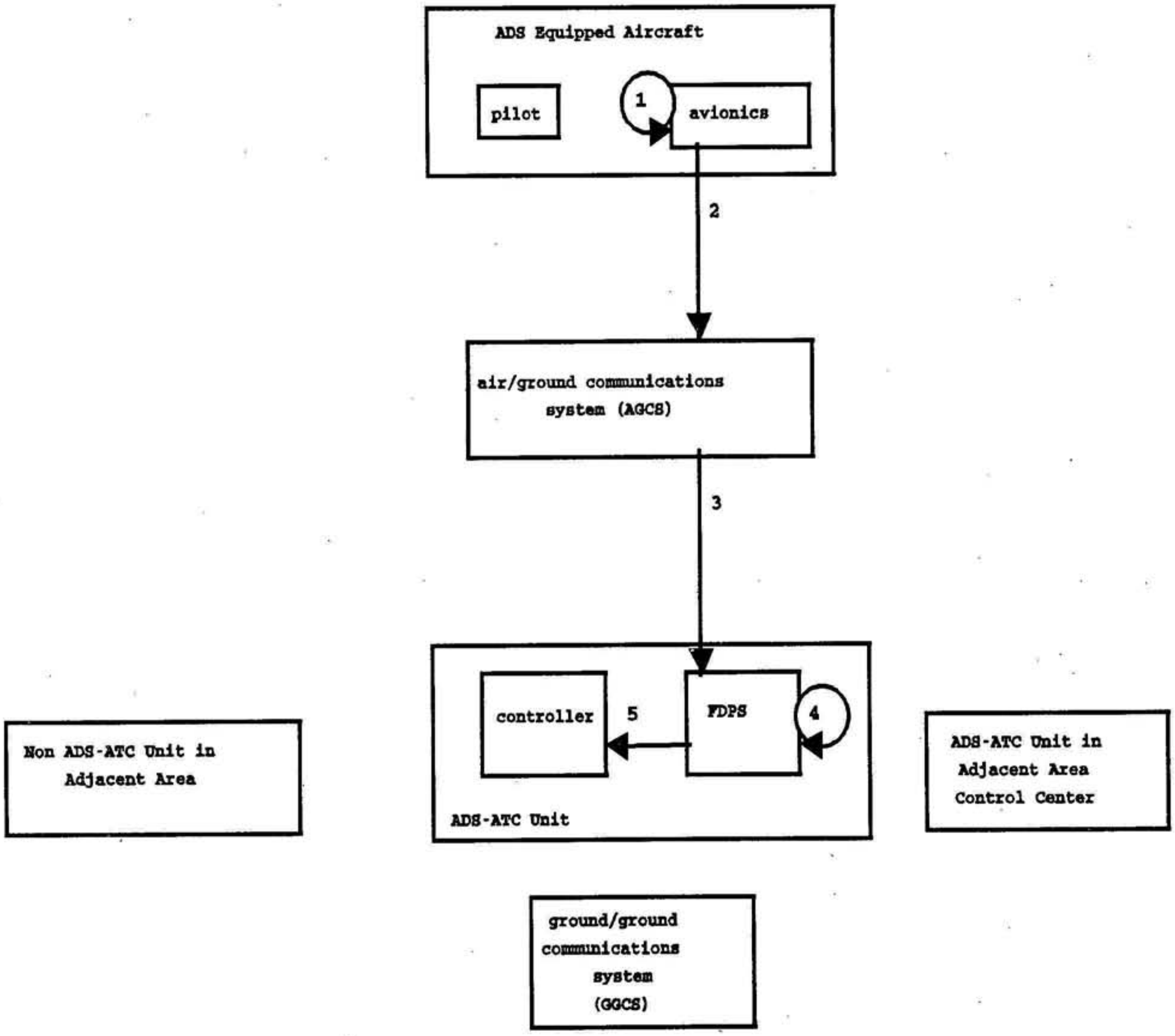
The FDPS will recognize the change in FOM status. [18.4]

The controller will be alerted to the change of status of the aircraft's navigational capabilities. [18.5]

System performance requirements

The time between the acceptance by the FDPS of the change to FOM and the completion of the database and display update shall not exceed 3 seconds.

O.R. 18 Functional thread diagram: Aircraft notification of changes to position determination capability



O.R. 19 PROVISION OF AN EMERGENCY MODE OF ADS OPERATION TO SUPPORT ATC ALERTING PROCEDURES AND TO ASSIST SEARCH AND RESCUE OPERATIONS

Functional statement

The system should provide for a pilot-initiated emergency mode which would support ATC alerting procedures and to assist search and rescue operations. It would also be permissable for avionics to automatically establish the emergency mode.

Functional thread description

The pilot will identify an emergency situation requiring ATC to be alerted. [19.1]

The pilot will use simple action to initiate an emergency mode. [19.2]

The avionics will recognize the pilot-initiated emergency mode. [19.3]

The avionics will generate and transmit the basic ADS report at a pre-set initial reporting rate (system parameter) together with the state of emergency. Flight identification and ground vector group will be included in every fifth report. [19.4, 5]

The FDPS will recognize the emergency mode and alert the controller. [19.5, 6]

The FDPS will be able to modify the emergency reporting rate if necessary. [19.7, 8, 9]

When an emergency report mode is declared, any existing periodic contract between the FDPS and that aircraft should be modified to a default emergency period contract. [19.10a]

While there is an emergency mode in effect, any request for a normal periodic contract should be ignored. [19.11a]

An emergency mode should not affect an event contract. [19.11b]

The periodic contract in effect when emergency mode is declared should be reinstated when the emergency ends. [19.10b]

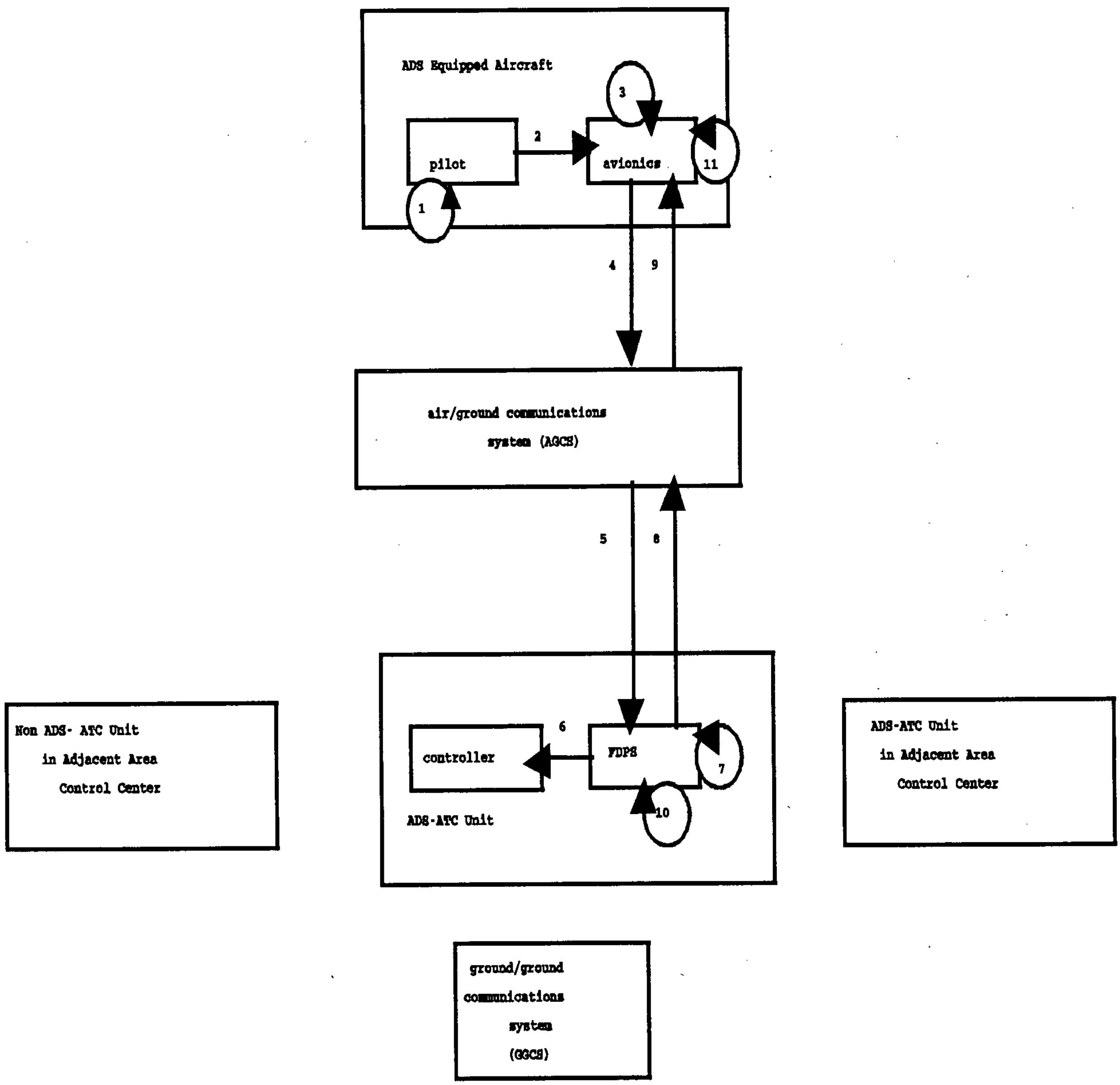
Typical parameters

t19.1 = 64 secs (initial default)

System performance requirements

The time between an emergency report being sent and its display to the recipient shall not exceed 5 seconds.

O.R. 19 Provision of an emergency mode of ADS operation to support ATC alerting procedures and to assist search and rescue operations



APPENDIX A

TO PART I, CHAPTER 4

PERFORMANCE REQUIREMENT PARAMETERS FOR THE ADS-ATC SYSTEM

To complement the operational requirements (O.R.s), the communications system will need to meet general performance standards which are summarized as:

The probability that a particular message will be delivered with one or more undetected errors shall be less than 10^{-7}.

The probability of non-receipt of a message shall be less than 10^{-6}.

The probability that a particular message will be misdirected shall be less than 10^{-7}.

The minimum availability of the end-to-end data communication system shall be not less than $1-10^{-6}$ to $1-10^{-4}$over a given period – typically one month.

Except in catastrophic situations, no single end-to-end outage should exceed 30 seconds. [End-to-end availability may be achieved through provision of alternate communications routings where feasible.]

Additionally, the following system performance requirement parameters have been identified for individual O.R.s, to ensure that the overall ADS-ATC system can fulfil its mission. These parameters are summarized below:

The aircraft time stamp shall be within 1 second of UTC.

O.R. 1 Nil

O.R. 2 From initiation to establishment of the data link between the avionics and the flight data processing system (FDPS), the time should not exceed 45 seconds.

O.R. 3 The probability that the registration process is in error shall not exceed 10^{-6}.

O.R. 4 The time between the initial request for profile data and the completion of the comparison shall not exceed 45 seconds.

O.R. 5 The probability that an incorrect ADS agreement is allocated to an aircraft shall not exceed 10^{-6}.

The time between uplink of the ADS agreement and receipt of an acknowledgement from the avionics shall not exceed 45 seconds.

O.R. 6 The probability that entry conditions into the ADS-ATC airspace are wrongly deemed to be acceptable shall not exceed 10^{-6}.

The time between receipt of initial ADS message and assessment of acceptability of entry conditions by the FDPS shall not exceed 45 seconds.

O.R. 7 For transfer of control and communications, the time between acceptance or clearance action by the controller and:

a) the completion of the database and display update shall not exceed 3 seconds;

b) arrival of an acceptance message at the transferring authority shall not exceed 45 seconds;

c) arrival of a clearance at the aircraft shall not exceed 45 seconds.

O.R. 8 The probability of the FDPS not recognizing entry of the aircraft into its airspace shall not exceed 10^{-6}.

The time between FDPS recognition of aircraft entry into its airspace and update of the controller display shall not exceed 3 seconds.

O.R. 9 The probability of an erroneous indication being provided to the controller shall not exceed 10^{-6}.

The time between the receipt of the message by the FDPS and an alert to the controller of an inconsistency shall not exceed 3 seconds.

O.R. 10 The probability that an out-of-conformance situation is not notified to the controller shall not exceed 10^{-7}.

The time between detection of an out-of-conformance condition and notification to the controller shall not exceed 3 seconds.

O.R. 11 The time between receipt of the ADS report and update of the tracking software driving the controller display shall not exceed 1 second.

O.R. 12 The probability that an aircraft will fail to make a report according to the ADS agreement in force shall not exceed 10^{-6}.

The time between the composition of an ADS report and its receipt by the FDPS shall no exceed 10 per cent of the reporting interval to a maximum of 15 seconds. Similarly, the time between the creation of an ADS management message and its receipt by the avionics shall not exceed 15 seconds.

O.R. 13 The probability of failure to achieve automatic transfer of control and communications shall not exceed 10^{-6}.

The time between transfer of control and communications and update of the avionics shall not exceed 5 seconds.

O.R. 14 Nil

O.R. 15 The probability of establishing an erroneous link shall not exceed 10^{-7}.

The time between a message being sent and its display to the recipient shall not exceed 10 seconds.

O.R. 16 Pilot-controller voice communications shall fulfil the following requirements: [*Note. – These performance requirements specifically address* satellite *voice communications*.]

a) near toll-quality intelligibility, including the capability of recognizing urgency in the transmission. Current passenger telephone quality is seen as meeting this ATC requirement;

b) voice audio delay shall not exceed 600 ms;

c) the call set-up should not exceed 10 seconds;

d) an emergency call shall ruthlessly preempt a lower-priority call;

e) the link will be full duplex;

f) a new call shall be able to be accepted or initiated within 1 second of termination of the preceding call;

g) the probability that a desired connection is not made shall not exceed 10^{-6}; and

h) the probability that a connection fails shall not exceed 10^{-6}.

O.R. 17 Nil

O.R. 18 The time between the acceptance by the FDPS of the change to FOM and the completion of the database and display update shall not exceed 3 seconds.

O.R. 19 The time between an emergency report being sent and its display to the recipient shall not exceed 5 seconds.

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APPENDIX B

TO PART I, CHAPTER 4

SUBSYSTEM REQUIREMENTS OF AN ADS-ATC SYSTEM

[BASED ON FUNCTIONAL THREAD DIAGRAMS AND FUNCTIONAL THREAD DESCRIPTIONS]

In order to achieve the operational requirements identified and specified above, the various subsystems will require a specific level of functional and performance capability. The ADS-ATC system, therefore, is seen to comprise the following subsystems:

a) aircraft avionics;

b) air-ground communications system (AGCS);

c) flight data processing system (FDPS); and

d) ground-ground communications system.

In addition, controller and pilot interactions are identified.

The performance requirements of these subsystems – both human and technical – are broken down below.

AVIONICS SUBSYSTEM

The ADS-equipped aircraft's avionics shall have the ability to initiate the log-on procedure. [2A.1, 2]

The ADS-equipped aircraft's avionics shall have the ability to send log-on requests containing the aircraft-unique identifier and aircraft position to an ADS-ATC system FDPS. [2A.3, 4]

The ADS-equipped aircraft's avionics shall have the ability to acknowledge the effective log-on. [2A.8, 9]

The ADS-equipped aircraft's avionics shall accept log-on requests from FDPS. [2B.3]

The ADS-equipped aircraft's avionics shall have the ability to respond to the log-on request and transmit its position. [2B.4, 5]

The ADS-equipped aircraft's avionics shall accept 'ACK' messages from FDPS. [2B.8]

The ADS-equipped aircraft's avionics shall have the ability to receive and process requests from the ADS-ATC system's FDPS for the aircraft's projected 4-D profile. [4.2, 3]

The ADS-equipped aircraft's avionics shall have the ability to send a projected 4-D profile as requested by the ADS-ATC system FDPS. [4.4, 5]

The ADS-equipped aircraft's avionics shall receive and process ADS agreement requests sent by the ADS-ATC unit's FDPS. [5.2, 3]

The ADS-equipped aircraft's avionics shall send ADS agreement acceptance messages to the requesting ADS-ATC unit's FDPS. [5.4, 5]

The ADS-equipped aircraft's avionics shall recognize the triggering event to start transmitting ADS messages. [6.1]

The ADS-equipped aircraft's avionics shall transmit ADS messages to the appropriate ATC unit's FDPS according to the ADS agreement. [6.2, 3]

The ADS-equipped aircraft's avionics shall register the appropriate clearance to enter the ADS-ATC airspace. [7.9]

The ADS-equipped aircraft's avionics shall display the clearance to the pilot. [7.10]

The ADS-equipped aircraft's avionics shall transmit the basic and projected profile blocks of the ADS message as required by the ADS-ATC FDPS. [8.2, 3]

The ADS-equipped aircraft's avionics shall confirm acceptance and respond to any new ADS agreement. [8.6, 7]

The ADS-equipped aircraft's avionics shall recognize the triggering event to generate a basic ADS report and projected profile block. [9.1]

The ADS-equipped aircraft's avionics shall generate and transmit a basic ADS report and projected profile block in accordance with the subject ATC unit's FDPS per the ADS agreement. [9.2, 3]

The ADS-equipped aircraft's avionics shall recognize the trigger to generate a basic ADS block as required by the ADS agreement. [10.1]

The ADS-equipped aircraft's avionics shall generate and transmit a basic ADS block to the subject ATC unit's FDPS as required by the ADS agreement. [10.2, 3]

The ADS-equipped aircraft's avionics shall recognize the trigger to generate an ADS report to the appropriate ADS-ATC unit. [12.1]

The ADS-equipped aircraft's avionics shall generate and transmit ADS reports as required by the ADS agreement to the appropriate ADS-ATC unit. [12.2, 3]

The ADS-equipped aircraft's avionics shall process messages received from the subject ADS-ATC unit to modify the existing ADS agreement. [12.6, 7]

The ADS-equipped aircraft's avionics shall register the releasing FDPS instruction to establish a connection with the accepting ADS-ATC. [13A.4, 5]

The ADS-equipped aircraft's avionics shall respond to the request from the accepting FDPS to establish a data link with the aircraft. [13A.8, 9a] and [13B.6, 7a]

The ADS-equipped aircraft's avionics shall receive and process ADS agreement requests sent by the accepting ADS-ATC unit's FDPS. [13A.8, 9b] and [13B.6, 7b]

The ADS-equipped aircraft's avionics shall have the ability to advise the pilot of the change of control authority. [13A.12, 13, 14, 15] and [13B.10, 11, 12, 13]

The ADS-equipped aircraft's avionics shall have the ability to terminate ADS agreement(s) with the releasing FDPS at the appropriate time or place as designated by the ADS agreement. [13A.16, 17] and [13B.14, 15]

The ADS-equipped aircraft's avionics shall have the ability to advise the pilot of the change of control of authority from the releasing FDPS. [14.6, 7, 8]

The ADS-equipped aircraft's avionics shall have the ability to send to the non-ADS-ATC FDPS the first contact information made by the pilot. [14.9, 10, 11]

The ADS-equipped aircraft's avionics shall have the ability to terminate agreement(s) with the releasing ADS-ATC unit's FDPS. [14.12, 13, 14]

The ADS-equipped aircraft's avionics shall allow a pilot to create a data link message using either the defined data link message set or free text message, or a combination of both. [15A.2]

The ADS-equipped aircraft's avionics shall generate and transmit the data link message to the appropriate ADS-ATC unit's FDPS. [15A.3, 4]

The ADS-equipped aircraft's avionics shall receive and process data link messages sent from the controlling ADS-ATC unit's FDPS. [15B.3, 4]

The ADS-equipped aircraft's avionics shall display the message to the pilot. [15B.5]

The ADS-equipped aircraft's avionics shall provide a simple mechanism to initiate establishment of direct controller-pilot voice communications. [16A.2]

The ADS-equipped aircraft's avionics shall make the availability of direct pilot-controller voice communication apparent to the pilot. [16A.6]

The ADS-equipped aircraft's avionics shall preempt other data link communications if an emergency status arises. [16B.3, 4]

The ADS-equipped aircraft's avionics shall indicate to the pilot that direct voice communication between controller and aircraft has been established. [16B.5]

The ADS-equipped aircraft's avionics shall receive and process the flight conformance criteria. [17.3]

The ADS-equipped aircraft's avionics shall recognize that one of the flight characteristics has been satisfied or exceeded. [17.4]

The ADS-equipped aircraft's avionics shall generate and transmit an appropriate ADS report for the specific flight variance. [17.5]

The ADS-equipped aircraft's avionics shall have the ability to recognize when the aircraft's navigation (figure of merit) has changed. [18.1]

The ADS-equipped aircraft's avionics shall further generate and transmit an additional 10 ADS reports at a reduced period of the lower of 10 seconds or 1/30 the normal reporting period (the period shall be no less than 1 second). [17.5]

The ADS-equipped aircraft's avionics shall generate and transmit the basic ADS report following the recognition of the change of the figure of merit. [18.2, 3]

The ADS-equipped aircraft's avionics shall have the ability to receive and encode a pilot-initiated emergency mode. [19.2]

The ADS-equipped aircraft's avionics shall have the ability to automatically transmit emergency ADS messages. [19.3a, 4)

The initial reporting period of the aircraft's avionics system shall be a system parameter. [19.3b]

The ADS-equipped aircraft's avionics shall have the ability to receive a request to modify the emergency mode reporting rate and process accordingly. [19.9]

While there is an emergency mode in effect, the ADS-equipped aircraft's avionics shall ignore any requests from a normal periodic contract. [19.11a]

While there is an emergency mode in effect, any event contract already set in the ADS-equipped aircraft's avionics shall not be affected. [19.11b]

AIR-GROUND COMMUNICATION SYSTEM (AGCS)

The AGCS shall transfer log-on requests from an ADS-equipped aircraft to an ADS-ATC system FDPS. [2A.3, 4]

The AGCS shall transfer log-on responses from an ADS-ATC system FDPS to an ADS-equipped aircraft. [2A.6, 7]

The AGCS shall transfer acknowledgment from an ADS-equipped aircraft to an ADS-ATC system FDPS. [2A.8, 9]

The AGCS shall transfer log-on requests from an ADS-ATC system FDPS to an ADS-equipped aircraft. [2B.2, 3]

The AGCS shall transfer log-on responses from an ADS-equipped aircraft to an ADS-ATC system FDPS. [2B.4, 5]

The AGCS shall transfer acknowledgment from an ADS-ATC system FDPS to an ADS-equipped aircraft. [2B.7, 8]

The AGCS shall transfer 4-D profile requests from an ADS-ATC system FDPS to the specified subject ADS-equipped aircraft. [4.2, 3]

The AGCS shall transfer 4-D profiles from the ADS-equipped aircraft to the requesting ADS-ATC FDPS. [4.4, 5]

The AGCS shall transfer ADS agreement requests from an ADS-ATC unit FDPS to the specified ADS-equipped aircraft. [5.2, 3]

The AGCS shall transfer ADS agreement acceptance messages from the aircraft avionics to the requesting ADS-ATC unit FDPS. [5.4, 5]

The AGCS shall transfer ADS messages from the aircraft avionics to the appropriate ATC unit's FDPS. [6.2, 3]

The AGCS shall transfer clearance messages sent by the ADS-ATC unit's FDPS to the aircraft. [7.8, 9, 10]

The AGCS shall transfer ADS messages sent by the ADS-equipped aircraft to the appropriate FDPS. [8.2, 3, 6, 7]

The AGCS shall transfer ADS agreements sent by an ADS-ATC FDPS to the aircraft, as required. [8.4, 5]

The AGCS shall transfer the basic ADS report plus projected profile block from the aircraft avionics to the subject ADS-ATC unit's FDPS. [9.2, 3]

The AGCS shall transfer basic ADS reports from the aircraft avionics to the appropriate ADS-ATC unit's FDPS. [10.2, 3]

The AGCS shall transmit ADS reports from the aircraft avionics to the FDPS appropriate ADS-ATC unit. [12.6, 7]

The AGCS shall transfer ADS reports to the appropriate ADS-ATC unit's FDPS in accordance with the ADS agreement. [12.2, 3]

The AGCS shall transmit messages from the ADS-ATC unit FDPS to the aircraft to modify ADS agreements. [12.6, 7]

The AGCS shall transfer the instructions from the releasing ADS-ATC system FDPS to an ADS-equipped aircraft to establish connection with the accepting ADS-ATC unit. [13A.4, 5]

The AGCS shall establish a data link between the aircraft and the accepting FDPS. [13A.8, 9a] and [13B.6, 7a]

The AGCS shall transfer the ADS agreement between the aircraft and the accepting FDPS. [13A.8, 9b] and [13B.6, 7b]

The AGCS shall transfer the messages advising the pilot of the change of control authority. [13A.13, 14] and [13B.11, 12]

The AGCS shall transfer the ADS agreement termination messages from the releasing FDPS to the transferred aircraft. [13A.16, 17] and [13B.14, 15]

The AGCS shall transfer control and communication information from the FDPS to the aircraft. [14.6, 7]

The AGCS shall transfer first contact information from the ADS-equipped aircraft to the accepting non-ADS-ATC unit. [14.10, 11]

The AGCS shall terminate all ADS contracts from the ADS-ATC FDPS to the specified subject ADS-equipped aircraft. [14.12, 13]

The AGCS will transfer data link messages sent from the data link-equipped aircraft's avionics to the appropriate ADS-ATC unit's FDPS. [15A.3, 4]

The AGCS will transfer data link messages from the ADS-ATC unit's FDPS to the appropriate aircraft. [15B.3, 4]

The AGCS shall establish an pilot-initiated voice communications link with the controller. [16A.3, 4]

The AGCS shall establish a controller-initiated voice communications link with the pilot. [16B.3, 4]

The AGCS shall transfer ADS agreements that establish flight conformance criteria from FDPS to avionics. [17.2, 3]

The AGCS shall transfer ADS reports for the specific flight variance from the aircraft avionics to the specific ADS-ATC unit's FDPS. [17.5, 6]

The AGCS shall transfer ADS agreements that establish flight characteristic values between the subject aircraft and the ADS-ATC unit's FDPS. [18.2, 3]

The AGCS shall transfer the ADS emergency messages initiated by the pilot or automatically by the ADS-equipped aircraft avionics to the ADS-ATC system FDPS. [19.4, 5]

The AGCS shall transfer requests from the ADS-ATC systems to the specified subject ADS-equipped aircraft to modify the emergency mode reporting rate. [19.8, 9]

ASSOCIATED CONTROLLER INTERACTIONS

The controller shall perform the acceptance action based on the information displayed to him. [7.2]

The controller shall inform the FDPS of his action. [7.3]

The controller shall have the ability to determine the display of figure of merit (or any ADS information not permanently displayed) of an ADS-equipped aircraft. [11.3]

The controller shall have the ability to modify the ADS agreement as required by the circumstances. [12.5]

The releasing and accepting controllers shall effect the transfer of control and communications. [13A.10, 11] and [13B.8, 9]

The releasing controller shall advise the pilot of the change of control authority. [13A.12] and [13B.10]

The controller shall have the ability to initiate the transfer of control and communication as required. [14.5]

The controller will recognize situations requiring data link messages to the pilot. [15B.1]

The controller shall identify emergency or urgent, non-routine, safety-related situations requiring voice communication with the pilot. [16B.1]

The controller shall use a simple action to initiate voice communications with the pilot. [16B.2]

FLIGHT DATA PROCESSING SYSTEMS

Each relevant FDPS shall extract ADS and data link capabilities from the filed flight plan (FPL) of the ADS-equipped aircraft. [1.2]

The FDPS shall accept the log-on request from the aircraft. [2A.4]

The FDPS shall maintain a correlation table of ACIDs and aircraft identifiers. [2A.5.b, 2B.6.b]

The FDPS shall correlate the aircraft-unique identifier with the aircraft identification. [2A.5.a]

The FDPS shall respond to a log-on request. [2A.6, 7]

The FDPS shall confirm the correlation between the aircraft-unique identifier and the aircraft identification. [2A.6.a]

The FDPS shall accept 'ACK' messages from the ADS-equipped aircraft's avionics for log-on request. [2A.8, 9]

The FDPS shall identify when it is needed to establish data link connection with an aircraft. [2B.1]

The FDPS shall have the capability to send a log-on request message. [2B.2, 3]

The FDPS shall accept the log-on request from the responding aircraft with its current position. [2B.4, 5]

The FDPS shall confirm the correlation of the aircraft-unique identifier stored in its data base. [2B.6a]

The FDPS shall update its data base using the position and other information transmitted by the aircraft. [2B.6b]

The FDPS shall have the capability to acknowledge the effective log-on. [2B.7, 8]

The FDPS will use FPL information to identify each flight's ADS capability, data link capability, voice capability, and record 24-bit address if applicable. [3.1]

The FDPS must also hold and maintain current information of a flight's communications and surveillance capabilities. [3.2]

The FDPS shall identify the need to confirm an aircraft's 4-D path a parameter time before the aircraft enters ADS-ATC airspace. [4.1]

The FDPS shall have the ability to request the projected 4-D profile from ADS-equipped aircrafts' avionics systems. [4.2, 3]

The FDPS shall have the ability to receive a projected 4-D profile requested from ADS-equipped aircraft. [4.4, 5]

The FDPS shall compare 4-D profiles received from ADS-equipped aircraft with its knowledge of the aircraft's flight profile. [4.6]

The FDPS shall determine if the profile is acceptable. [4.6]

The FDPS shall identify and allocate an ADS agreement for the aircraft based on current flight plan, information obtained from the aircraft and ATM requirements for the prevailing, dynamic ATC situation. [5.1]

The FDPS shall generate and transmit ADS agreement requests to the avionics of the appropriate aircraft. [5.2, 3]

The FDPS shall acknowledge acceptance of the ADS agreement upon receipt of an ADS acceptance message from the avionics. [5.4, 5]

The FDPS shall have the ability to acquire ADS reports sent from ADS-equipped aircraft avionics for flight-following planning. [6.2 3]

The FDPS shall use ADS reports to update its flight database. [6.4]

The FDPS will probe to ensure entry conditions into the subject airspace remain acceptable. [6.4]

The FDPS will be capable of presenting the up-dated position of the aircraft which will be made available to the controller. [6.5]

The FDPS shall identify the need to display the final flight details of an aircraft for acceptance. [7.1]

The FDPS shall update its data base to reflect the acceptance of the aircraft by the controller. [7.3]

The FDPS shall display the current flight details, including the FOM, to the appropriate controller. [7.1]

The FDPS shall identify the controller to whom it will display the flight details. [7.1]

The FDPS shall update the display to indicate the cleared status. [7.4]

The FDPS shall generate an acceptance message to the offering agency if required byboundary agreement. [7.5]

The FDPS shall be aware of the boundary agreement. [7.5]

The FDPS shall transmit the acceptance message to the offering agency. [7.6; 7]

The FDPS shall transmit the appropriate clearance to the aircraft. [7.8, 9, 10]

The FDPS shall be aware of the intended point of entry of the aircraft. [8.1]

The FDPS shall recognize when an aircraft is entering the ADS-ATC airspace. [8.1]

The FDPS of the accepting unit shall have the ability to receive ADS reports from the ADS-equipped aircraft's avionics as requested by the current ADS agreement. [8.2, 3]

The FDPS shall have the ability to modify the ADS agreement of the entering aircraft as required once the aircraft is within the jurisdiction of the controller. [8.4, 5]

The FDPS shall have the ability to register the ADS-equipped aircraft's avionics confirmation of acceptance and accept the avionics' new responses to any new ADS agreement. [8.6, 7]

The FDPS shall receive and process ADS reports containing the flight projected profile block. [9.2, 3]

The FDPS shall compare the projected profile reported by the aircraft with the projected profile stored in the FDPS. [9.4]

The FDPS shall generate and display appropriate messages to the controller where there is an inconsistency between the reported projected profile and the data held in the FDPS. [9.5]

The FDPS shall receive and process ADS reports transmitted by the ADS-equipped aircraft's avionics. [10.2, 3]

The FDPS shall compare the aircraft 4-D position with the 4-D position predicted by the FDPS. [10.4]

The FDPS shall generate appropriate messages to the controller when the 4-D position in the ADS report does not conform to the predicted 4-D FDPS position. [10.5]

The FDPS shall have the ability to acquire the ADS position sent by ADS-equipped aircraft. [11.1.a]

The FDPS shall have the ability to process the ADS position sent by ADS-equipped aircraft. [11.1.b]

The FDPS shall have flight profile information on the known traffic in or entering the ADS-ATC airspace. [11.1.c]

The FDPS shall have access to a meteorological model suitable for achieving the tracking objectives. [11.1.c]

The FDPS shall have tracking capabilities to extrapolate the ADS-equipped aircraft's position, based on previously received ADS position reports for that aircraft. [11.1.c]

The FDPS shall have the ability to carry out conflict probe. [11.1.d]

The FDPS shall have the ability to update the controller's display using ADS reports. [11.2.a]

The FDPS shall have the ability to display to the controller warnings generated by conflict probe. [11.2.b]

The FDPS shall have the ability to display to the controller alternative clearances to resolve detected conflicts. [11.2.b]

The FDPS shall have the ability to display the figure of merit (or any ADS information not permanently displayed) of an ADS-equipped aircraft when requested by the controller. [11.3, 4]

The FDPS shall receive and process ADS messages generated by the aircraft in accordance with ADS agreements. [12.2, 3]

The FDPS shall process ADS reports based on the following priority [12.4]:

1) emergency;

2) "out-of-conformance"* reports,

3) other ADS reports.

The FDPS shall be capable of generating and transmitting messages to the aircraft to modify the ADS agreements as needed by the controller. [12.5, 6, 7]

The FDPS shall have access to the details of the boundary. [13.A.1.a, 13.B.1.a]

The releasing FDPS shall have the ability to send the receiving ADS-ATC unit's FDPS a co-ordination message concerning the aircraft to be transferred. [13A.2, 3]

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*Out-of-conformance variance parameters are defined under Operational Requirement 17.

The releasing FDPS shall have the ability to send the receiving ADS-ATC unit's FDPS the co-ordination message followed by ADS data concerning the aircraft to be transferred. [13B.2, 3]

The releasing FDPS shall have the ability to instruct the aircraft to establish a connection with the accepting ADS-ATC unit. [13A.4, 5]

The releasing FDPS shall have the ability to display to the releasing controller the information pertaining to the approach of the ADS-equipped aircraft to the transfer point. [13A.6] and [13B.4]

The accepting FDPS shall have the ability to display to the accepting controller the information pertaining to the approach of the ADS-equipped aircraft to the transfer point. [13A.7] and [13B.5]

The accepting FDPS shall have the ability to request the establishment of a data link with the aircraft. [13A.8, 9a] and [13B.6, 7a]

The accepting FDPS shall have the ability to establish an ADS agreement with the aircraft. [13A.8, 9b] and [13B.6, 7b]

The releasing FDPS shall have the ability to receive and process the releasing controller's notification of the control authority and to transmit the relevant messages to the pilot via the ADS-ATC aircraft's avionics. [13A.12, 13, 14, 15] and [13B.10, 11, 12, 13]

The releasing FDPS shall have the ability to terminate its ADS agreement(s) with the transferred aircraft at the appropriate time or place as designated in the ADS agreement. [13A.16 17] and [13B.14, 15]

The accepting FDPS shall have the ability to send the releasing ADS-ATC unit's FDPS ADS data concerning the aircraft until no longer required by the boundary agreement. [13B.16, 17]

The FDPS shall have access to the details of the boundary agreement. [14.1.a]

The FDPS shall have the ability to select the boundary agreement appropriate to the route/level of the ADS-equipped aircraft. [14.1.b]

The FDPS shall have the ability to send to the receiving non-ADS-ATC unit the EST message for the ADS- equipped aircraft to be transferred. [14.2.a, 3]

The FDPS shall have the ability to inform the controller of the approach by the ADS-equipped aircraft of the transfer point or area. [14.4]

The releasing FDPS shall have the ability to receive and process the releasing controller's initiation of the transfer of control and communications in accordance with current letters of agreement between the units. [14.5]"

The releasing FDPS shall have the ability to advise the pilot of the ADS-equipped aircraft of the change of control authority. [14.6, 7, 8]

The FDPS shall have the ability to terminate all ADS agreements with the transferred ADS-equipped aircraft. [14.12, 13, 14]

The FDPS shall receive and process data link messages sent from data link-equipped aircraft under the ADS-ATC unit's control. [15A.3, 4]

The FDPS shall display the message to the controller. [15A.5]

The FDPS shall allow a controller to create a data link message using either the defined message set or free text message, or a combination of both. [15B.2]

The FDPS shall generate and transmit the data link message to the appropriate aircraft's avionics. [15B.3, 4]

The FDPS shall preempt other data link communications if an emergency status arises. [16A.3, 4, 5]

The FDPS shall provide a simple mechanism to initiate establishment of direct controller-pilot voice communications. [16B.2, 3, 4, 5]

The FDPS shall have the ability to confirm the availability of direct pilot-controller voice communications to the controller. [16B.6]

The FDPS shall determine the flight conformance criteria applicable to the airspace and phase of flight. [17.1]

The FDPS shall generate within the ADS agreement the reporting criteria. [17.2]

The FDPS shall receive ADS reports for the specific flight variance. [17.6]

The FDPS shall have the ability to receive ADS reports for the navigation capability change. [18.2, 3]

The FDPS shall have the ability to recognize aircraft's change of figure of merit status. [18.4]

The FDPS shall have the ability to alert the controller of the change of status of the aircraft's navigational capabilities. [18.5]

The FDPS shall have the ability to receive and process emergency mode report messages and alert the controller. [19.5, 6]

The FDPS shall have the ability to modify the emergency reporting rate. [19.7, 8]

When an emergency report mode is declared, the FDPS shall have the ability to hold any existing periodic contract with that aircraft in abeyance and modify the contract to default emergency periodic contract. [19.10a]

When the emergency mode ends, the FDPS shall reinstate the periodic contract which existed just prior to the declaration of the emergency mode. [19.10b]

Ground-ground communications subsystem (GGCS)

The GGCS shall exchange digital interface messages identified in support of the FDPS requirements identified above.

The GGCS shall disseminate FPLs for ADS-equipped aircraft from the pilot to appropriate ADS-ATC units. [1.2]

The GGCS shall transfer acceptance messages to offering ATC units. [7.6, 7]

The GGCS shall transfer co-ordination messages concerning the aircraft to be transferred between the releasing FDPS and the receiving ADS-ATC unit's FDPS. [13A.2, 3] and [13B.2, 3]

The GGCS shall transfer all messages between the releasing and accepting controllers via their respective FDPSs to effect the transfer of control and communications. [[13A.10, 11] and [13B.8, 9]

The GGCS shall transfer ADS data concerning the aircraft being transferred between the accepting FDPS and the releasing ADS-ATC unit's FDPS until no longer required by the boundary agreement. [13B.16, 17]

The GGCS shall transfer co-ordination messages concerning ADS-equipped aircraft to be transferred between the releasing ADS-ATC unit's FDPS and the receiving non-ADS-ATC unit. [14.2, 3]

Associated pilot interactions

The pilot shall include information regarding ADS and data link capability in the FPL. [1.1]

The pilot or the avionics shall be required to initiate the log-on procedure at a given time (t2A.1) before an ADS-equipped aircraft enters an ADS-ATC airspace. [2A.1, 2]

The pilot shall register that clearance to the aircraft to enter ADS-ATC airspace has been granted. [7.8, 9, 10]

The pilot shall register the change of control authority. [13A.12, 13, 14, 15] and [13B.10, 11, 12, 13]

The pilot shall register the change of control authority advised by the releasing ADS-ATC unit's FDPS. [14.6, 7, 8]

The pilot shall be required to establish contact with the accepting non-ADS-ATC unit, using normal communication procedures. [14.9, 10, 11]

The pilot shall recognize situations requiring a data link message to the controller. [15A.1]

The pilot shall be required to initiate a data link message ;using either a defined message set or a free text message or a combinaiton of both. [15A.2]

The pilot shall register a defined set of free text messages displayed by the avionics and sent by the controller over a data link. [15B.5]

The pilot shall identify emergency or urgent, non-routine, safety-related situations requiring voice communication with the controller. [16A.1]

The pilot shall use a simple action to initiate voice communications with the controller. [16A.2]

When the pilot identifies an emergency situation requiring ATC alerting, he will use a simple action to initiate the emergency mode. (19.1, 2]

GENERAL REQUIREMENTS

The availability of a voice link will be made apparent to the pilot. [16A.6]

The availability of a voice link will be made apparent to the controller. [16B.5]

PART I – AUTOMATIC DEPENDENT SURVEILLANCE

CHAPTER 5. DATA LINK REQUIREMENTS FOR ADS

5.1 REQUIREMENTS

[*Note: The following material, and that in the associated Appendices A, B, and C to this chapter, is extensively based on* MOPS for ADS, *developed by RTCA SC-170.*]

5.1.1 **General**

5.1.1.1 This chapter describes the operating method and related data link communications requirements for the automatic dependent surveillance application.

5.1.2 **Scope and objectives**

5.1.2.1 The application encompasses the information exchanges required for the surveillance of aircraft, normally in non-radar airspace, based on FDPS-controlled automatic reporting of aircraft-derived data regarding position, intent and related flight information.

5.1.2.2 The primary objective of the ADS application is to provide aircraft position data for maintaining safe separation of aircraft and to allow improved airspace capacity and more efficient utilization.

5.1.3 **Operating method**

5.1.3.1 ADS contract requests will typically be initiated, within the FDPS, by knowledge of flight progress into various airspace situations, as sensed by the FDPS based on information from flight plans, progress reports and/or ADS reports.

5.1.3.2 After valid ADS application process addresses are exchanged between aircraft and the FDPS, the appropriate ATS facility will be enabled to establish a connection with the ADS-capable aircraft. After the aircraft accepts the connection request, ADS contracts can be established. The termination of the connection is normally initiated by the ATS facility.

5.1.3.3 The aircraft is also capable of terminating the connection. Details of connection termination processes are given in Appendix B to this chapter.

5.1.3.4 Table 5.1-1 details the expected message exchange rate in the four environments specified by the global co-ordinated plan for transition to the CNS/ATM Systems by FANS (II)/4. The rates shown are the expected averages, per flight.

	Oceanic-continental enroute low density	Oceanic high-density	Continental high-density	Terminal area high-density
Periodic contract request	1 to 3 per FIR *	1 to 2 per FIR *	1 to 2 per FIR *	1 to 2 per FIR *
Event contract request	1 per FIR	1 per FIR	1 per FIR	1 per FIR
Cancel contract request	2 per FIR	2 per FIR	2 per FIR	2 per FIR
ADS periodic report (with basic ADS block)	1 every 5 to 20 min *	1 every 1 to 5 min. *	1 every 10 s. to 5 min. *	1 every 4 to 10 s. *
Air and/or ground vector blocks in ADS periodic report	1 every 10th report.	1 every 4th report	1 every 4th report	1 every 4th report
Meteorological information block in ADS periodic report	1 per way-point, or 1 per hour, for designated aircraft	1 per way-point, or 1 per hour, for designated aircraft	1 per way-point, or 1 per hour, for designated aircraft	Negligible
ADS event report with projected profile	1 per way-point	1 per way-point	1 per way-point	1 per way-point
ADS demand report with extended projected profile	1 per FIR	1 per FIR	1 per FIR	1 only
Other ADS Messages	Under exceptional conditions	Under exceptional conditions	Under exceptional conditions	Under exceptional conditions

Table 5.1-1. Exchange rates expected for ADS messages (of various types, for various airspaces)

*Where ranges of values are shown, they reflect substantial uncertainty in the expectations. They do not merely reflect expected variation among data contributing to the averages.

5.1.4 Expected benefits

5.1.4.1 Benefits will include enabling of tactical control, reduction of horizontal separations (in non-radar airspaces) and improved tracking based on reporting of aircraft intent data (in radar airspaces).

5.1.5 Information exchanges

5.1.5.1 Air-ground message flows required for each type of air-ground ADS information exchange are defined in Appendix B to this chapter — ADS Service Descriptions.

5.1.5.2 Each connection shall be capable of supporting a periodic contract, an event contract, or an event contract and a periodic contract. The ADSF shall support any number of demand contracts on each connection without altering any existing contracts. In addition, a single aircraft may have connections with up to four ATS units.

5.1.5.3 The message flow diagram for connection initiation is shown in Figure 5.1-1. The messages are identified as follows:

1: FPL
2: "Connection Request" (ATN protocol)
3: "Connection Confirm" (ATN protocol)
4: any ADS message

The transmission of message 2 shall require receipt of message 1.

The transmission of message 3 shall require receipt of message 2.

The transmission of message 4 shall require receipt of message 3.

5.1.5.4 A separate process will be employed to disseminate aircraft ADS application addresses to ATC facilities.

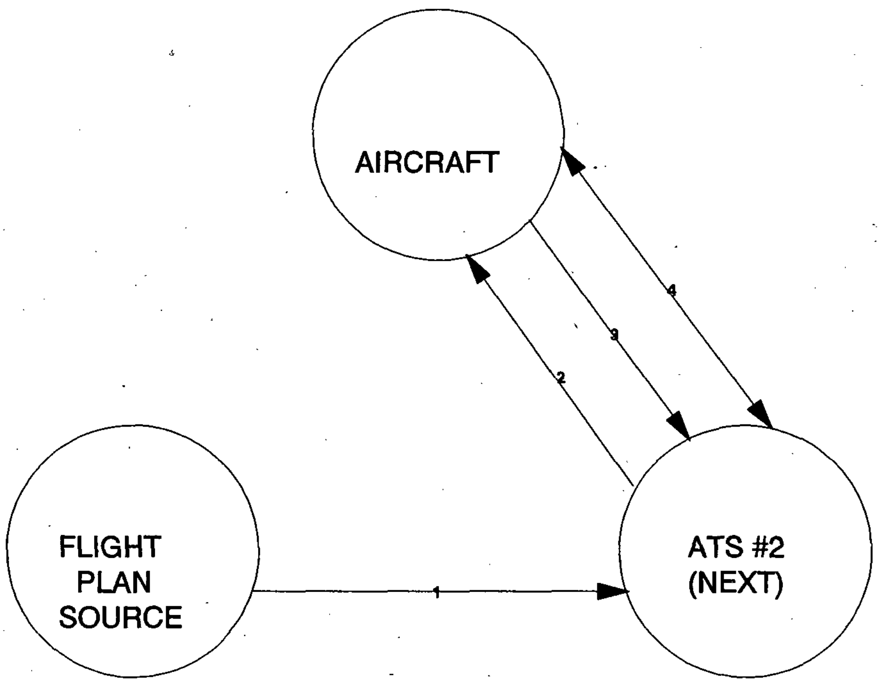


Figure 5.1-1. ADS connection initiation

5.1.5.5 Any ATC facility may initiate a connection with a given aircraft, provided that the aircraft does not have current ADS connections with four ATC facilities already. Procedures shall be established to ensure that only proper ATC facilities initiate ADS connections with a given aircraft.

5.1.5.6 When establishing a connection, the ATC facility shall provide a message with the [icaofacilitydesignation][tp4table] message element only as user data in the "Connection Request". The [icaofacilitydesignation] variable shall reflect the appropriate ATC facility information and the [tp4table] shall reflect the level of required performance.

5.1.5.7 Figure 5.1-2 illustrates an ADS-capable aircraft with current connections to two ATC units (solid lines, each labelled "1"). The controlling ATC unit can send an FPL or CPL (solid lines labelled "2") to the ATC units which will have future control of the aircraft or which have an interest due to the proximity of the aircraft to the ATC unit's FIR. The dashed lines labelled "1" and "2" depict future contract capability. Assumptions of this figure are:

1) local agreements are in place for when to send FPL/CPL to neighbouring ATC units which are not controlling the aircraft; and

2) local agreements are in place for when a neighbouring ATC unit, which is not controlling the aircraft, can establish/end ADS connections and contracts with that aircraft.

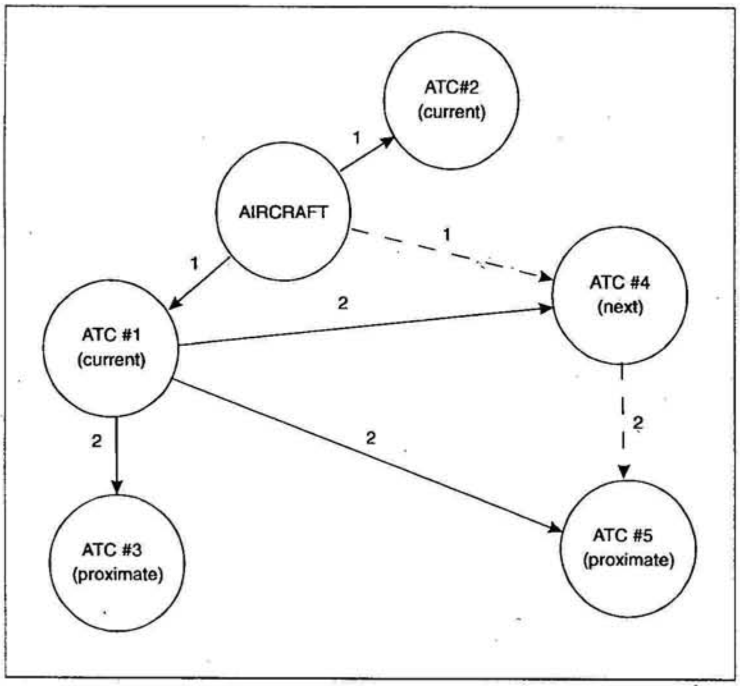


Figure 5.1-2. Multiple ADS contracts

5.1.5.8 There may be times when more than four ATC units require ADS report information. ADS report messages received from an aircraft can be forwarded to neighbouring ATC units. This is illustrated in Figure 5.1-3. In this figure, the solid line labelled "1" depicts an ADS report message. ATC unit #1 receives the report and forwards it to neighbouring ATC units, which is the solid line labelled "2". The dashed lines labelled "1" and "2" represent a future contract connection and forwarding of the ADS report message, respectively. Underlying assumptions of this figure are:

1) local agreements are in place for when to send the ADS ground-ground message to other ATC units (these agreements state the maximum acceptable delay from when the ATC unit receives the ADS report from the aircraft until that report is sent to the other ATC units);

2) if a local agreement is in place, it shall be assumed that the ADS report is forwarded at the same rate as the ADS contract with the aircraft; and

3) local system interfaces support total system performance requirements for ground-ground dissemination.

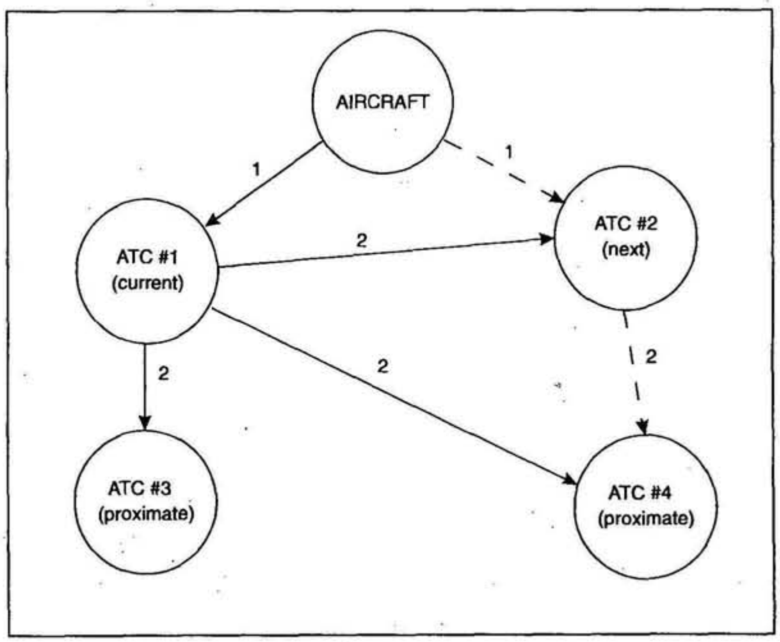


Figure 5.1-3. ADS report ground dissemination

5.1.5.9 Table 5.1-2 identifies the exchange requirements for each ADS message type.

Message	Purpose	Triggering Event	Source/ Destination	Transfer Time*	Comms Failure Notification Time*
Periodic contract request	Request establishment of routine ADS reporting contract; specify what data are to be reported and at what rate	Airspace proximity, changing airspace conditions	FDPS/avionics	15 sec	75 sec
Event contract request	Request establishment of event-triggered ADS reporting contract; specify certain flight conditions under which relevant data blocks shall be reported	Airspace proximity, changing airspace conditions	FDPS/avionics	15 sec	75 sec
Non-compliance notification	Indicates that a valid contract request cannot be fully complied with and details why	Contract initiation, cancellation, modification	Avionics/FDPS	15 sec	75 sec
ADS report	Provide ADS data according to associated contract request. Also provides operating mode information (emergency/normal mode)	Contract conditions for initiating a report are met	Avionics/FDPS	0.4 to 5 seconds, as commensurate with periodic reporting rate and mode (emergency or normal)	2 to 25 sec
Cancel contract request	Request cancellation of a specific associated contract	Air traffic conditions no longer require certain reporting	FDPS/avionics	15 sec	75 sec
Cancel all contracts and terminate connection	Request cancellation of all associated contracts and terminate the ADS connection	Air traffic conditions no longer require any reporting nor communication via ADS to aircraft	FDPS/avionics	15 sec	75 sec
Cancel emergency mode request	Cancels previously declared emergency state	Emergency condition has passed or is no longer applicable	FDPS/avionics	15 sec	75 sec
Cancel emergency mode indication	Indicates cancellation of previously declared emergency state	Emergency condition has passed or is no longer applicable	Avionics/FDPS	15 sec	75 sec

Table 5.1-2. ADS message exchange requirements

Message	Purpose	Triggering Event	Source/ Destination	Transfer Time*	Comms Failure Notification Time*
Negative acknowledgement	Indicates that an error has been detected in an uplink message and details the nature of that error	Any uplink message	Avionics/FDPS	15 sec	75 sec
Acknowledgement	Indicates that a valid request has been received	Contract initiation, cancellation, modification Emergency mode cancellation	Avionics/FDPS	15 sec	75 sec

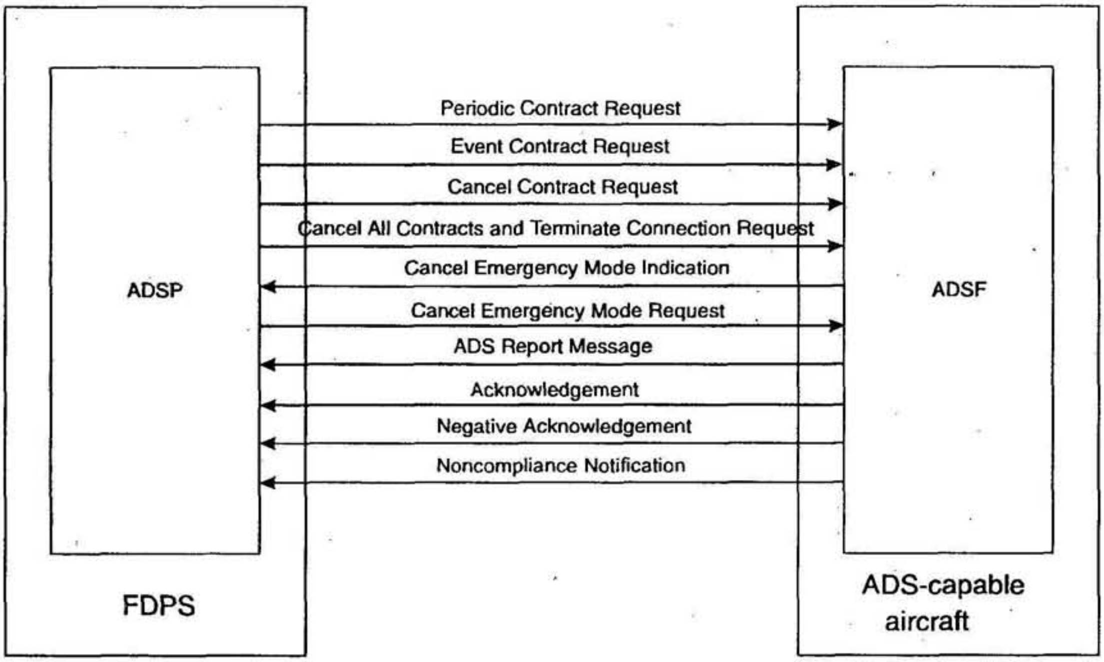
*Because all ADS messages between a particular FDPS and a particular aircraft will usually be exchanged over a single transport connection, the transfer time requirements are dictated by the message type which has the minimum time requirements: ADS report downlinks, including those for emergency mode reports, and periodic contract request uplinks.

Table 5.1-2. ADS message exchange requirements (Continued)

5.1.5.10 The FDPS or the aircraft can initiate a message exchange to accomplish a specific ADS function. The following ten messages are available on the FDPS-ADS interface:

a) periodic contract request;
b) event contract request
c) cancel contract request;
d) cancel all contracts and terminate connection request;
e) cancel emergency mode indication;
f) cancel emergency mode request;
g) ADS report;
h) acknowledge;
i) negative acknowledge; and
j) non-compliance notification.

5.1.5.11 The actual handling and processing of the messages are accomplished by the ADS processor (ADSP) within the FDSP and by the ADS function (ADSF) within the avionics. The ADSP handles the exchange of ADS messages for the FDPS for the purpose of establishing, modifying and cancelling reporting contracts with the ADS-capable aircraft. The ADSF handles the exchange of ADS messages for the aircraft for the purpose of providing data, derived from on-board navigation and position-fixing systems, to the FDPS. The various ADS messages are shown in Figure 5.1-4. Details of these messages and explanations of the corresponding open systems interconnection (OSI)-type services are described in Appendix B to this chapter.



Note: The model depicted is a conceptual model. It does not represent actual partitioning of application software.

Figure 5.1-4 ADS messages

5.1.6 Message contents

5.1.6.1 Table 5.1-3 identifies the content of each ADS message type. Appendix C to this chapter defines message data elements, ranges and resolutions in detail. The abstract syntax notation one (ASN.1) representation of the communications data structures is contained in Appendix A to this chapter.

Message	Message Content
Periodic contract request	– Time period for basic reports – Identification of each additional data group to be reported, and period-modulus for each – Indication (period = 0) if demand (single) report is requested – Contract request number
Event contract request	– Identification of each type of flight event which should initiate basic reports: speed change, heading change, altitude variance, extended projected profile change, way-point change, FOM change. Identification of additional data groups, which are to be reported, is implied by the event type, as specified in Appendices C and D to this chapter. – Contract request number

Message	Message Content
Non-compliance notification	– Number of requested data block types which the aircraft is not able to provide – Identification of each such block type and reason: data undefined or data unavailable – Contract request number
ADS report	– Indication of aircraft emergency – Basic ADS block – Additional data blocks according to associated contract
Cancel contract request	– Contract request number
Cancel all contracts and terminate connection request	– Nil
Cancel emergency mode request	– Contract request number
Cancel emergency mode indication	– Nil
Negative acknowledgement	– Contract request number – Negative acknowledgement reason
Acknowledgement	– Contract request number

Table 5.1-3. Content of ADS message types (Continued)

5.1.7 Communication system interface

5.1.7.1 Priority

5.1.7.1.1 Given the ATN functionality concerning connections, all ADS connections shall be established utilizing a priority value representative of safety of flight priority. The transport priority value shall be three, with the allowance of the establishment of up to four ATS ADSP connections.

5.1.7.1.2 When the ADSF application receives a service request with a transport priority other than three, the ADSF application shall deny service. Application data uplinked on this connection shall not be processed by the ADSF.

5.1.7.2 The communication service shall provide:

a) guaranteed end-to-end message delivery;

b) indication of end-to-end failure; and

c) indication of failure to meet the quality of service (QOS) requirements per message.

5.1.7.3 QOS parameters shall be adapted to indicate the following preferences:

a) sequencing over transit delay;

b) transit delay over cost; and

c) cost over residual error probability.

5.1.7.4 The communication system utilized by ADS shall support a connectionless network layer over a connection-oriented transport layer.

5.1.8 **Information handling**

5.1.8.1 The end-systems handling priority of ADS messages shall be:

1) emergency (those ADS reports which indicate aircraft emergency mode);

2) messages (ADS reports) containing the projected profile group; and

3) other messages.

5.1.8.2 The respective urgency levels would be 1) critical, 2) urgent and 3) routine.

5.1.9 **Information security**

5.1.9.1 This information exchange, concerned with the control of aircraft in flight, is to be afforded the maximum security for authentication, access control and data integrity.

— — — — — — — —

APPENDIX A

TO PART I, CHAPTER 5

ADS MESSAGE STRUCTURE – ASN.1 REPRESENTATION

The following abstract syntax notation one (ASN.1) description of the ADS message user data serves to further describe the meaning of the ADS message data elements.

The following material is based extensively on ADS MOPS developed by RTCA SC-170, but contains substantial additions.

```
ads-messages    DEFINITIONS IMPLICIT TAGS          ::=

BEGIN

ADS-Uplink-Message                    ::= SET
{
        cancel-all-contracts          [1]     NULL                OPTIONAL,
        cancel-contract-request       [2]     Request-Number      OPTIONAL,
        cancel-emergency-mode         [6]     Request-Number      OPTIONAL,
        periodic-contract             [7]     Periodic-contract   OPTIONAL,
        event-contract                [8]     Event-contract      OPTIONAL,
        emergency-periodic-contract   [9]     Periodic-contract   OPTIONAL,
        reserved                      [255]   NULL                OPTIONAL
}

Periodic-contract                     ::= SEQUENCE
{
   Request-Number,
   SET
   {
                                          [11]    Reporting-Interval    OPTIONAL,
      flight-ID-modulus                   [12]    INTEGER (0..255)      OPTIONAL,
      projected-profile-modulus           [13]    INTEGER (0..255)      OPTIONAL,
      ground-vector-modulus               [14]    INTEGER (0..255)      OPTIONAL,
      air-vector-modulus                  [15]    INTEGER (0..255)      OPTIONAL,
      weather-modulus                     [16]    INTEGER (0..255)      OPTIONAL,
      airframe-ID-modulus                 [17]    INTEGER (0..255)      OPTIONAL,
      aircraft-intent-modulus             [21]    Navigational-Intent   OPTIONAL,
      extended-projected-profile-modulus  [31]    INTEGER (0..255)      OPTIONAL,
      reserved                            [255]   NULL                  OPTIONAL
   }
}
-- A modulus with a value of zero will cancel reporting of the particular group.
```

```
Reporting-Interval                      ::= CHOICE
{
   demand-contract-mode                 [0]     INTEGER (0..63),
   one-second-scale                     [1]     INTEGER (0..63),
       -- (1..63 sec)
   eight-second-scale                   [2]     INTEGER (0..63),
       -- (8 sec .. 8.4 min)                 :
   sixty-four-second-scale              [3]     INTEGER (0..63)
       -- (1.07 min .. 1 hr. 7.2 min)
}
-- If the scale bits are zero, then a single immediate response is being requested. Many timer
-- values can be specified using more than one scale. The choice of scale is then arbitrary.

Navigational-Intent                     ::= SEQUENCE
{
   intent-modulus                       INTEGER (0..255),
   intent-projection-time               INTEGER (0..255)
}
-- The intent-projection-time is relative to the current time stamp.

Event-contract                          ::= SEQUENCE
{
   Request-Number,
   SET
   {
      lateral-deviation-change          [10]    INTEGER (0..255)      OPTIONAL,
      vertical-rate-change              [18]    INTEGER (1..256)      OPTIONAL,
      -- unit = ft/min
      -- If present, a climb/descend report will be generated if the vertical acceleration
      -- exceeds the value specified.

      altitude-threshold                [19]    Altitude-range        OPTIONAL,
      --A level report will be generated if the level indication falls outside
      -- the range specified.

      way-point-change                  [20]    NULL                  OPTIONAL,
      air-speed-change                  [24]    INTEGER (0..255)      OPTIONAL,
      ground-speed-change               [25]    INTEGER (0..255)      OPTIONAL,
      heading-change                    [26]    INTEGER (0..255)      OPTIONAL,
      fom-change                        [27]    INTEGER (0..31)       OPTIONAL,
      track-angle-change                [28]    INTEGER (0..255)      OPTIONAL,
      altitude-change                   [29]    INTEGER (0..255)      OPTIONAL,
      extended-projected-profile-change [30]    INTEGER (1..20)       OPTIONAL,
      reserved                          [255]   NULL                  OPTIONAL
   }
}
```

```
level-range                          ::= SEQUENCE
{
   ceiling                           Level,
   floor                             Level
}

ADS-Downlink-Message                 ::= SET
{
   positive-acknowledgement          [3]     Request-number               OPTIONAL,
                                     [4]     Negative-Acknowledge         OPTIONAL,
                                     [5]     Noncompliance-Notification   OPTIONAL,
                                             ADS-report-type              OPTIONAL
}

ADS-report-type                      ::= CHOICE
{
   basic-ADS-report                  [7]     ADS-report                   OPTIONAL,
   emergency-ADS-report              [9]     ADS-report                   OPTIONAL,
   lateral-deviation-event           [10]    ADS-report                   OPTIONAL,
   vertical-rate-event               [18]    ADS-report                   OPTIONAL,
   level-range-deviation-event       [19]    ADS-report                   OPTIONAL,
   way-point-change-event            [20]    ADS-report                   OPTIONAL,
   air-speed-change-event            [24]    ADS-report                   OPTIONAL,
   ground-speed-change-event         [25]    ADS-report                   OPTIONAL,
   heading-change-event              [26]    ADS-report                   OPTIONAL,
   fom-change-event                  [27]    ADS-report                   OPTIONAL,
   track-angle-change-event          [28]    ADS-report                   OPTIONAL,
   altitude-change-event             [29]    ADS-report                   OPTIONAL,
   extended-projected-profile-event  [30]    ADS-report                   OPTIONAL,
   reserved                          [255]   NULL                         OPTIONAL
}

Negative-Acknowledge                 ::= SEQUENCE
{
   Request-Number,
   Reason
}

Reason ::= CHOICE
{
   duplicate-optional-group-tag             [1]   INTEGER (0..255),
   -- extension contains relative offset of duplicate tag
   duplicate-reporting-rate-tag             [2]   INTEGER (0..255),
   -- extension contains relative offset of duplicate tag
   empty-event-contract-request             [3]   NULL,
   improper-operational-mode-tag            [4]   NULL,
   unmatched-cancel-request-number          [5]   NULL,
   duplicate-request-number                 [6]   NULL,
   undefined-contract-type                  [7]   INTEGER (0..255),
   -- extension contains undefined type value (first octet of request)
```

```
   undefined-error                          [8]     NULL,
   not-enough-data                          [9]     NULL,
   level-error                              [10]    NULL,
   vertical-rate-error                      [11]    NULL,
   aircraft-intent-error                    [12]    NULL,
   lateral-deviation-error                  [13]    NULL,
   air-speed-change-error                   [14]    NULL,
   ground-speed-change-error                [15]    NULL,
   heading-change-error                     [16]    NULL,
   track-angle-change-error                 [17]    NULL,
   level-change-error                       [18]    NULL,
-- errors for air and ground speed, heading and track angle change are when threshold is 0
   reserved                                 [255]   NULL
}

Noncompliance-notification                  ::= SEQUENCE
{
   Request-number,
   SET OF                                   Message-group (SIZE (0..255))
}

Message-group                               ::= SEQUENCE
{
   message-group-tag                        INTEGER (0..255),
   undefined-flag                           BOOLEAN, -- false is unavailable
   entire-group-unavailable                 BOOLEAN, -- if true, then the following
                                                     -- parameter list must be empty
   SEQUENCE OF
   {
      parameter-number                      INTEGER (0..15)
   } SIZE (0..63)
      -- Using MBER, the number of parameters will fill the remainder of the octet
      -- with the two flag bits.
}

ADS-report                                  ::= SEQUENCE
{
   Basic-ADS,
   SET
   {                                        [12]    Flight-ID               OPTIONAL,
                                            [13]    Projected-Profile       OPTIONAL,
                                            [14]    Ground-Vector           OPTIONAL,
                                            [15]    Air-Vector              OPTIONAL,
                                            [16]    Weather                 OPTIONAL,
                                            [17]    Airframe-ID             OPTIONAL,
                                            [22]    Intermediate-Intent     OPTIONAL,
                                            [23]    Short-Term-Intent       OPTIONAL,
```

```
                                        [31]    Extended-Projected-Profile   OPTIONAL,
  reserved                              [255]   NULL                         OPTIONAL
  }
}
-- In the reporting of an event, the basic ADS group will report a position and time stamp
-- corresponding to the event that occurred. The time interval for generating the basic
-- ADS report will be reset, provided that all optional groups for the next basic report
-- is included in the event report. ADS report functional groupings

Basic-ADS                               ::= SEQUENCE
{
  Position,
  Time-Stamp,
  Figure-of-Merit
}

Position                                ::= SEQUENCE
{
  Latitude,
  Longitude,
  -- An invalid position is indicated both by a Latitude of -180 deg and a Figure of
  -- Merit Position accuracy of zero

  Level
}

Eta                                     ::=INTEGER (0..16383)
-- LSB=1 second; for projected profile, ETA at next way-point is relative to the current time stamp.
For
-- extended projected profile, ETA at next way-point is relative to the current time stamp. Any
following
-- ETAs at next way-points are relative to previous way-points

Figure-of-Merit                         ::= SEQUENCE
{
  reserved                              BIT STRING                   (SIZE (2)),
  multiple-nav-units                    BOOLEAN,
  Position-Accuracy,
  tcas-operational                      BOOLEAN
}

Projected-Profile                       ::= SEQUENCE
{
  next-way-point                        Position,
  next-time                             Eta,
  following-way-point                   Position
}
```

```
Ground-Vector                                ::= SEQUENCE
{
   valid-track                               BOOLEAN,
   track                                     INTEGER (-2048..2047),
   -- unit = 0.087890625 deg = 5.2734375 min,
   -- valid range (-180..179.9121094) east > 0

   ground-speed                              INTEGER (0..8191),
   -- invalid= 8191
   -- MSB = 2048 knots, unit= 0.5 knots
   -- valid range (0..4095) knots

   vertical-rate                             INTEGER (-2048..2047)
   -- invalid = -2048
   -- unit = 16 ft/min, climb > 0
   -- valid range (-32752..32752) ft/min
}

Air-Vector                                   ::= SEQUENCE
{
   valid-heading                             BOOLEAN,
   heading                                   INTEGER (-2048..2047),
   -- MSB (sign bit) =180 deg, unit = 0.087890625 deg = 5.2734375 min,
   -- valid range (-180..179.9121094), east > 0

   mach-or-ias                               INTEGER (0..8191),
   -- invalid = 8191
   -- MSB = mach 2.048, unit = mach 0.0005
   -- valid range (0..4.095) mach

   vertical-rate                             INTEGER (-2048..2047)
   -- invalid = -2048
   -- MSB (sign bit) = 32768 ft/min, unit = 16 ft/min, climb > 0
   -- valid range (-32752..32752) ft/min
}

Weather                                      ::= SEQUENCE
{
   wind-speed                                INTEGER (0..511),
   -- invalid = 511, unit = 0.5 knots, valid range (0..255) knots

   valid-wind-direction                      BOOLEAN,

   wind-direction                            INTEGER (-256..255),
   -- unit = 0.70 deg, valid range (-179.3..179.3) degrees

   temperature                               INTEGER (-2048..2047)
   turbulence                                INTEGER (0..15)
}
```

```
Intermediate-Intent                 ::= SEQUENCE
{
   distance                         INTEGER (0..65535),

   valid-track                      BOOLEAN,
   track                            INTEGER (-2048..2048),
   -- MSB (sign bit) = 180 deg, unit = 0.87890625 deg = 5.2734375 min,
   -- valid range (-180..179.9121094) east > 0

   Level,
   projected-time                   INTEGER (0..16383)
}

Short-Term-Intent                   ::= SEQUENCE
{
   Position,
   projected-time                   INTEGER (0..16383)

Extended-Projected-Profile          ::=SEQUENCE
{
   number-of-way-points             qqqqqqqqq    ::=INTEGER (1..20),
   POSITION-TIME-BLOCK              ::=SEQUENCE SIZE (1..20) OF SEQUENCE
   {
      next-way-point                Position,
      next-time                     Eta
   }
}

}--   PRIMITIVE ELEMENT DEFINITIONS

Request-Number                      ::= INTEGER (0..255)
   -- TBD: It may be necessary to prohibit the use of 255 in periodic contract requests, to ensure that
      emergency mode contracts, which have a default contract number of 255, will not be
      inadvertently cancelled.

Time-Stamp                          ::= INTEGER (0..32767)
   -- UTC modulo 1 hour
   -- MSB = 2048 sec, unit = 0.125 seconds, invalid = 4095.875 seconds

Latitude                            ::= INTEGER (-524288..524288)
   -- valid range (-90..90), invalid = -180 degrees, north > 0

Longitude                           ::= INTEGER (-1048576..1048576)
   -- valid range (-180..179.9998283), east > 0
   -- An invalid longitude is indicated by a corresponding invalid latitude

Flight-ID                           ::= IA5String              (SIZE(8))
   -- Field 7 of ICAO flight plan or aircraft registration number. Left justified string
   -- of 6-bit ASCII characters. This may be supported either with Minimum Bit
   -- Encoding Rules or by defining the 6 bit code set.
```

```
Airframe-ID                          ::= BIT STRING               (SIZE(24))
   -- 24 bit ICAO airframe identifier

Altitude ::= INTEGER (-32768..32767)
   -- unit = 4 feet, invalid = -32768
   -- valid range (-131068..131068)

Position-Accuracy                    ::= ENUMERATED
{
   complete-loss                     (0),
   under30nm                         (1),
   under15nm                         (2),
   under8nm                          (3),
   under4nm                          (4),
   under1nm                          (5),
   under-25nm                        (6),
   under-05nm                        (7)
}

END
```

– – – – – – – –

APPENDIX B

TO PART I, CHAPTER 5

ADS SERVICE DESCRIPTIONS

5.B.1 Overview

Message transmission between the ADSP and the ADSF are described in terms of OSI model services. A service user is the requesting initiator of a particular task. A service provider performs the actual requested task. Therefore, a service is invoked by a user in order to have the provider accomplish a specific ADS function.

Application services for transferring information between the FDPS and an ADS-capable aircraft are described in an abstract notation format describing the operation being performed by the service in terms of the initiating message (argument) and the associated responses (result or error). The basic service procedure, which describes the service transaction (argument and associated result or error), is illustrated in Figure 5.B-1. If no response is expected from the service provider (i.e. there is no result nor error) then the service is said to be unconfirmed. Such a service is denoted by an "unconfirmed" suffix.

Transaction time 1 (t1) is the starting point of the service to be initiated. Transaction time 2 (t2) is the time it takes to transmit the message over the communication service provider from the initiator to the recipient. Transaction time 3 (t3) is the application time it takes the recipient to process the incoming message and produce a positive or negative acknowledgment. Transaction time 4 (t4) is the time it takes to transmit the acknowledgment over the communication service provider to the service initiator.

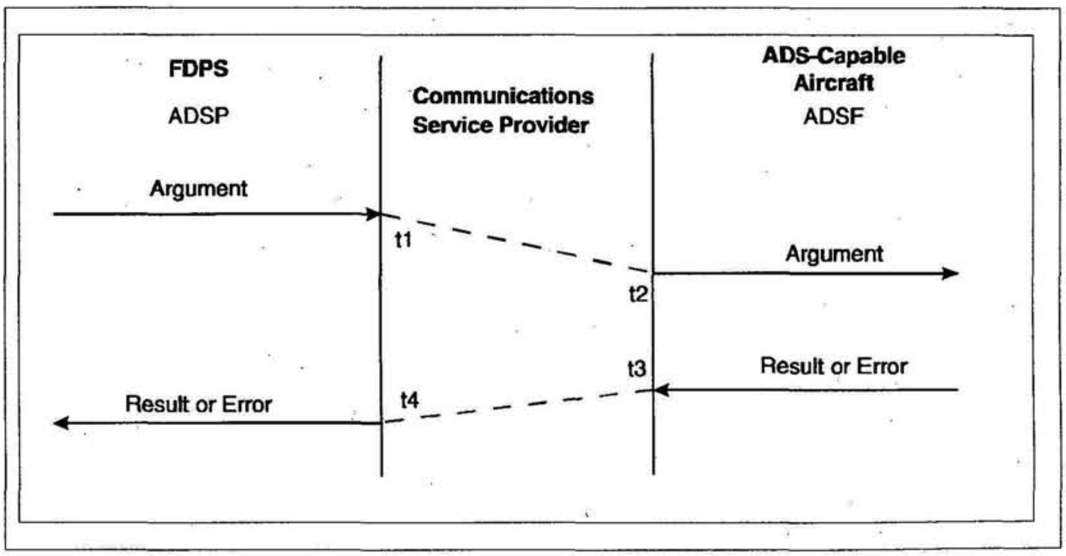


Figure 5.B-1. Basic application service procedure

The following seven services are available on the ADSP-ADSF interface:

a) submit periodic contract;

b) submit event contract;

c) cancel contract;

d) cancel all contracts and terminate connection;

e) cancel emergency mode indication unconfirmed;

f) cancel emergency mode; and

g) report position unconfirmed.

Details of each service are described in the following subsections.

5.B.2 Submit periodic contract service

The submit periodic contract (SubmitPeriodicContract) service is used by the FDPS to inform an aircraft how often an ADS report with desired options or on-request blocks of data is to be sent. This is accomplished by sending a periodic contract request (PCR) message with the desired on-request blocks and report intervals specified. A demand contract is a PCR with a zero-valued reporting interval. An emergency PCR is identical to the normal PCR, except for the ADS-request identifier. The PCR is used by the ADSF to determine which optional blocks (if any) are to be sent and the interval of the report transmissions. In the case of a demand contract, the reporting moduli specified in the contract request may have any values, and shall be considered valid, and shall be ignored by the avionics. The periodic contract remains in effect until it is cancelled or replaced with a new periodic contract.

a) *Service definition.* The service consists of a PCR argument, an acknowledge message (ACK), or a non-compliance notification message (NCN) result, and a negative acknowledge message (NAK) error. The abstract definition for this service is as follows:

SubmitPeriodicContract ::=	ABSTRACT-OPERATION
ARGUMENT	PCR
RESULTS	ACK
	NCN
ERROR	NAK

b) *Service procedure.* The SubmitPeriodicContract service is initiated when an FDPS issues a PCR to the ADS-capable aircraft. The aircraft subjects the PCR to source verification and syntax and format checks. If the message is found to be free of errors, the aircraft transmits an ACK. If the message is found to contain error(s), the aircraft transmits a NAK, indicating the error(s) to the FDPS. If the message contains a defined on-request block identifier that cannot now or ever be responded to because of data or function unavailability, or if the message contains an undefined on-request block identifier, the aircraft sends an NCN. Figure 5.B-2 illustrates the SubmitPeriodicContract service procedure.

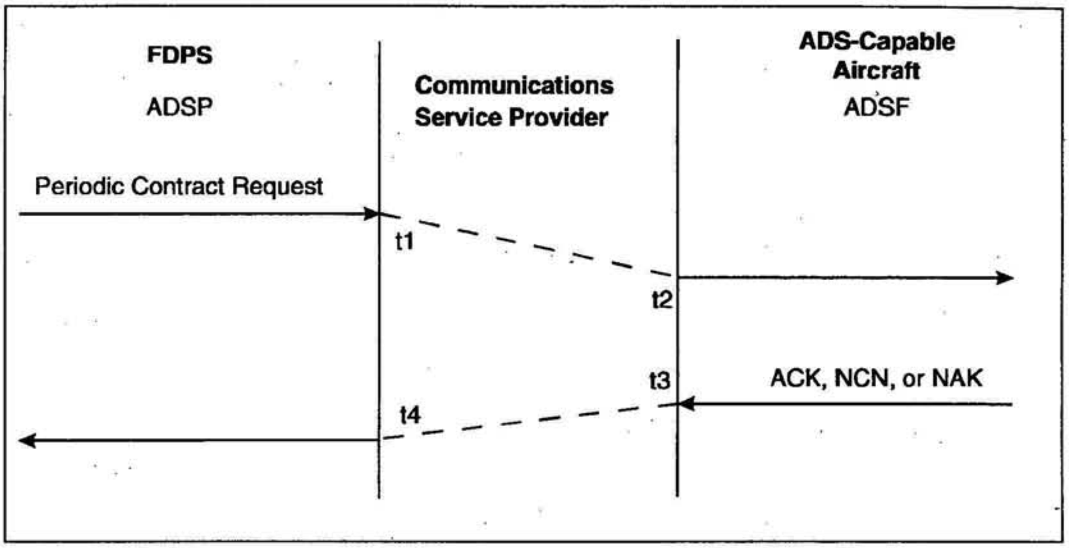


Figure 5.B-2. ATS-SubmitPeriodicContract service time-sequence diagram

c) *Conditions of transfer*. This service is initiated by the FDPS to start or modify a contract with an ADS-capable aircraft. After the FDPS invokes the SubmitPeriodicContract service, the aircraft sends the first report immediately and subsequent reports at specified intervals. When a periodic contract has been established on a connection that receives another periodic contract of the same operational mode, the existing contract is modified to reflect the optional data contained in the new periodic contract. The reporting rate is modified to reflect the new reporting rate or, if a reporting rate is not included, the default reporting rate. If an on-request block identifier which was not in the existing periodic contract is included, that block is added. If an on-request block identifier which was already in the existing periodic contract is included, the modulus for that on-request block is modified to reflect the new value. A modulus of zero causes reporting of that on-request block to cease.

A periodic contract remains in effect until it is cancelled or replaced with another periodic contract. A demand contract request (i.e. a PCR which contains a reporting rate octet with a scaling factor of zero) has no effect on other ADS contracts.

If an emergency mode is declared by the aircraft, a default emergency periodic contract is put into effect. This contract is defined as a periodic contract, with the default emergency reporting interval, containing the Basic ADS Block. The Flight Identification and Ground Vector Blocks are included with every fifth report, beginning with the first emergency report sent. The default emergency report period shall be the lesser of 50 per cent of the existing periodic contract reporting rate, or 64 seconds. When the default emergency contract is applied, the periodic reporting interval for a connection shall never be increased. The periodic contract that was in effect when the emergency mode was declared should be reinstated when the emergency mode ends.

d) *Sequence of services*. There is no relationship between the SubmitPeriodicContract and any other services described for this interface.

5.B.3 **Submit event contract service**

The submit event contract (SubmitEventContract) service is used by the FDPS to inform an aircraft about the conditions that will cause it to transmit a series of ADS reports. When a contracted event occurs, the avionics shall transmit an ADS report immediately. An event contract remains in effect until it is cancelled.

a) *Service definition.* The SubmitEventContract service consists of an event contract request (ECR) argument, an ACK or NCN result, and a NAK error. The abstract operation definition for this service is as follows:

SubmitEventContract	::=	ABSTRACT-OPERATION
ARGUMENT		ECR
RESULTS		ACK
		NCN
ERROR		NAK

b) *Service procedure.* The SubmitEventContract service is initiated when an FDPS issues an ECR argument to the ADS-capable aircraft. The aircraft subjects the ECR to source verification and syntax and format checks. If the message is found to be free of errors, the aircraft transmits an ACK. If the message is found to contain error(s), the aircraft transmits a NAK, indicating the error(s) to the FDPS. If the message contains a defined on-request block identifier that cannot now or ever be responded to because of data or function unavailability, or if the message contains an undefined on-request block identifier, the aircraft sends an NCN. Figure 5.B-3 illustrates the SubmitEventContract service procedure.

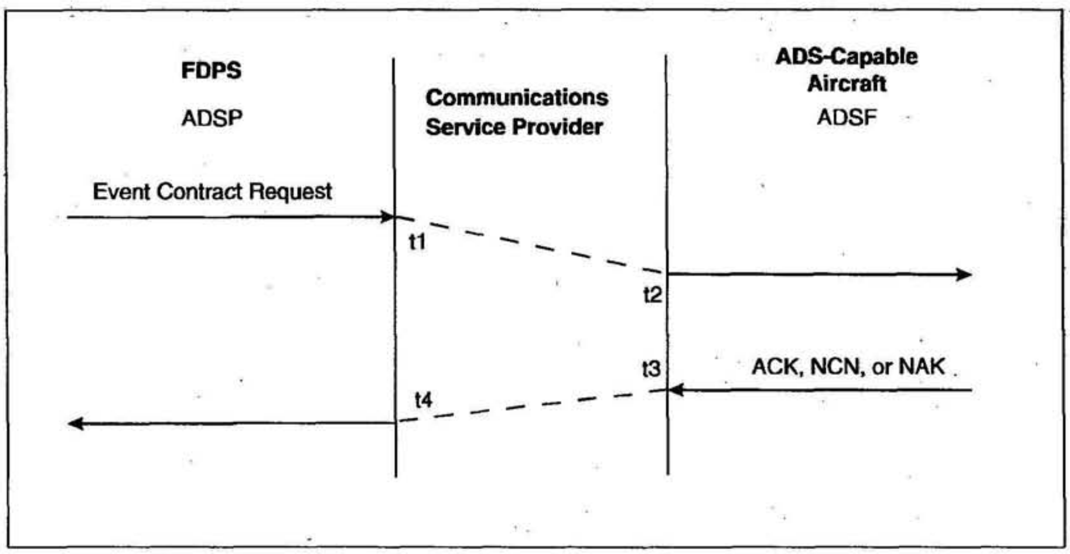


Figure 5.B-3. ATS-SubmitEventContract service time-service diagram

c) *Conditions of transfer.* This service is initiated by the FDPS to either start or update a contract with an ADS-capable aircraft. Once an event contract has been established, it remains in effect until it is cancelled. Event contracts are not modifiable. When an event contract has been established on a connection that receives another event contract, the existing contract is replaced by the new contract. Once an event contract is in effect, "change event" triggers remain armed, even after the associated events occur. The event contract is not affected by emergency mode operation.

d) *Sequence of services*. There is no relationship between the SubmitEventContract service and any other services described for this interface.

5.B.4 Cancel contract service

The cancel contract (CancelContract) service is used by the FDPS to cancel a contract between a particular aircraft and an FDPS.

a) *Service definition*. The service consists of a cancel contract request (CCR) argument, an ACK result and a NAK error. The abstract definition for this service is as follows:

```
CancelContract      ::=     ABSTRACT-OPERATION
     ARGUMENT               CCR
     RESULT                 ACK
     ERRORS                 NAK
```

b) *Service procedure*. The CancelContract service is initiated when the FDPS issues a CCR argument to the ADS-capable aircraft. The aircraft subjects the CCR to source verification and syntax and format checks. When the ADS-capable aircraft receives a CCR with a contract request number matching that of an active contract on the connection, the specified contract is cancelled and an ACK is returned to the FDPS. When the ADS-capable aircraft receives a CCR with a contract request number which does not match that of an active contract on the connection, a NAK is returned to the FDPS. Figure 5.B-4 illustrates the CancelContract service procedure.

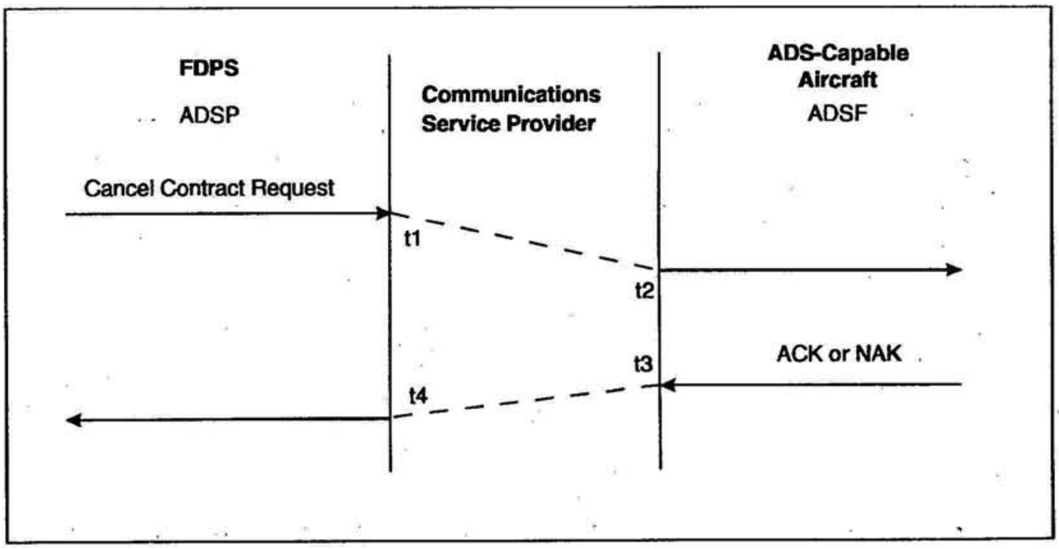


Figure 5.B-4. ATS-CancelContract service time-sequence diagram

c) *Conditions of transfer*. This service is initiated by the FDPS to cancel an existing event or periodic contract.

d) *Sequence of services*. There is no relationship between the CancelContract service and any other services described for this interface.

5.B.5 Cancel all contracts and terminate connection service

The cancel all contracts and terminate connection (CancelAllContractsAndTerminateConnection) service is used by the FDPS to cancel all existing contracts between an ADS-capable aircraft and an FDPS and terminate the connection.

a) *Service definition*. The service consists of a cancel all contracts and terminate connection request (CTC) message argument and a NAK error. The abstract definition for this service is as follows:

```
CancelAllContractsAnd
TerminateConnection    ::=  ABSTRACT-OPERATION
    ARGUMENT                CTC
     ERRORS                 NAK
```

b) *Service procedure*. The CancelAllContractsAndTerminateConnection service is invoked when the FDPS issues a CTC argument to the ADS-capable aircraft. The aircraft subjects the CTC to source verification and syntax and format checks. If the message is found to contain error(s), the aircraft transmits a NAK. If there is no error, the ADSF terminates the connection and does not respond. Figure 5.B-5 illustrates the CancelAllContractsAndTerminateConnection service procedure.

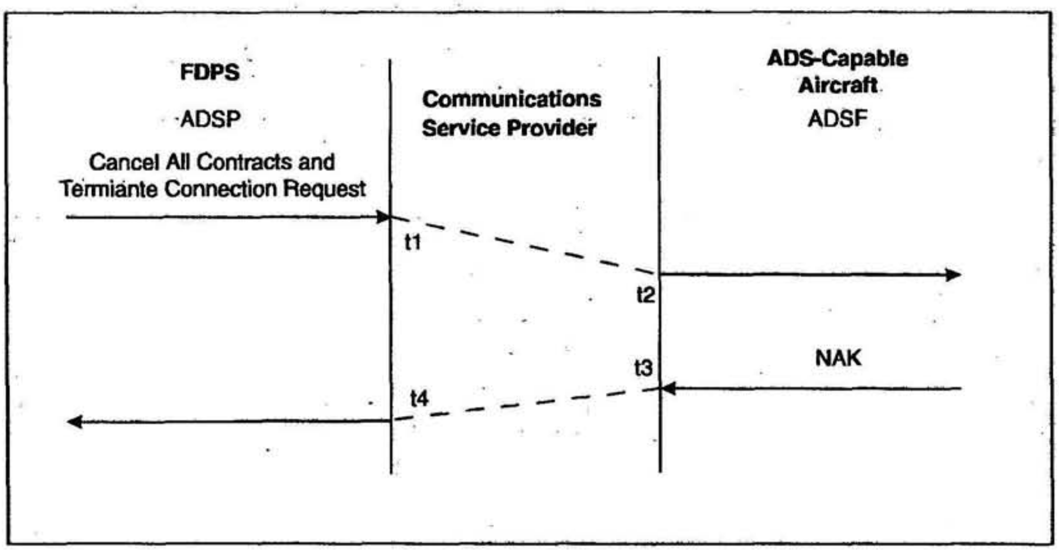


Figure 5.B-5. ATS-CancelAllContractsAndTerminateConnection service time-sequence diagram

c) *Conditions of transfer*. This service is initiated by the FDPS to cancel all existing contracts with a particular aircraft and terminate the connection.

d) *Sequence of services*. There is no relationship between the CancelAllContractsAndTerminateConnection service and any other services described for this interface.

5.B.6 Cancel emergency mode indication unconfirmed service

The cancel emergency mode indication unconfirmed (CancelEmergencyModeIndicationUnconfirmed) service is initiated by the flight crew of an ADS-capable aircraft to cancel a previously declared emergency situation. This service causes all emergency contracts in effect with a specific aircraft to be modified to the non-emergency contracts that were in effect before the emergency condition was declared.

a) *Service definition*. The service consists of a cancel emergency mode indication (CLI) argument. The abstract operation definition for this service is as follows:

```
CancelEmergencyModeIndication  ::=   ABSTRACT-OPERATION
    ARGUMENT                         CLI
```

b) *Service procedure*. This service is initiated when an ADS-capable aircraft sends a CLI with its next periodic report, changing the ADS report Identifier to non-emergency. The non-emergency periodic contract which was in effect prior to the emergency mode is reinstated. Figure 5.B-6 illustrates the CancelEmergencyModeIndicationUnconfirmed service procedure.

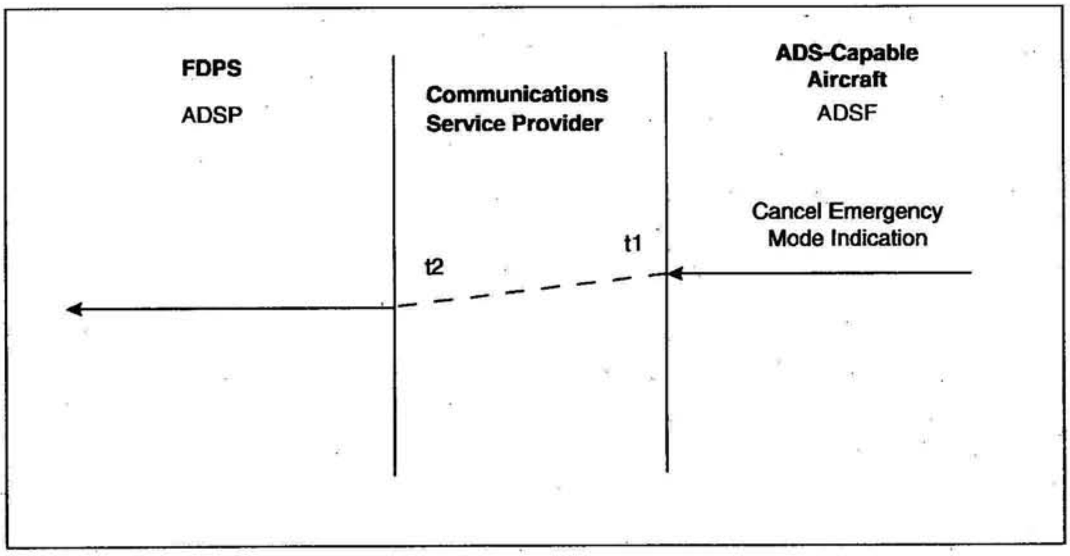


Figure 5.B-6. ATS-CancelEmergencyModeIndicationUnconfirmed service time-sequence diagram

c) *Conditions of transfer*. This service is initiated by the flight crew of an ADS-capable aircraft to cancel an existing emergency state.

d) *Sequence of services*. There is no relationship between the CancelEmergencyModeIndicationUnconfirmed service and any other service described for this interface.

5.B.7 Cancel emergency mode service

The cancel emergency mode (CancelEmergencyMode) service is used by the FDPS to end a previously declared emergency condition. Any periodic contracts that were in effect before the emergency condition was declared are reinstated. In order for the aircraft to declare another emergency condition after the CancelEmergencyMode service is invoked, the aircraft must first initiate a CancelEmergencyModeIndication service.

a) *Service definition.* The service consists of a cancel emergency mode request (CER) argument, an ACK result or a NAK error. The abstract definition for this service is as follows:

```
CancelEmergencyMode ::=  ABSTRACT-OPERATION
    ARGUMENT             CER
    RESULT               ACK
    ERRORS               NAK
```

b) *Service procedure.* The service is initiated when an FDPS issues a CER argument to the ADS-capable aircraft. The aircraft subjects the CER to source verification and syntax and format checks. If the message is in the proper format, the connection transitions to normal periodic contract mode and an ACK is included in the next periodic report. The periodic contract that was in effect prior to the emergency condition is reinstated. If the aircraft receives a CER while the connection is not in the emergency mode, a NAK is returned. Figure 5.B-7 illustrates the CancelEmergencyModeIndication service procedure.

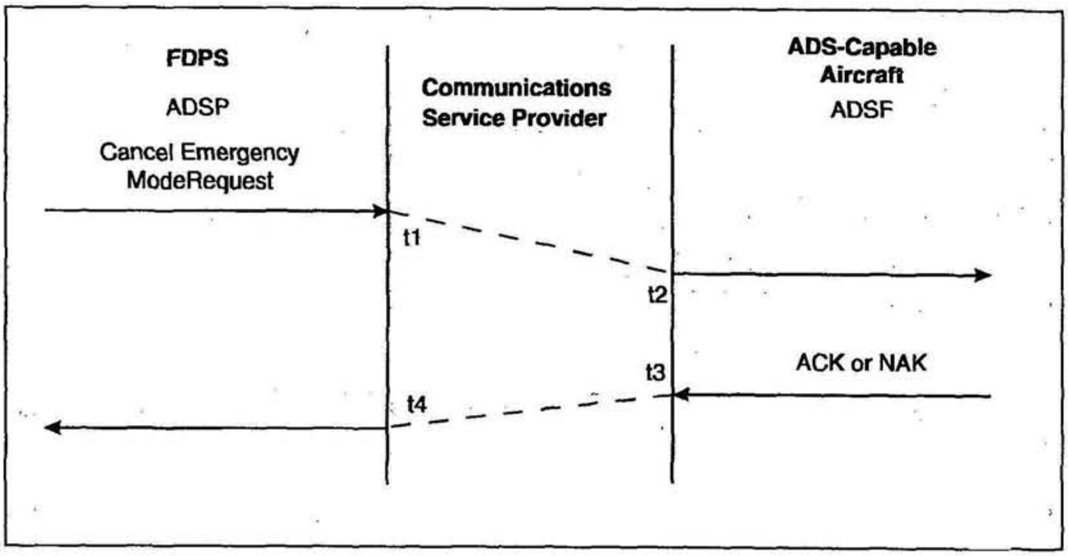


Figure 5.B-7. ATS-CancelEmergencyMode service time-sequence diagram

c) *Conditions of transfer.* This service is initiated by an FDPS to cancel an emergency reporting mode with a particular ADS-capable aircraft.

d) *Sequence of services.* There is no relationship between the CancelEmergencyMode service and any other services described for this interface.

5.B.8 Report position unconfirmed service

The report position unconfirmed (ReportPositionUnconfirmed) service is used by an ADS-capable aircraft to transmit position reports to the FDPS according to the terms of an individual contract established with a specific FDPS.

a) *Service definition*. The service argument consists of an ADS report message (ARM).

```
ADS-ReportPositionUnconfirmed  ::=   ABSTRACT-OPERATION
        ARGUMENT                     ARM
```

b) *Service procedure*. The service is initiated when the FDPS establishes a contract with an ADS-capable aircraft. The ARM is assembled and sent with the basic ADS block and all specified on-request blocks that can be complied with, according to the appropriate established contract and conditions. Figures 5.B-8 and 5.B-9 illustrate the ReportPositionUnconfirmed service for normal and emergency modes, respectively. Figure 5.B-8 shows the reports generated from a PCR, ECR and demand contract. In all cases, it is assumed that the contract request message is valid. Figure 5.B-9 illustrates the emergency mode case where first a legal emergency PCR is sent to the ADS-capable aircraft. This is handled exactly like a normal mode PCR during normal mode, and an emergency mode reporting contract is set up and executed. The other case shows what happens when a normal mode PCR is sent during an emergency mode. The normal mode PCR is NAK'd and a default emergency contract (see Submit periodic contract service) is set up and executed.

c) *Conditions of transfer*. The ReportPositionUnconfirmed service is initiated by an ADS-capable aircraft after receipt of a contract request from the FDPS. A periodic contract causes an ADS report to be transmitted immediately and then at pre-set intervals. An event contract specifies conditions of transmission. An ADS report will be transmitted when those conditions occur. An on-demand contract results in a single immediate transmission. Depending on the event that occurs, different on-request blocks shall be included with the basic ADS block.

d) *Sequence of services*. The ReportPositionUnconfirmed service must be initiated by a SubmitPeriodicContract or SubmitEventContract service.

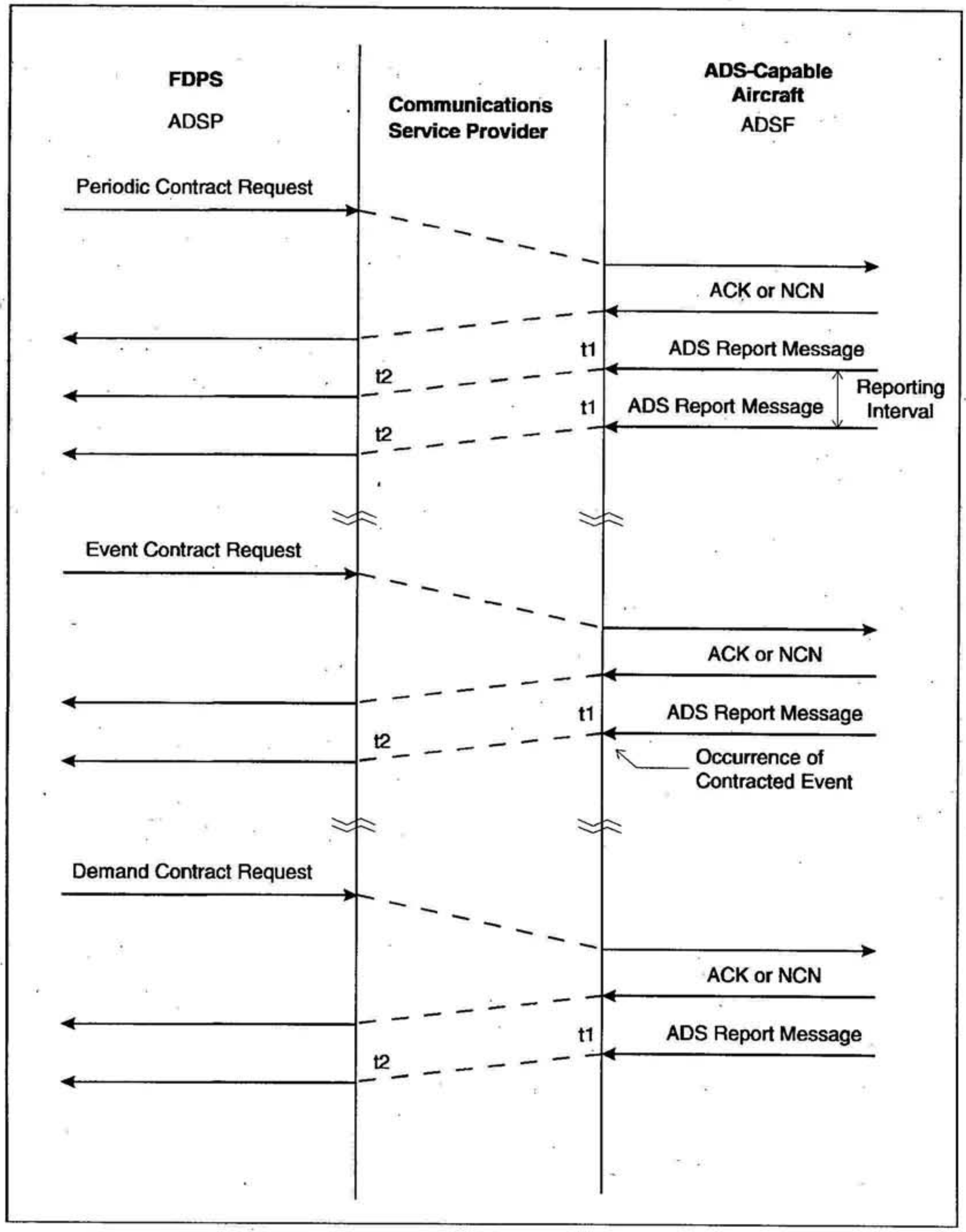


Figure 5.B-8. ATS-ReportPositionUnconfirmed service time-sequence diagram – Normal mode

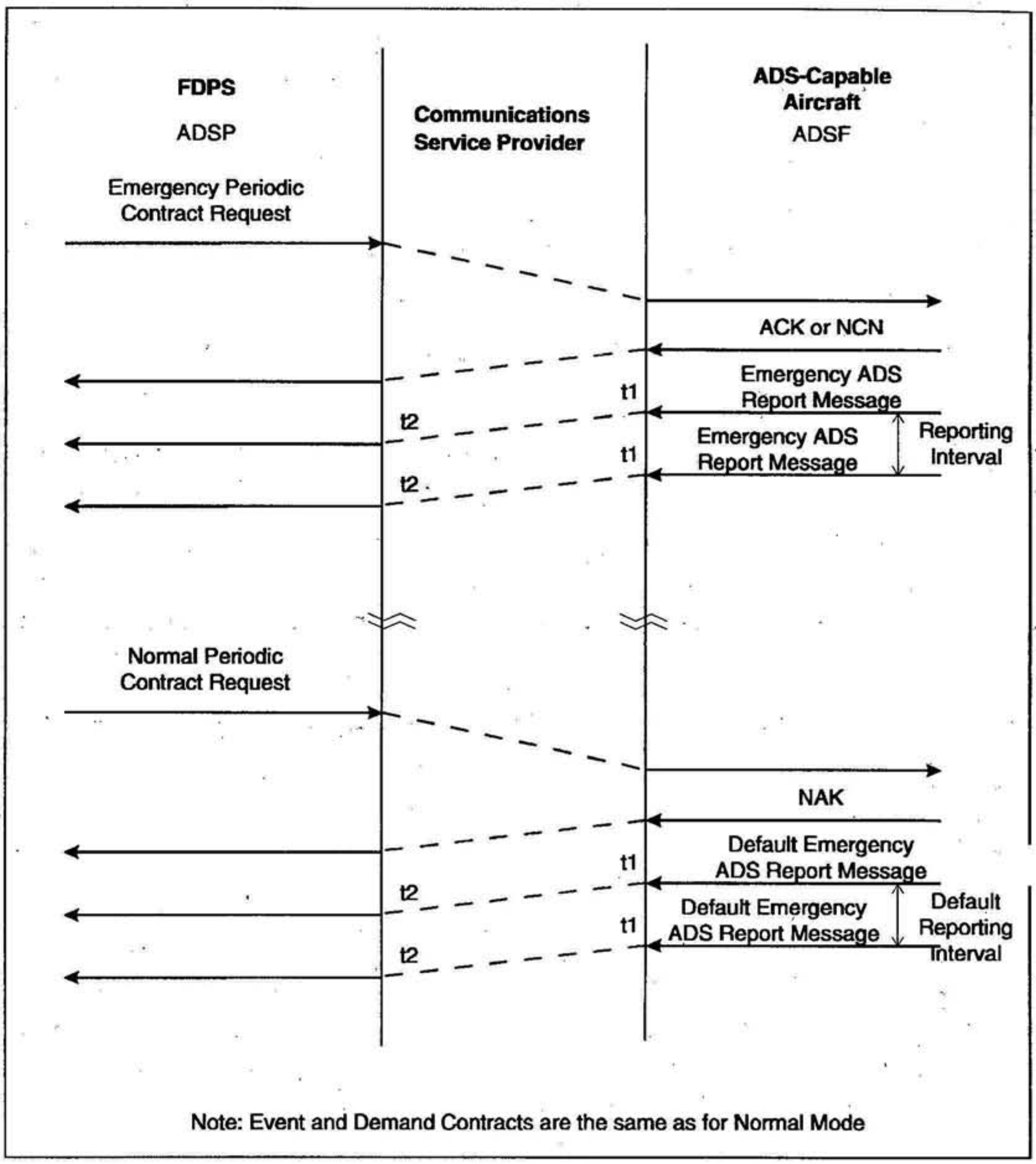


Figure 5.B-9. ATS-ReportPositionUnconfirmed service time-sequence diagram – Emergency mode

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APPENDIX C

TO PART I, CHAPTER 5

ADS MESSAGE DATA ELEMENTS AND RESOLUTIONS/RANGES

The following material is based extensively on ADS MOPS developed by RTCA SC-170.

5.C.1 Data element identifiers in uplinks

The valid identifier values for data elements in ADS uplink messages are given in Table 5.C-1.

Identifier Value	Identifier Description
1	Cancel all contracts and terminate connection
2	Cancel contract
6	Cancel emergency mode
7	Periodic contract
8	Event contract
9	Emergency periodic contract
10	Lateral deviation change
11	Reporting rate
12	Flight identification block
13	Projected profile block
14	Ground vector block
15	Air vector block
16	Meteorological information block
17	Airframe identification block
18	Vertical rate change
19	Altitude range deviation
20	Way-point change
21	Aircraft intent block*
24	Airspeed change
25	Groundspeed change
26	Heading change
27	FOM change
28	Track angle change
29	Level change
30	Extended projected profile change
31	Extended projected profile block
* Intent blocks are not required for minimal operation.	

Table 5.C-1. Valid uplink identifier values

5.C.2 Data element identifiers in downlinks

The valid downlink identifier values for the ADS messages are given in Table 5.C-2.

Identifier Value	Identifier Description
3	Acknowledgement
4	Negative acknowledgement
5	Non-compliance notification
6	Cancel emergency mode indication
7	Periodic report
9	Emergency periodic report
10	Lateral deviation change event
12	Flight identification block
13	Projected profile block
14	Ground vector block
15	Air vector block
16	Meteorological information block
17	Airframe identification block
18	Vertical rate change event
19	Altitude range deviation event
20	Way-point change event
22	Intermediate intent block*
23	Short term intent block*
24	Air speed change event
25	Ground speed change event
26	Heading change event
27	FOM change event
28	Track angle change event
29	Altitude change event
30	Extended projected profile change event
31	Extended projected profile block
* Intent blocks are not required for minimal operation.	

Table 5.C-2. Downlink identifier values

5.C.3 Periodic contract request message

The periodic contract request (PCR) is interpreted as a mandatory request identifier octet and a mandatory contract request number octet followed by optional blocks of data. The optional blocks of data are:

a) reporting rate identifier octet followed by the reporting rate octet; and

b) on-request block identifier octet followed by the on-request block modulus octet, followed by zero or more octets of parameter data as required.

These optional blocks of data may appear in any order following the contract request number.

The reporting rate, or interval, octet defines how often the basic ADS block is sent. When the PCR does not contain a reporting rate identifier, then a default reporting interval is applied: 64 seconds for an emergency report; 304 seconds for a normal report. The format of the reporting rate octet is defined as follows: bits 6 through 1 define the rate, in binary format, and bits 8 and 7 define the scaling factor (SF) to be used when computing the reporting interval using the following table:

Bits			**Scaling Factor**
8	**7**	**6 through 1**	
0	0	rate, multiplied by the scaling factor	0 seconds, used for demand contract request
0	1	rate, multiplied by the scaling factor	1 second
1	0	rate, multiplied by the scaling factor	8 seconds
1	1	rate, multiplied by the scaling factor	64 seconds

Table 5.C-3. Reporting rate scaling factor codes

The reporting interval is determined by the following algorithm:

Reporting interval = (1 + rate) * SF

where SF is the scaling factor in bits 8–7 and rate is the value in bits 6–1.

Figure 5.C-1 illustrates the bit map representation of the PCR. All optional data are shown. The ADS-request identifier and the ADS contract request number are required data. The remaining data are optional. Note that the format of the emergency PCR is identical to that of the normal PCR except for the value of the ADS-request identifier (i.e. 7 for normal mode and 9 for emergency mode).

Octet	MSB 8	7	6	5	4	3	2	LSB 1
1	ADS-request Ident. (7)							
2	ADS Contract Request Number							
3	Reporting Rate Ident. (11)							
4	SF		Rate					
5	Flight ID Block (12)							
6	Flight ID Block Modulus							
7	Projected Profile Block (13)							
8	Projected Profile Block Modulus							
9	Ground Vector Block (14)							
10	Ground Vector Block Modulus							
11	Weather Block (16)							
12	Weather Block Modulus							
13	Airframe ID Block (17)							
14	Airframe ID Block Modulus							
15	Air Vector Block (15)							
16	Air Vector Block Modulus							
17	Aircraft Intent Block (21)							
18	Aircraft Intent Block Modulus							
19	Aircraft Intent Projection Time							
20	Ext. Projected Profile Block (31)							
21	Ext. Proj. Profile Block Modulus							

5.C.4 Event contract request message

The event contract request (ECR) is interpreted as a mandatory request identifier octet and a mandatory contract request number octet followed by optional blocks of data. These optional blocks of data are:

a) vertical rate change identifier octet followed by vertical rate change threshold octet;

b) way-point change identifier octet;

c) lateral deviation change identifier octet followed by the lateral deviation change threshold octet;

d) level range deviation identifier octet followed by the ceiling and floor altitude data, each two octets in length;

e) airspeed change identifier octet followed by the airspeed change threshold octet;

f) groundspeed change identifier octet followed by the ground speed change threshold octet;

g) heading change identifier octet followed by the heading change threshold octet;

h) extended projected profile change identifier octet;

i) FOM change identifier octet;

j) track angle change identifier octet followed by the track angle change threshold octet; and

k) level change identifier octet followed by the altitude change threshold octet.

These optional blocks of data may appear in any order following the mandatory contract request number. Figure 5.C-2 illustrates the bit map representation of the ECR. Note that all optional data are shown in the bit map. The only required data are the ADS-request identifier, ADS contract request number, and one optional data block.

Octet	MSB 8 7 6 5 4 3 2 1 LSB
1	ADS-request Ident. (8)
2	ADS Contract Request Number
3	Vertical Rate Change Ident. (18)
4	S Vert. Rate Change Threshold
5	Altitude Range Ident. (19)
6–7	Ceiling
8–9	Floor
10	Waypoint Change Ident. (20)
11	Lateral Deviation Ident. (10)
12	Lateral Deviation Threshold

S = Sign Bit

Octet	MSB 8 7 6 5 4 3 2 1 LSB
13	Air Speed Change Ident. (24)
14	Air Speed Change Threshold
15	Ground Speed Change Ident. (25)
16	Ground Speed Change Threshold
17	Heading Change Ident. (26)
18	Heading Change Threshold
19	Ext. Proj. Profile Change Ident. (30)
20	FOM Change Ident. (27)
21	Track Angle Change Ident. (28)
22	Track Angle Change Threshold
23	Altitude Change Ident. (29)
24	Altitude Change Threshold

Figure 5.C-2. Event contract request

The optional data are used to specify requirements for generating event reports as follows:

a) The vertical rate change event can be triggered in two ways. If the vertical rate threshold is positive, then the event is triggered when the aircraft's rate of climb is greater than the vertical rate threshold. If the vertical rate threshold is negative, then the event is triggered when the aircraft's rate of descent is less than the vertical rate threshold.

b) The way-point change event is triggered by a change to the next or next-plus-one way-point (due to a flight plan change or way-point sequence).

c) The lateral deviation change event is triggered when the absolute value of the lateral distance between the aircraft's actual position and the aircraft's expected position on the active flight plan becomes greater than the lateral deviation threshold.

d) The level range deviation event is triggered when the aircraft's altitude becomes greater than the level ceiling or less than the level floor.

e) The airspeed change event is triggered when the aircraft's airspeed differs negatively or positively from its value at the time of the previous air vector ADS report, by an amount which is equal to the airspeed change threshold which is specified in the event contract request.

f) The groundspeed change event is triggered when the aircraft's groundspeed differs negatively or positively from its value at the time of the previous ground vector ADS report, by an amount which is equal to the groundspeed change threshold which is specified in the event contract request.

g) The heading change event is triggered when the aircraft's heading differs positively or negatively from its value at the time of the previous air vector ADS report, by an amount which is equal to the heading change threshold which is specified in the event contract request.

h) The extended projected profile change event is triggered by a change to any one of the next or (next+1) way-points (due to a flight plan change).

i) The FOM change event is triggered by a change in the navigational accuracy, navigational system redundancy or traffic alert and collision avoidance system (TCAS) availability.

j) The track angle change event is triggered when the aircraft's track angle differs negatively or positively from its value at the time of the previous ground vector ADS report, by an amount which is equal to the track angle change threshold which is specified in the event contract request.

k) The level change event is triggered when the aircraft's level differs negatively or positively from its value at the time of the previous ADS report by an amount which is equal to the level change threshold which is specified in the event contract request.

Typical data blocks to be sent when each type of event is reported are shown in Table 5.C-4.

Event Report Type	Report Data Blocks, in Addition to Basic Block
Vertical rate change	Ground vector
Way-point change	Projected profile
Lateral deviation change	Ground vector
Level range deviation	Ground vector
Airspeed change	Air vector
Groundspeed change	Ground vector
Heading change	Air vector
Extended projected profile change	Extended projected profile
FOM change	
Track angle change	Ground vector
Level change	Ground vector

Table 5.C-4. Event report data blocks

If the ADSF cannot comply with a particular ECR and no other events were requested with the contract request, an NCN is returned and the ADSP and the ADSF both transition to a state as if the contract request were fulfilled. This avoids the ADSF responding with a NAK to a request that is valid but cannot be met.

5.C.5 Cancel contract request message

The bit map representation of the CCR message is illustrated in Figure 5.C-3.

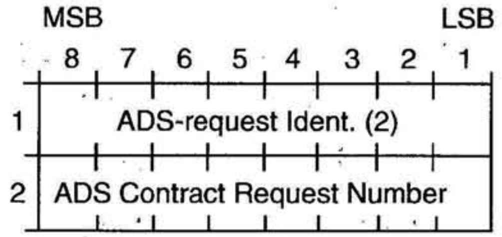


Figure 5.C-3. Cancel contract request

5.C.6 Cancel all contracts and terminate connection request message

The bit map representation of the CTC message is illustrated in Figure 5.C-4.

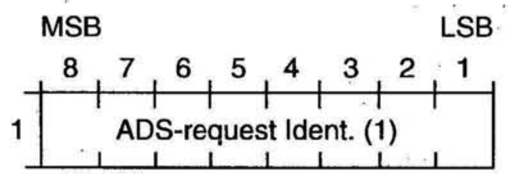


Figure 5.C-4. Cancel all contracts and terminate connection request

5.C.7 Cancel emergency mode indication message

The bit map representation of the CLI message is illustrated in Figure 5.C-5.

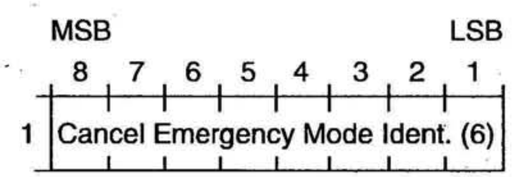


Figure 5.C-5. Cancel emergency mode indication

5.C.8 **Cancel emergency mode request message**

The bit map representation of the CER message is illustrated in Figure 5.C-6.

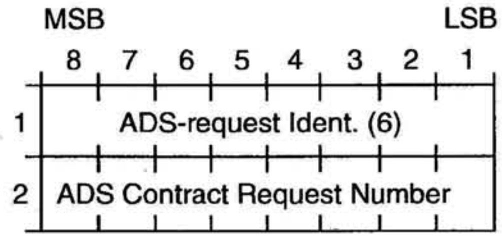


Figure 5.C-6. Cancel emergency mode request

5.C.9 **ADS report message**

The ADS-capable aircraft assembles an ADS report message (ARM) using data depicted in Figures 5.C-7 (a), (b) and (c) and Table 5.C-4.

The basic ADS block is included in every report. The ADS-report identifier contained in the basic ADS block defines the type of report generated: emergency periodic, normal periodic or event. The best available latitude and longitude position information is included. The ADS-capable aircraft uses the source of valid position data consistent with the highest figure of merit (FOM) outlined in Table 5.C-5.

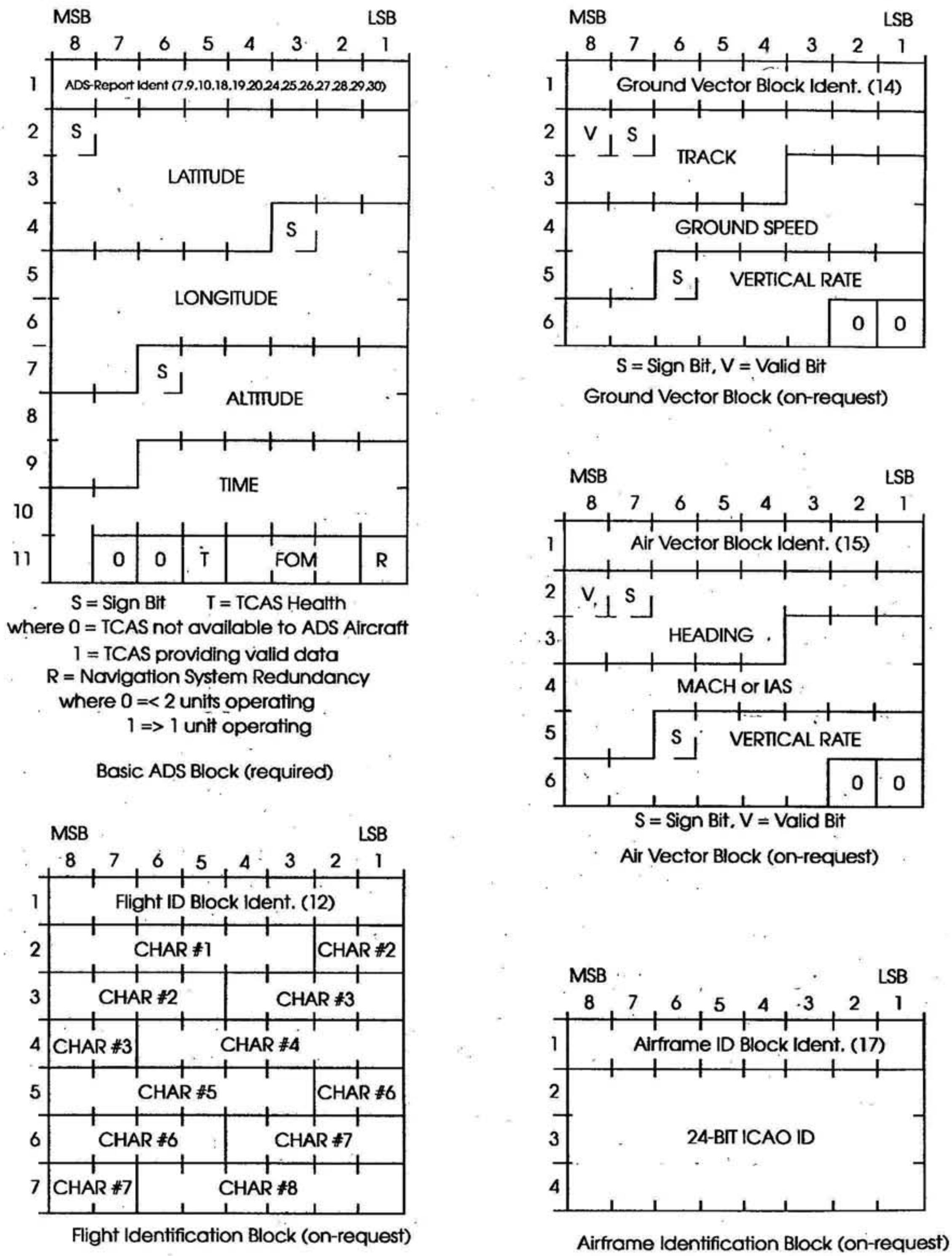


Figure 5.C-7 (a). ADS report message

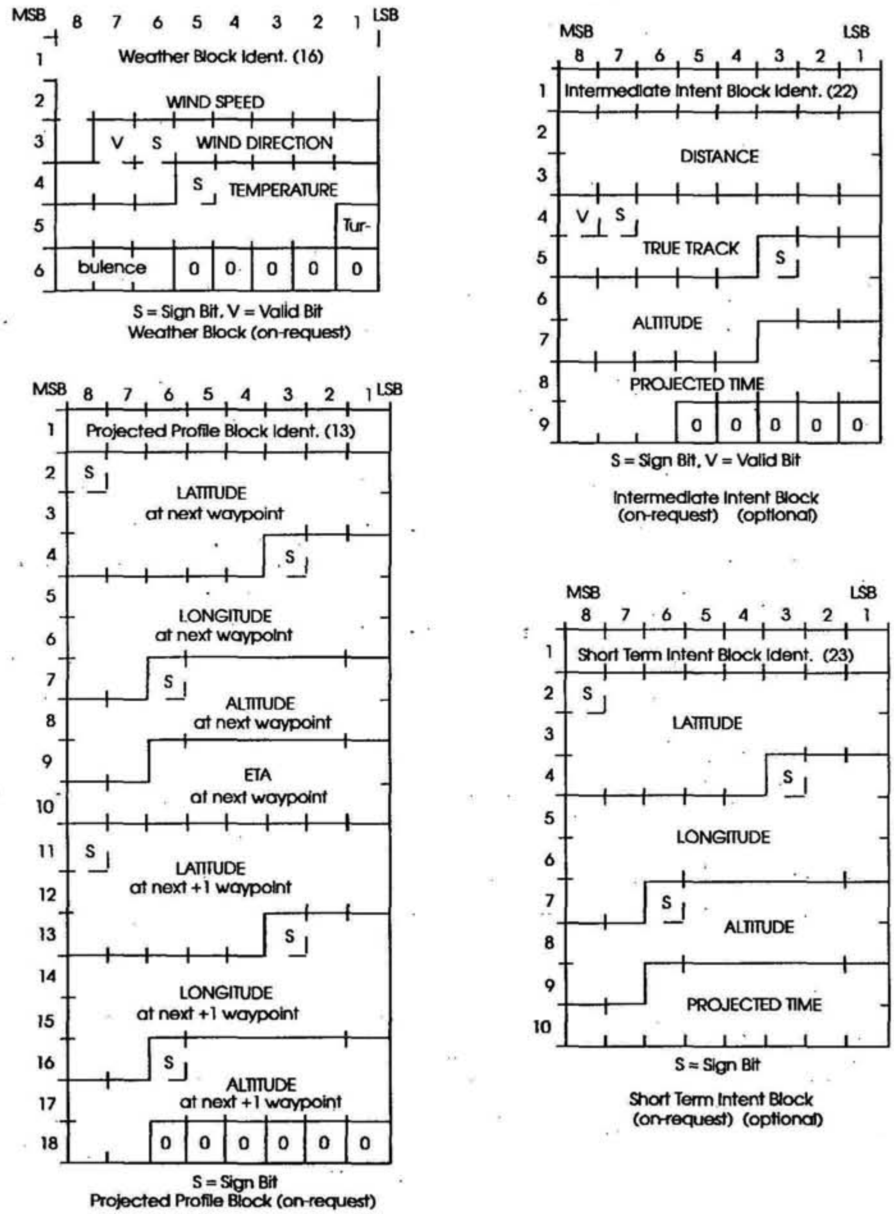
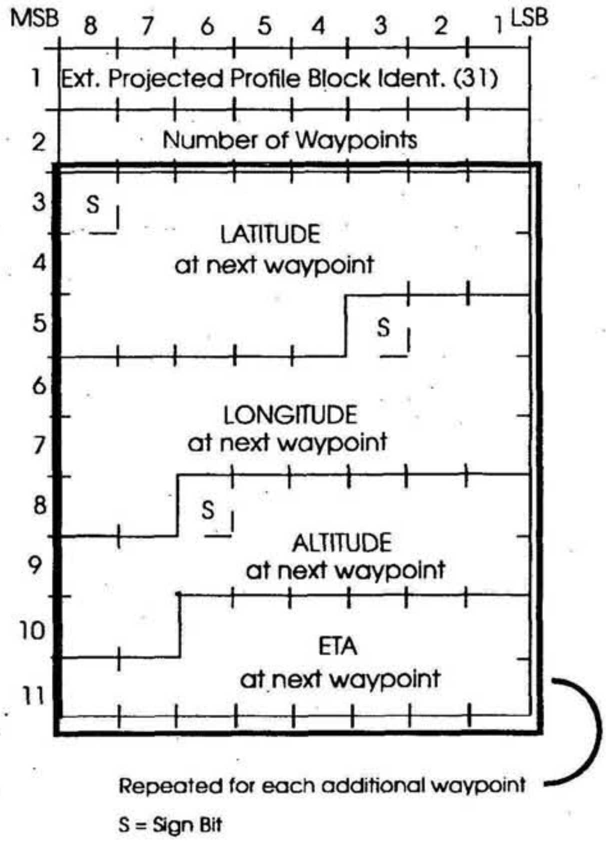


Figure 5.C-7 (b). ADS report message (Continued)



Extended Projected Profile Block (on-request)

Figure 5.C-7 (c). ADS report message (Continued)

Figure of merit level	**Accuracy of position determination (within 95% probability)**	**The reason the navigation accuracy value was chosen**
0	Complete loss of navigational capabilities	Inability to determine position within 30 nautical miles is considered total loss of navigation.
1	<30 nautical miles	Consistent with INS on long flight without updates, dead reckoning for 11.5 hours or with NDBs widespread.
2	<15 nautical miles	Consistent with INS on Pacific leg (7 to 7.5 hours with drift rate of two nautical miles per hour).
3	<8 nautical miles	Consistent with INS (with or without OMEGA) in North Atlantic (3.5 to 4 hours) and with domestic NAV beyond 50 nautical miles from VOR.
4	<4 nautical miles	Consistent with VOR accuracies at 51 nautical miles or with oceanic legs of less than two hours.
5	<1 nautical mile	Consistent with potential RHO-RHO applications of ground-based DME, RNAV using multiple DME position updates.
6	<0.25 nautical mile	Consistent with ground wave Loran-C "absolute" accuracies.
7	<0.05 nautical mile	Consistent with expected GPS accuracies.

Table 5.C-5. Figure of merit – Minimum position accuracy

The on-request data blocks may be appended to the basic ADS block in any order, with the exception of the aircraft intent blocks, which are not required for minimum operation. When the aircraft intent blocks are included in a report, the intermediate intent block(s), if any, follow the basic ADS block, and the short-term intent block follows the last intermediate intent block. When there are no intermediate intent blocks, the short-term intent block follows the basic ADS block.

When the aircraft intent blocks are required, their contents are determined as follows:

a) the short-term point is determined by the predicted location of the aircraft in X minutes, where X is the aircraft intent projection time contained in the PCR; and

b) intermediate intent points are any points between the aircraft's present position and the short-term point where an level, track or speed change is predicted to occur.

The intermediate intent points are defined by parameters indicating level at the intermediate intent point, distance and true track from the previous intermediate intent point, and projected time from present position. If a previous intermediate intent point does not exist, then distance and true track will be from the present position.

When the datum for a particular parameter is invalid, an ADS-capable aircraft uses a default value as defined in Table 5.4.C.2-1. When an entire on-request block is unavailable or undefined, it is omitted from the reports. When one or more parameters of a message block are unavailable, an ADS-capable aircraft uses default values instead.

5.C.10 Acknowledgement message

Except for the cancel all contracts and terminate connection request, an acknowledgement (ACK) message is sent once for each valid request. The ADS contract request number contained in the ACK corresponds to the ADS contract request number being acknowledged. The bit map representation of the ACK message is illustrated in Figure 5.C-8.

	MSB 8 7 6 5 4 3 2 1 LSB
1	Acknowledgement Ident. (3)
2	ADS Contract Request Number

Figure 5.C-8. Acknowledgement message

5.C.11 Negative acknowledgement message

The negative acknowledgement (NAK) message is sent once for each invalid request. Errors are defined as follows:

a) invalid request identifier;

b) duplicate on-request block identifier;

c) duplicate reporting rate identifier;

d) an event request identifier with no data;

e) a request without enough data;

f) an out-of-range input message parameter (see Tables 5.C-7 and 5.C-8); and

g) a periodic request identifier for an operational mode different from the connection's current operational mode.

An identifier defines the type of request made by the FDPS or the type of response issued from the avionics. For valid uplink and downlink message identifiers, see the related section of this appendix.

It is also considered to be an error if a cancel contract request is received when that contract is not active, or a contract request is received with a contract request number the same as a contract already in effect on a particular connection. Following the generation of three consecutive NAKs on the same connection, the avionics ADSF cancels all contracts on the respective connection and terminates that connection.

The ADS contract request number contained in the NAK corresponds to the number of the ADS contract request being negatively acknowledged. The NAK reason codes are defined in Table 5.C-6. The extended data octet is only used with NAK reason codes 1, 2 and 7 and contains the data defined in the table.

For NAK reason 7, the first octet of the request contains a number not defined for uplink requests. The second octet of the request is assumed to be the ADS contract request number (returned in the second octet of the NAK).

Reason Code	Description
1	Duplicate on-request block identifier. The number of the octet which contained the duplicate on-request block identifier in the uplink message is contained in the extended data octet, with the first octet in the uplink message considered as octet one.
2	Duplicate reporting rate identifier. The number of the octet which contained the duplicate reporting rate identifier in the uplink message is contained in the extended data octet, with the first octet in the uplink message considered as octet one.
3	Event contract request with no data
4	Improper operational mode identifier
5	ADS contract request number in CCR does not match the ADS contract request number of an existing contract.
6	ADS contract request number in contract request matches the ADS contract request number of an existing contract.
7	Undefined contract request identifier. Extended data octet contains undefined contract request identifier.
8	Undefined error
9	Not enough data in request
10	Floor level parameter greater than or equal to ceiling altitude parameter (altitude range change event)
11	Vertical rate change threshold parameter equal to zero (vertical rate change event)
12	Aircraft intent projection time parameter equal to zero (aircraft intent on-request block)
13	Lateral deviation change threshold parameter equal to zero (lateral deviation change event).
14	Airspeed change threshold parameter equal to zero (airspeed deviation event)
15	Groundspeed change threshold parameter equal to zero (groundspeed deviation event)
16	Heading change threshold parameter equal to zero (heading change event)
17	Track angle threshold parameter equal to zero (track angle change event)
18	Level change threshold parameter equal to zero (altitude change event)

Table 5.C-6. Negative acknowledgement reasons

The bit map representation of the NAK message is illustrated in Figure 5.C-9.

	MSB 8	7	6	5	4	3	2	LSB 1
1	Negative Acknowledgement Ident. (4)							
2	ADS Contract Request Number							
3	Reason Code							
4	Extended Data (Reasons 1, 2, 7)							

Figure 5.C-9. Negative acknowledgement message

5.C.12 Non-compliance notification message

The non-compliance notification (NCN) message is sent once for each valid contract request that cannot be complied with. The NCN message consists of the following five mandatory octets:

a) non-compliance notification identifier;

b) ADS contract request number that cannot be complied with;

c) the number of on-request blocks and events that cannot be complied with;

d) the identifier of the first on-request block or event that cannot be complied with; and

e) a fifth octet containing the coded data.

The bit map representation of the NCN is illustrated in Figure 5.C-10.

	MSB 8	7	6	5	4	3	2	LSB 1
1	Noncompliance Notification Ident. (5)							
2	ADS Contract Request Number							
3	Number of Message Blocks							
4	First Message Block Ident.							
5	0/1	0/1	0	0	# of Parameters			
6	Parameter Num.				Parameter Num.			

Figure 5.C-10. Non-compliance notification message

The most significant bit (bit 8) of the fifth octet defines whether the on-request block is undefined or unavailable. A one (1) indicates undefined; a zero (0) indicates unavailable. If undefined, the remainder of the octet is not used and no additional octets follow. If unavailable, the next bit (bit 7) defines whether the entire on-request block or event is unavailable. A one (1) indicates that the entire on-request block or event is unavailable, and the remainder of the octet is not used. A zero (0) indicates that one or more parameters of an on-request block are not available. Bits 6 and 5 are reserved and provisionally set to 0 (zero). The remaining four bits in the fifth octet contain the number of parameters that are not available.

If parameters are not available, as many parameter octets as needed to define the unavailable parameters follow the fifth octet. Each parameter octet that follows is divided in half; each half contains a parameter number. This parameter number references the location of the parameter in the on-request block. If an odd number of parameters is unavailable, the last four bits of the last parameter octet are all zeros.

When the ADSF uses the NCN message to indicate that it will not support a reporting rate of four seconds or less (because the ADSF already has one connection reporting at the faster rate), the reporting rate identifier is contained in octet four, the first bit of octet five is set to zero, and the second bit of octet five is set to one. The remaining bits of octet five are not used. A reporting rate of 64 seconds is applied when an NCN message containing the reporting rate identifier is sent.

Since multiple on-request blocks or events may be specified in the same NCN, the format of octets four and five are repeated as often as necessary. Each time parameters are unavailable, they follow the format of the parameter octet as defined above.

There are differences between ADSF non-compliance and the aircraft's inability to meet the conditions for a requested event. If an ADSF does not have level as an input parameter, then the ADSF will send an NCN when an level change event is received. However, if the ADSF does have an level input and the ADSF receives an event request, an ACK is sent even if the requested level cannot be attained. This might occur if the ceiling level were greater than the maximum certified level of the aircraft. The

ADSF would have no knowledge of this limitation and would NOT respond with an NCN. Instead, this event would never occur.

When an undefined on-request block identifier or event identifier is encountered in a request, the ADSF sends an NCN. The data processed to that point is considered valid and is acted on accordingly. The remaining data in the uplink is ignored. Table 5.C-1 defines the valid uplink identifier values.

Since multiple requests may be sent in a single uplink, a valid request that follows a request containing an undefined on-request block identifier or event identifier will be ignored. The FDPS should be aware that an NCN due to an undefined identifier, which is sent in response to the first request in a multiple-request uplink, requires that the second request be sent again. This is because the ADSF must ignore the undefined on-request block identifier or event identifier. Since the data associated with the identifier is an unknown number of octets, the ADSF cannot therefore continue processing the remainder of the uplink in a deterministic manner.

5.C.13 Resolutions and ranges of data elements in ADS messages

Parameter	Valid Range	Resolution	Reference (8)	Out-of-range Value	Non-valid Value (1)
Latitude	± 90°	0.000172°	WGS84		(3)
Longitude	± 180°	0.000172°	WGS84		(3)
Level	± 131 064 ft	4 ft	MSL or Standard atmosphere	± 131 068 ft	- 131 072 ft
Time stamp (5)	0 - 3 599.875 s	0.125 s	GPS UTC (Default)	3 600 s	3 601 s
Flight ID	Alphanumeric	N/A	ISO6		Space (4)
Mach	0 - 4.0945 Mach	0.0005 Mach		4.095 Mach	4.0955 Mach
Groundspeed	0 - 4 0945 kt	0.5 kt	Ground track	4 095 kt	4 095.5 kt
Wind speed	0 - 254.5 kt	0.5 kt	WGS84	255 kt	255.5 kt
True wind direction	- 180 - + 179.296875°	0.703125°	Geographic north (6)		Valid bit = 1 (5)
Vertical rate	± 32 736 ft/min	16 ft/min		± 32 752	- 32 768 ft/min
Temperature	± 511.5°C	0.25°C	Celsius scale	± 511.75°	- 512°C
True track angle	- 180 - + 179.912°	0.08789°	Geographic north (7)		Valid bit = 1 (5)
True heading	- 180 - + 179.912°	0.08789°	Geographic north (7)		Valid bit = 1 (4)
Distance	0 - 8 181.625 NM	0.125 NM	WGS84	8 191.750 NM	8 191.875 NM
ETA	0 - 16 381 s	1 s	UTC	16 382 s	16 383 s
Projected time	0 - 16 381 s	1 s	UTC	16 382 s	16 383 s

Table 5.C-7. ADS report message parameters

Notes:

(1) When the value available to the ADSF is invalid, an artificial value should be inserted for the invalid value in the case of a value without a sign bit. This artificial value reflects a coding for all bits in the value field as "1". In the case of a value with a sign bit using two's complement notation, this artificial value reflects a negative full value, by setting the sign bit to "1" and the remainder of the value bits to "0". The value of the MSB is accurate by definition. The value of the LSB is an approximation.

(2) When the value available to the ADSF is valid but out of range, the off-range value will be set to the highest or lowest valid value.

(3) When either the latitude or longitude for a position are invalid, both are set to – 180 degrees. In the basic ADS block, the FOM is also set to 0.

(4) When the flight identification is invalid, all characters are encoded as spaces. When the flight identification is less than eight characters, the flight identification is encoded left justified and the unused characters are encoded as spaces.

(5) The validation of the direction parameter is indicated by the immediately preceding bit, where 0 = valid and 1 = invalid.

(6) The time stamp is expressed as the time elapsed since the most recent hour. Times are rounded, not truncated, to accurately yield the value loaded into the time stamp field.

(7) There are discontinuities at the north and south poles.

(8) The reference column may be modified after further work.

Parameter	Valid Range	Approximate LSB Value
Aircraft intent projection time	1 to 255 min	1 min
Lateral deviation change threshold	0.125 to 31.875 NM	0.125 NM
Vertical rate change threshold	– 8 192 to 8 128 ft/min (2)	64 ft/min
Ceiling level	– 131 072 to + 131 068 ft (3)	4 ft
Floor level	– 131 072 to + 131 068 ft (3)	4 ft
Airspeed change threshold	0.005 to 1.275 Mach	0.005 Mach
Groundspeed change threshold	1 to 255 kt	1 kt
Track angle change threshold	2° to 180°, and – 2° to – 180°	2°
Level change threshold	4 to 1 020 ft	4 ft
Heading change threshold	2° to 180°, and – 2° to – 180°	2°

Table 5.C-8. ADS uplink message parameters

Notes:

(1) Signed numerical values are interpreted in two's complement notation.

(2) Zero is not a valid value for the vertical rate change threshold.

(3) The ceiling level must be greater than the floor level.

(4) No default value applicable to ADS uplink threshold parameter.

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APPENDIX D

TO PART I, CHAPTER 5

FUNCTIONAL REQUIREMENTS FOR ADS CONTRACTS

1. INTRODUCTION

1.1 The requirement to fulfil the terms of ADS agreements will be met by a contract, or a series of contracts. An ADS contract specifies under what conditions ADS reports will be initiated and what data groups will be contained in the reports. There are two types of contracts: periodic and event.

2. CONTRACTS

2.1 A periodic contract provides ADS reports at a constant rate to support monitoring of flight progress,and flight plan conformance.

2.2 A periodic contract should be established by a request from the FDPS. The contract request should contain the periodic report rate for the basic ADS block as well as any optional ADS data blocks to be sent, and their periodicity. A report rate of zero should generate a single report. Once a periodic contract is in effect, it should remain in effect until cancelled or replaced with another periodic contract as required by the ADS agreement.

2.3 Upon establishment of a periodic contract, the aircraft should initiate the first report immediately,and subsequent reports periodically.

2.4 Each aircraft should be able to support contracts with up to four ground end-systems simultaneously. Each aircraft should support one periodic contract, one event contract and one single-report contract with each ground system.

2.5 A new periodic contract request with a given ground system should replace any existing periodic contract associated with that ground system. However, a request for a single report should have no effect on other ADS contracts.

3. EVENT CONTRACTS

3.1 An event contract specifies which of the following types of events shall initiate ADS event reports:

1) geographic: crossing of waypoint, specified latitude, specified longitude, specified level, specified FIR boundary, specified point;

2) deviation: specified deviation from cleared route or level; or

3) change: specified change in aircraft heading, level, or speed.

3.2 An event contract can contain more than one event type. Event contracts should not affect any periodic contract in effect.

3.3 For geographic events the FDPS must specify: (a) which types of geographic events are to trigger a report, (b) the geographic value(s), and (c) which optional data blocks are to be reported when each event occurs. A single report shall be initiated each time the event occurs.

3.4 For deviation events the FDPS must specify: (a) which types of deviations are to trigger a report, (b) threshold parameters, and (c) which optional data blocks are to be reported when each event occurs. A single report shall be initiated each time the event occurs.

3.5 For change events the FDPS must specify: (a) which types of changes are to trigger reports, (b) change parameters, and (c) the number of ADS reports to be sent, and the interval between them. Only basic ADS reports shall be sent.

4. CONTRACT ACKNOWLEDGEMENTS AND NOTIFICATIONS

4.1 Acknowledgements

4.1.1 When an aircraft receives a periodic contract request, or an event contract request, it should immediately send a contract acknowledgement to the requester. If the contract request can be completely complied with, the acknowledgement message should contain the acknowledgement message tag and the contract request number.

4.2 Non-compliance notification

4.2.1 If the contract request cannot be fully complied with, then a non-compliance notification is sent. This message should contain the contract request number that cannot be complied with, the number of non-compliant optional data blocks that cannot be complied with, followed by each non-compliant data block tag and reason for non-compliance (undefined or unavailable).

4.3 Negative acknowledgement

4.3.1 If an error is detected in the contract request, a negative acknowledgement should be sent to the ground system with the contract request number and error reason.

5. CONTRACT TERMINATION

5.1 Cancel contracts request

5.1.1 There are two types of cancel contract request messages: cancel contract and cancel all contracts. In the first case, the contract with the specified contract number is cancelled; in the second case, all existing contracts between a particular aircraft and the sending facility are cancelled.

5.1.2 The cancel contract request message from the ground should contain a contract number. If that number matches the one that is in effect for an existing periodic contract and/or event contract, then the corresponding contract(s) should be cancelled. Otherwise the request should be ignored. This is to allow an ATC unit to cancel one contract without inadvertently cancelling another contract.

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PART II

AIR TRAFFIC SERVICES DATA LINK APPLICATIONS

PART II CONTAINS VALUABLE TECHNICAL INFORMATION ON CONTROLLER-PILOT DATA LINK COMMUNICATIONS (CPDLC) AND AIR TRAFFIC SERVICES INTERFACILITY DATA COMMUNICATIONS (AIDC).

THIS PART IS NOT YET COMPLETE WITH REGARD TO THE DESCRIPTION AND OPERATIONAL REQUIREMENTS FOR DATA LINK APPLICATIONS.

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PART II – AIR TRAFFIC SERVICES DATA LINK APPLICATIONS

CHAPTER 1. INTRODUCTION

1.1 GENERAL

1.1.1 One of the keys to the future air traffic management system lies with the two-way exchange of data, both between aircraft and the ATC system and between ATC systems. In the future, it is expected that communications with aircraft will increasingly be by means of digital data link. This will allow more direct and efficient linkages between ground and cockpit systems. At the same time, extensive data exchange between ATC systems will allow efficient and timely dissemination of relevant aircraft data, and will cater for more efficient co-ordination and hand-over of flights between ATC units. In turn, this will reduce controller and pilot workload and will allow an increase in capacity.

1.1.2 ICAO has developed a communications systems architecture that provides a range of capabilities to suit the needs of air traffic services (ATS) providers and their users, from basic low-speed data to high-speed digital voice, including the aeronautical mobile-satellite service (AMSS). Various air-ground communication data links will be integrated through an aeronautical telecommunication network (ATN) based on an open system interface (OSI) architecture. Eventually, the ATN will allow worldwide connectivity and an established quality of service which will provide optimum routing and delivery.

1.2 PURPOSE OF PART II

1.2.1 The purpose of Part II is to:

a) explain the concepts of ATS data link communications and associated requirements;

b) identify how ATS data link communications will enhance existing air traffic services;

c) provide guidance material for aviation authorities, airspace users and service providers of ATS data link, including system concept and description, operational requirements, air traffic services, procedures, and implementation and transition strategies.

1.2.2 During the transition towards the CNS/ATM systems, the number of data link applications which require a globally uniform approach and standardization will increase. Therefore, Part II of this document will require regular updating to include additional data link applications.

1.2.3 Air-ground data link applications have to be supported by air-ground data link media, i.e. VHF data link (VDL), satellite data link, SSR Mode S data link or any other suitable means. Although some applications will be more or less dedicated to a specific data link medium, this document will not relate an application with a data link medium. This is beyond the scope of operational requirements and might limit the applicability.

1.3 HUMAN FACTORS

1.3.1 Air-ground data link applications will be implemented in order to provide benefits, e.g. by providing the human and/or machine with more or better information, which will support the human fulfilling its responsibility or which will allow that certain tasks are performed automatically to relieve human workload.

1.3.2 The final objective of the introduction of new technologies is often to increase air traffic capacity, while maintaining or increasing the level of safety. If humans are to meet their agreed responsibilities, the specifications and design of the ATS system have to match the human capabilities and limitations. In the case of data link applications, this sets requirements for the role of the human in the exchange and use of data, and sets requirements for the human-machine interface. These requirements might be different for different data link applications.

1.3.3 Specific guidance on this issue can be found in several documents, e.g. in the ICAO Human Factors Digests (circulars). In considering the application of data link, special consideration should be given to digests no. 1 (Fundamental Human Factors Concepts, Circ. 216), no. 5 (Operational Implications of Automation in Advanced Technology Flight Decks, Circ. 234), and no. 8 (Human Factors in Air Traffic Control, Circ. 241).

1.3.4 Human factors related to specific data link applications are described under the headings of those applications. Some more general human factors, to be considered in conjunction with the guidance material mentioned in the previous paragraph, are listed below (partly extracted from the ICAO Global Plan):

a) the level of safety targeted for the future system should be defined not only with reference to various system statistics, but also with reference to error-inducing mechanisms related to human capabilities and limitations, as well as important individual cases;

b) the definition of system and resource capacity should include reference to the responsibilities, capabilities and limitations of ATS personnel and air crews, who must retain situational awareness and understanding in order to carry out all of their responsibilities;

c) the provision of large volumes of potentially relevant information to users and ATS personnel should be limited to what is absolutely necessary and be mediated by methods that effectively package and manage such information, to prevent information overload while providing information pertinent to particular operational needs;

d) the responsibilities of pilots, air traffic controllers and system designers should be clearly defined prior to the implementation of new automated systems and tools;

e) services and procedures will be provided to ensure the preservation of situational awareness for both data link- and non-data link-equipped aircraft and ground facilities;

f) when operating a data link system, there will not be an increase in head down time that would adversely affect safe operation;

g) voice communication will be available to supplement data link system operation; and

h) maximum use of data link will not impose undue competition for display or control resources.

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APPENDIX A

TO PART II, CHAPTER 1

OPERATIONAL REQUIREMENTS FOR ATS DATA LINK APPLICATIONS

O.R. 1 IDENTIFICATION OF AN AIRCRAFT'S DATA LINK AND ADS CAPABILITIES FROM THE FILED FLIGHT PLAN

Functional statement

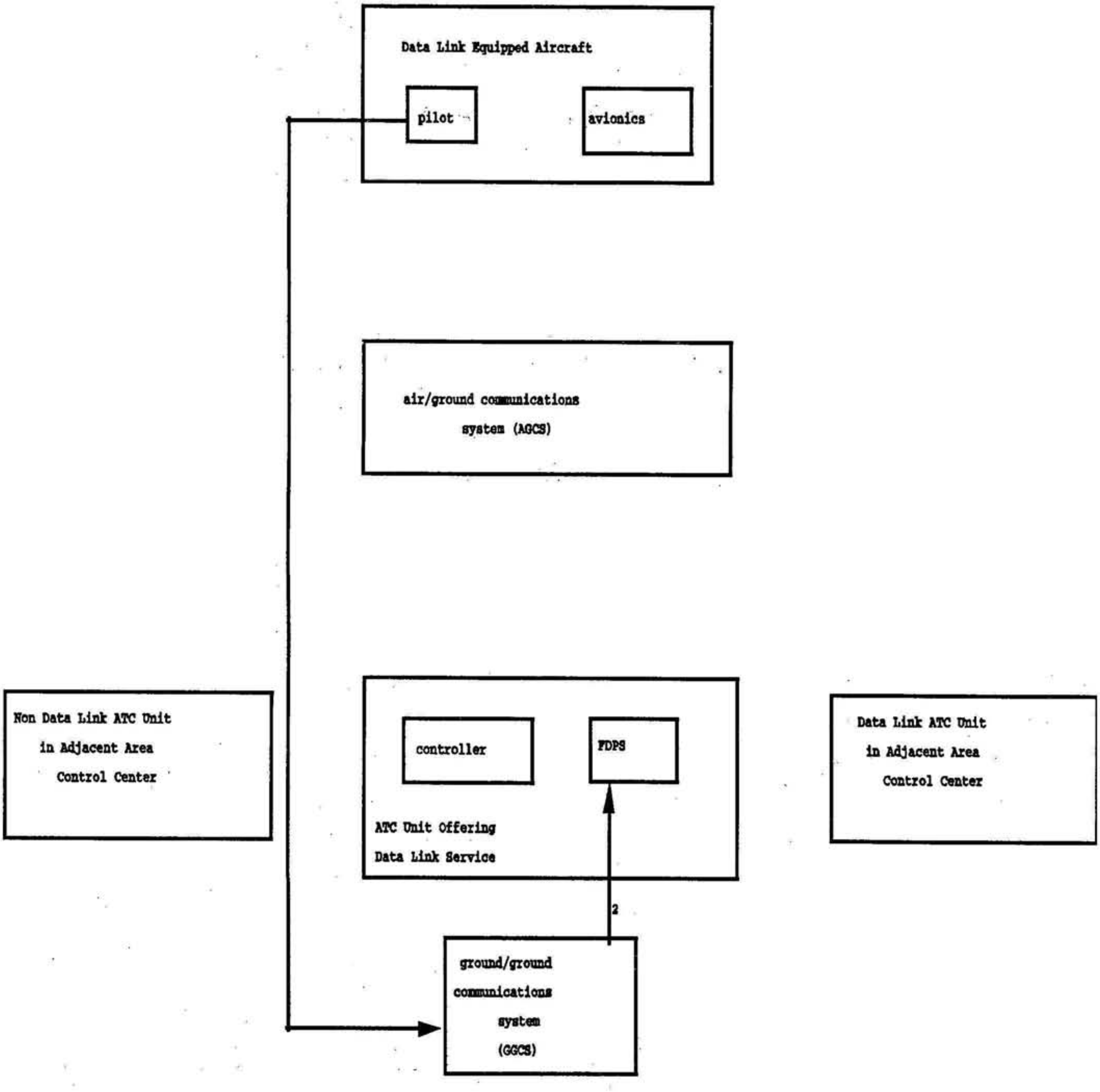
ATC units need advance notification of aircraft equipage.

Prior to the aircraft entering airspace where data link is available, the ATC unit's FDPS database will be updated to reflect the aircraft equipage from data included in the received flight plan.

Functional thread description

The pilot shall include details about data link capability in the flight plan. [1.1, 2]

O.R. 1 Functional thread diagram: Identification of an aircraft's data link capabilities from the filed flight plan



O.R. 2 ESTABLISHMENT OF A DATA LINK BETWEEN AIRCRAFT AVIONICS AND THE FDPS

Functional statement

Before entering an airspace where the data link service is provided by the ATC automation system, a data link connection will need to be established between the avionics and the FDPS in order to register the aircraft and start the data link dialogue when necessary. Normally, this will be initiated from the aircraft, either by the avionics or, possibly, by pilot intervention. However, it is foreseen that, in exceptional circumstances, establishment of the link could be initiated by the controller or the FDPS.

Functional thread description

Data link establishment procedure

Method A: Airborne initiation [normal procedure]

A time parameter (t2A.1) before a data link-equipped aircraft enters airspace where data link services are provided, the pilot or the avionics will need to initiate the log-on procedure. [2A.1, 2]

The avionics will then send the log-on request message which contains the aircraft-unique identifier and the aircraft's current position. [2A.3, 4]

The FDPS will correlate the aircraft-unique identifier with the aircraft identification stored in the FDPS database. [2A.5a]

The FDPS will enter the correlated information into its database. [2A.5b]

The FDPS will then respond to the aircraft's log-on request. [2A.6, 7]

The avionics will acknowledge that the log-on has been effected. [2A.8, 9]

Method B: Ground initiation [exception – where Method A cannot be implemented]

A time parameter (t2B.1) before the FDPS estimates that a data link-equipped aircraft will enter its airspace where data link service is provided, it will identify the need to establish a data link connection with that aircraft. [2B.1]

The FDPS will then generate and send the log-on request message to the aircraft, using the aircraft-unique identifier, and the aircraft identification stored in the FDPS database. [2B.2, 3]

The aircraft will respond to the log-on request and transmit its current position. [2B.4, 5]

The FDPS will confirm the correlation of the aircraft-unique identifier with the aircraft identification stored in the FDPS database. [2B.6a]

The FDPS will update its database using the transmitted position data and other information. [2B.6b]

The FDPS will acknowledge that the log-on has been effected. [2B.7, 8]

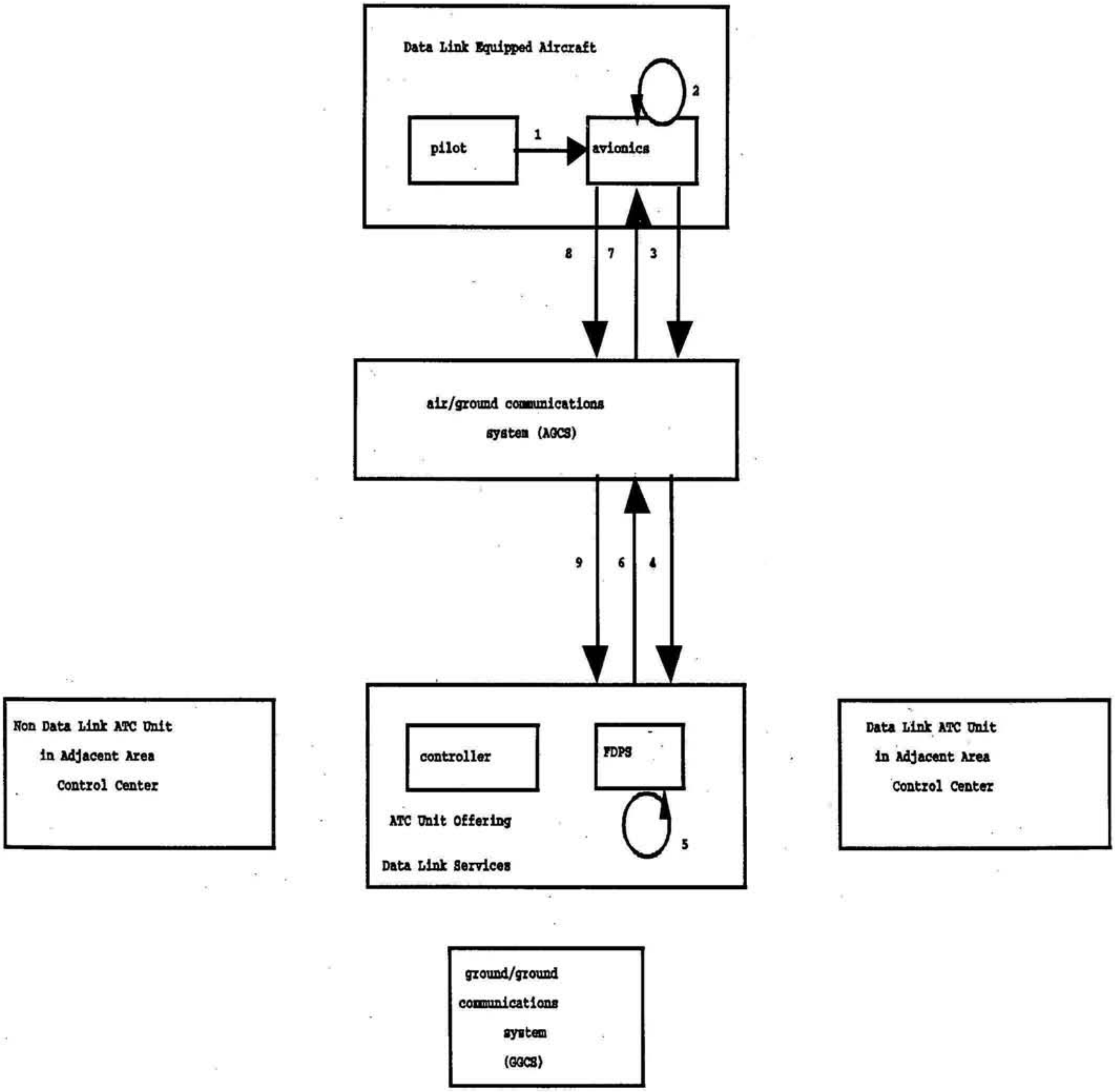
Typical parameters

t2A.1 = 10 − 120 minutes (local procedures)
t2B.1 = 10 − 120 minutes (local procedures)

System performance requirements

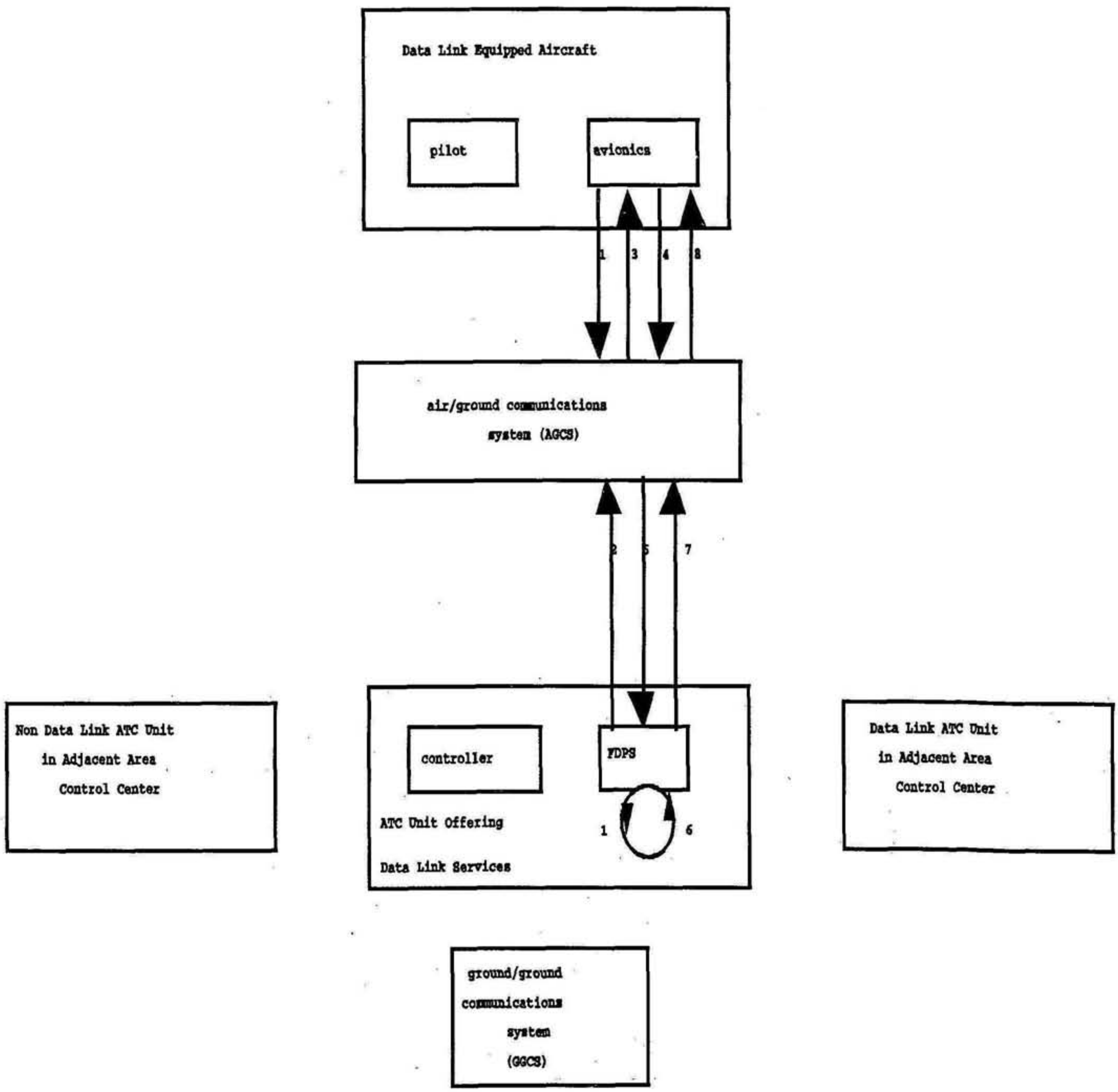
Although not critical from a system viewpoint, it is anticipated that, from initiation to establishment of the data link, the time should not exceed 45 seconds.

O.R. 2 Functional thread diagram: Establishment of a data link between aircraft avionics and the FDPS



Method A: Airborne Initiation

O.R. 2 Functional thread diagram: Establishment of a data link between aircraft avionics and the FDPS



Method B: Ground Initiation

O.R. 3 REGISTRATION OF THE COMMUNICATIONS AND SURVEILLANCE CAPABILITIES OF AN AIRCRAFT WITH THE RECEIVING DATA LINK UNIT'S FDPS

Functional statement

The FDPS will identify the communications and surveillance capabilities of aircraft in order to establish appropriate data link communications.

Functional thread description

For each flight, the FDPS will identify the following aircraft capabilities [3.1]:

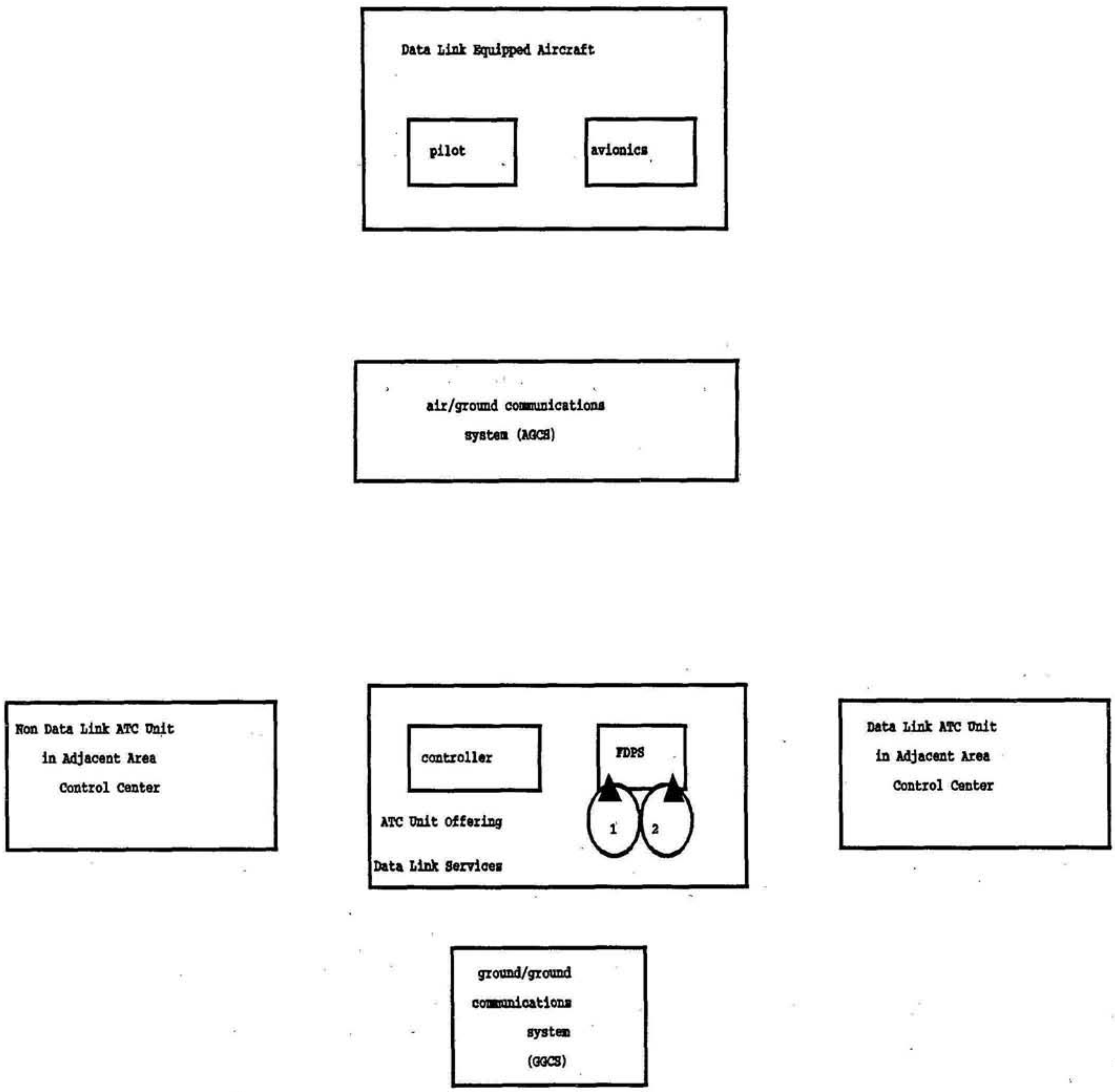
- data link capability;
- voice communications capability; and
- the aircraft's unique address.

The FDPS will maintain a list of participating aircraft, and their current capability, on a real-time basis. [3.2]

System performance requirements

The probability that the registration process is in error shall not exceed 10^{-6}.

O.R. 3 Functional thread diagram: Registration of the communications and surveillance capabilities of an aircraft with the receiving data link ATS facility



O.R. 4 PROVISION OF CONTROLLER-PILOT DATA LINK COMMUNICATIONS (CPDLC)

Functional statement

The system shall support the interchange of data link messages between the pilot and controller to support the effective provision of the ADS-ATC service.

Functional thread description

Downlink: Pilot to controller

The pilot will identify a situation requiring a data link message to the controller. [4A.1]

The pilot will initiate a data link message using either the defined message set or a free-text message or a combination of both. [4A.2]

The avionics will construct and transmit the data link message to the controlling ADS-ATC unit's FDPS. [4.A.3, 4]

The FDPS will display the message to the appropriate controller. [4.A.5]

Uplink: Controller to pilot

The controller will identify a situation requiring a data link message to the pilot. [4B.1]

The controller will initiate a data link message using either the defined message set or a free-text message or a combination of both. [4.B.2]

The FDPS will construct and transmit the data link message to the appropriate aircraft's avionics. [4.B.3, 4]

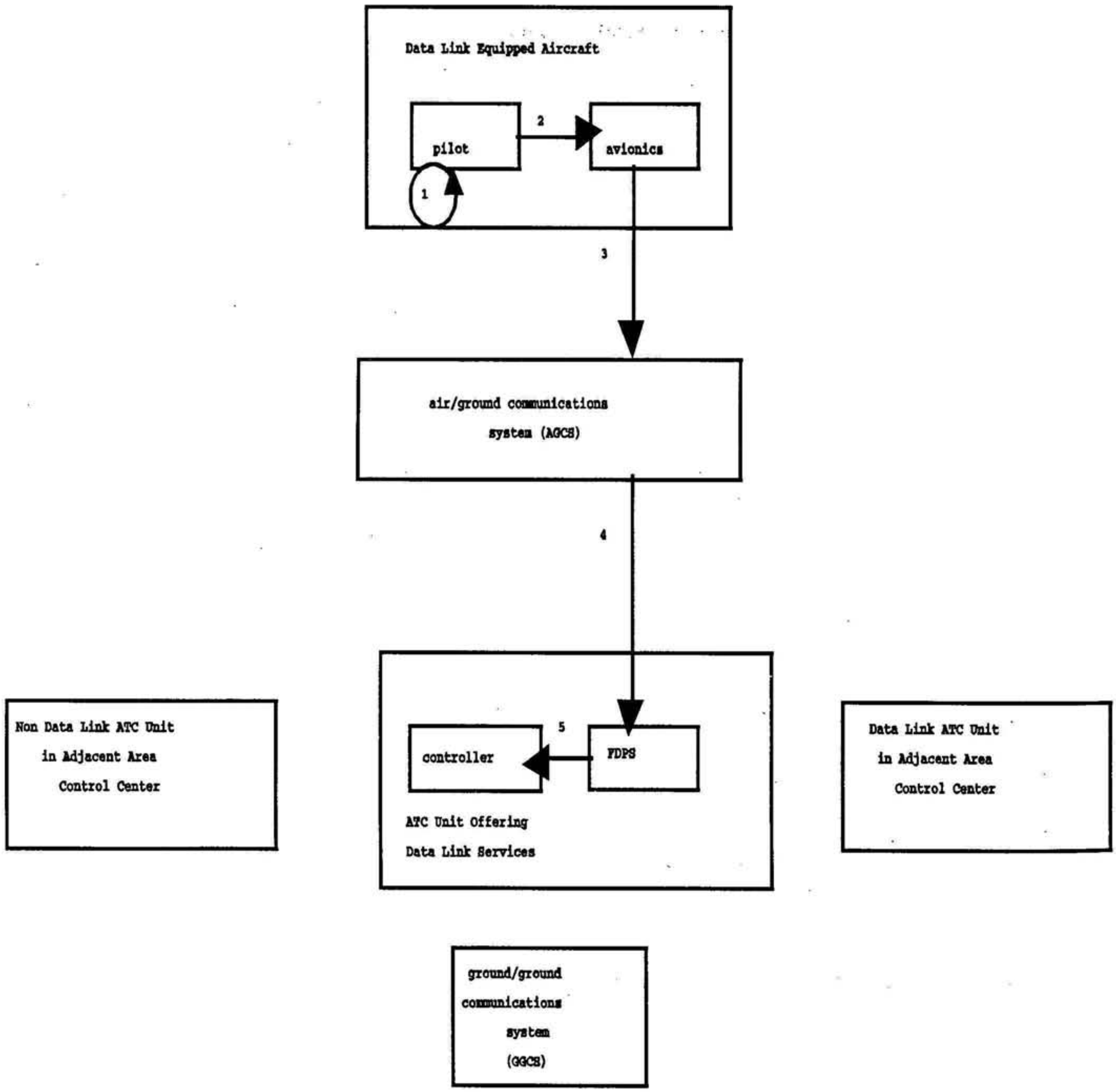
The avionics will display the message to the pilot. [4.B.5]

System performance requirements

The probability of establishing an erroneous link shall not exceed 10^{-7}

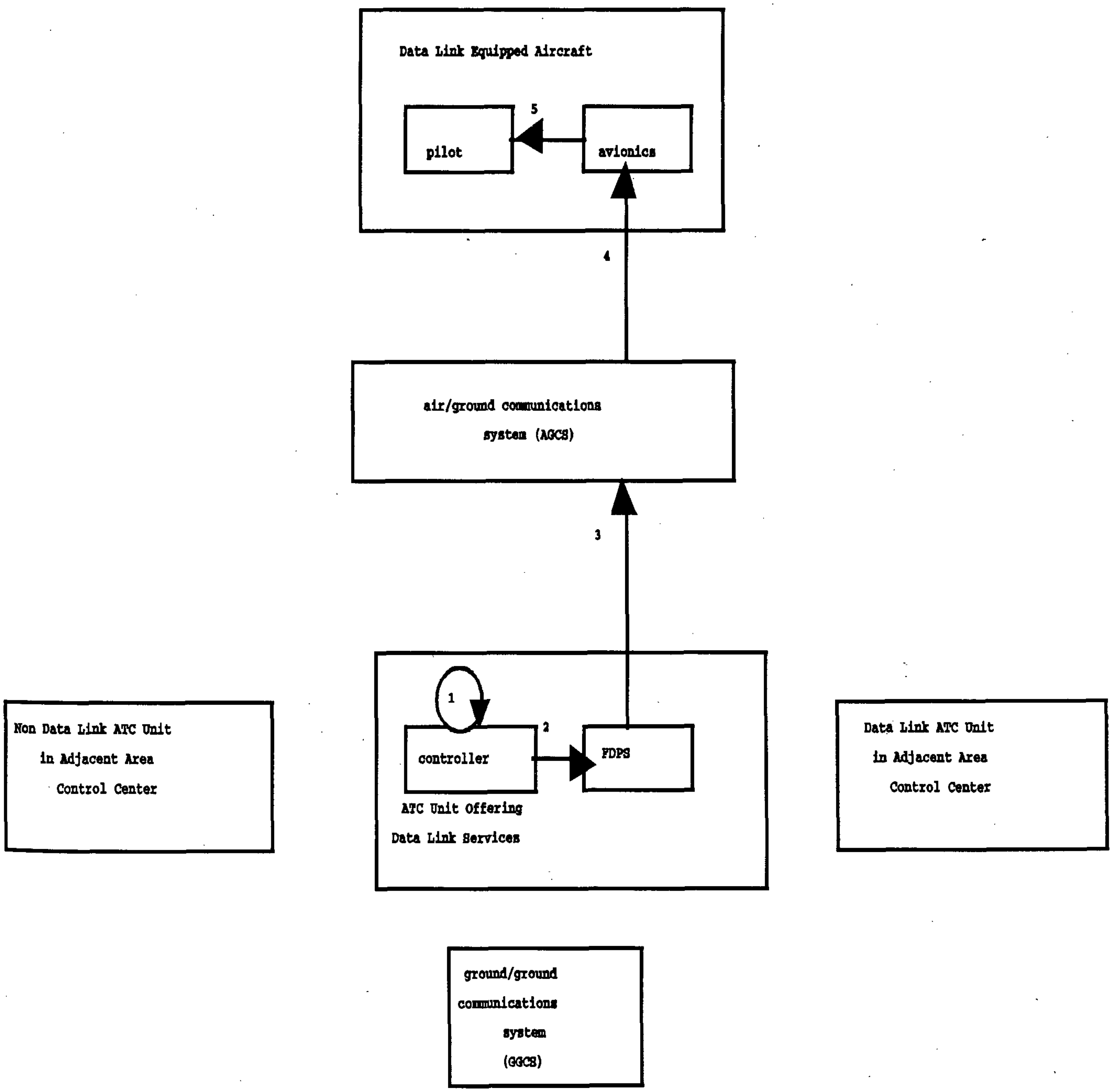
The time between a message being sent and its display to the recipient shall not exceed 10 seconds.

O.R. 4 Functional thread diagram: Provision of direct controller-pilot data link communications



Method A: Airborne Initiation

O.R. 4 Functional thread diagram: Provision of direct controller-pilot data link communications



Method B: Ground Initiation

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APPENDIX B

TO PART II, CHAPTER 1

PERFORMANCE REQUIREMENT PARAMETERS FOR THE DATA LINK SYSTEM

To complement the operational requirements (O.R.s), the communications system will need to meet general performance standards which are summarized as:

The probability that a particular message will be delivered with one or more undetected errors shall be less than 10^{-7}.

The probability of non-receipt of a message shall be less than 10^{-6}.

The probability that a particular message will be misdirected shall be less than 10^{-7}.

The minimum availability of the end-to-end data communication system shall be not less than $1-10^{-6}$ to $1-10^{-4}$ over a given period – typically one month.

Except in catastrophic situations, no single end-to-end outage should exceed 30 seconds. [End-to-end availability may be achieved through provision of alternate communications routings where feasible.]

Additionally, the following system performance requirement parameters have been identified for individual O.R.s, to ensure that the overall data link system can fulfil its mission. These parameters are summarized below:

The aircraft time stamp shall be within 1 second of UTC.

O.R. 1 Nil

O.R. 2 From initiation to establishment of the data link between the avionics and the flight data processing system (FDPS), the time should not exceed 45 seconds.

O.R. 3 The probability that the registration process is in error shall not exceed 10^{-6}.

O.R. 4 The probability of establishing an erroneous link shall not exceed 10^{-7}.

The time between a message being sent and its display to the recipient shall not exceed 10 seconds.

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APPENDIX C

TO PART II, CHAPTER 1

SUBSYSTEM REQUIREMENTS OF A DATA LINK SYSTEM

[BASED ON FUNCTIONAL THREAD DIAGRAMS AND FUNCTIONAL THREAD DESCRIPTIONS]

In order to achieve the operational requirements identified and specified above, the various subsystems will require a specific level of functional and performance capability. The data link system, therefore, is seen to comprise the following subsystems:

a) aircraft avionics;

b) air-ground communications system (AGCS);

c) flight data processing system (FDPS); and

d) ground-ground communications system.

In addition, controller and pilot interactions are identified.

The performance requirements of these subsystems — both human and technical — are broken down below.

AVIONICS SUBSYSTEM

The data link-equipped aircraft's avionics shall have the ability to initiate the log-on procedure. [2A.1, 2]

The data link-equipped aircraft's avionics shall have the ability to send log-on requests containing the aircraft-unique identifier and aircraft position to a data link system FDPS. [2A.3, 4]

The data link-equipped aircraft's avionics shall have the ability to acknowledge the effective log-on. [2A.8, 9]

The data link-equipped aircraft's avionics shall accept log-on requests from FDPS. [2B.3]

The data link-equipped aircraft's avionics shall have the ability to respond to the log-on request and transmit its position. [2B.4, 5]

The data link-equipped aircraft's avionics shall accept 'ACK' messages from FDPS. [2B.8]

The data link-equipped aircraft's avionics shall allow a pilot to create a data link message using either the defined data link message set or free text message, or a combination of both. [4A.2]

The data link-equipped aircraft's avionics shall generate and transmit the data link message to the appropriate data link unit's FDPS. [4A.3, 4]

The data link-equipped aircraft's avionics shall receive and process data link messages sent from the controlling data link unit's FDPS. [4B.3, 4]

The data link-equipped aircraft's avionics shall display the message to the pilot. [4B.5]

AIR-GROUND COMMUNICATION SYSTEM (AGCS)

The AGCS shall transfer log-on requests from a data link-equipped aircraft to a data link system FDPS. [2A.3, 4]

The AGCS shall transfer log-on responses from a data link system FDPS to a data link-equipped aircraft. [2A.6, 7]

The AGCS shall transfer acknowledgment from a data link-equipped aircraft to a data link system FDPS. [2A.8, 9]

The AGCS shall transfer log-on requests from a data link system FDPS to a data link-equipped aircraft. [2B.2, 3]

The AGCS shall transfer log-on responses from a data link-equipped aircraft to a data link system FDPS. [2B.4, 5]

The AGCS shall transfer acknowledgment from a data link system FDPS to a data link-equipped aircraft. [2B.7, 8]

The AGCS shall transfer data link messages sent from the data link-equipped aircraft's avionics to the appropriate data link unit's FDPS. [4A.3, 4]

The AGCS shall transfer data link messages from the data link unit's FDPS to the appropriate aircraft. [4B.3, 4]

FLIGHT DATA PROCESSING SYSTEMS

Each relevant FDPS shall extract data link capabilities from the filed flight plan (FPL) of the data link-equipped aircraft. [1.2]

The FDPS shall accept the log-on request from the aircraft. [2A.4]

The FDPS shall maintain a correlation table of ACIDs and aircraft identifiers. [2A.5.b, 2B.6.b]

The FDPS shall correlate the aircraft-unique identifier with the aircraft identification. [2A.5.a]

The FDPS shall respond to a log-on request. [2A.6, 7]

The FDPS shall confirm the correlation between the aircraft-unique identifier and the aircraft identification. [2A.6.a]

The FDPS shall accept 'ACK' messages from the data link-equipped aircraft's avionics for log-on requests. [2A.8, 9]

The FDPS shall identify when it is needed to establish data link connection with an aircraft. [2B.1]

The FDPS shall have the capability to send a log-on request message. [2B.2, 3]

The FDPS shall accept the log-on request from the responding aircraft with its current position. [2B.4, 5]

The FDPS shall confirm the correlation between the aircraft-unique identifier stored in its data base. [2B.6a]

The FDPS shall update its data base using the position and other information transmitted by the aircraft. [2B.6b]

The FDPS shall have the capability to acknowledge the effective log-on. [2B.7, 8]

The FDPS will use FPL information to identify each flight's data link capability, voice capability, and record 24-bit address if applicable. [3.1]

The FDPS must also hold and maintain current information of a flight's communications capabilities. [3.2]

The FDPS will receive and process data link messages sent from data link-equipped aircraft under the data link unit's control. [4A.3, 4]

The FDPS will display the message to the controller. [4A.5]

The FDPS will allow a controller to create a data link message using either the defined message set or free text message, or a combination of both. [4B.2]

The FDPS will generate and transmit the data link message to the appropriate aircraft's avionics. [4B.3, 4]

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PART II – AIR TRAFFIC SERVICES DATA LINK APPLICATIONS

CHAPTER 2. CONTROLLER-PILOT DATA LINK COMMUNICATIONS (CPDLC)

2.1 GENERAL

2.1.2 Controller-pilot data link communications (CPDLC) is a means of communication between controller and pilot, using data link instead of voice for ATC communications.

2.1.2 The CPDLC application provides the ATS facility with data link communications services. The services defined herein include clearances, expected clearances, requests, reports and related ATC information. A "free-text" capability is also provided to exchange information not conforming to defined formats.

2.1.3 Sending a message by CPDLC consists of selecting the addressee, selecting the appropriate message from a displayed menu or by other means which allow fast and efficient message selection, and executing the transmission. Receiving the message takes place by display and/or printing of the message.

2.1.4 CPDLC will be applied in order to remedy a number of shortcomings of voice communication, such as voice channel congestion, misunderstanding due to bad voice quality and/or misinterpretation, and corruption of the signal due to simultaneous transmissions.

2.1.5 Implementation of CPDLC will significantly change the way pilots and controllers communicate. The effect of CPDLC on operations should be carefully studied before deciding the extent to which voice will be replaced by data link.

2.1.6 Among others, the following aspects of CPDLC are to be taken into account in considering its application and in defining procedures:

a) the total time required for selecting a message, transmission of the message, and reading and interpretation of the message;

b) the heads-down time for the pilot and controller; and

c) the inability of the pilot to listen to other transmissions in the same area of operation.

2.2 OPERATIONAL CONCEPT

2.2.1 CPDLC is expected to find initial applications for en-route operations in areas where the use of voice communications is considered not efficient or (for routine operations) unnecessary, thereby reducing voice channel use and eventually reducing the number of required voice channels. The extent to which CPDLC can be applied will be restricted due to limitations such as mentioned under §2.1.6.

2.2.2 Voice communications will continue to be required. Their inherent short transmission delays are well suited to those applications where a rapid exchange, short transactions communications style is required, for example, in high density en-route or terminal airspace and for emergency and non-routine communications. The current level of safety will be maintained despite a change from a voice only-based ATC system to a voice and data link-based ATC system.

2.2.3 **Components of a CPDLC system**

2.2.3.1 A CPDLC system consists of six major components, each of which will be developed according the needs of the users within the constraints of the operational requirements. The six components are the pilot interface, airborne avionics, data link, ground communication interface, ATC automation and controller interface.

2.2.3.2 Pilot interface

2.2.3.2.1 The pilot interface to the data link system must be efficient and easy to operate. Pilot-controller messages require some rapid entry mechanism. Use of data link for pilot-controller communications will result in changes to cockpit procedures, since messages currently transmitted by voice will require system input by the pilot, and receipt of a message will require reading text. Procedures and system should prevent system input errors.

2.2.3.2.2 Possible impact of loss of situational awareness for flight crews need to be considered.

2.2.3.3 Airborne avionics

2.2.3.3.1 CPDLC should be supported by avionics equipment which is able to gather the data from the pilot interface, format the data and direct the data to the appropriate air-ground data link. This on-board equipment should also have the capability to receive messages originated by the controlling ATS unit. Avionics should make maximum use of (data link) equipment already in place in the aircraft.

2.2.3.4 Data link

2.2.3.4.1 The required air-ground data link will be compatible and could be either satellite data link, VHF digital data link, Mode S data link, or any other medium which meets the operational requirements. The ATN and on-board avionics will select the most suitable path based on time-varying considerations such as geographical location, cost, delay, throughput and link availability. For example, in oceanic airspace, satellite data links will most likely be used, while in domestic airspace VHF or Mode S could be used. The resulting system will appear seamless (i.e. independent of the communications system) from the user's perspective.

2.2.3.4.2 Voice communication will be available to supplement data link system operation.

2.2.3.5 Ground communication interface

2.2.3.5.1 The air-ground data link will be connected to the ATC system through a terrestrial communications network. The network will conform to the protocol suite defined as part of the ATN concept. For messages from controller to pilot, the ground ATN routers must choose the most suitable data link device available and route the message to that transmitting station.

2.2.3.6 ATC automation

2.2.3.6.1 CPDLC will require some level of message processing that should be included in the ATC automation component.

2.2.3.6.2 Error detection and correction alerting mechanisms should be implemented.

2.2.3.6.3 The ATC system will allow for safe recovery from response delays, non-response, system failures, system management errors or others errors which impede operation. Systems will be capable of delivering messages associated with error notification and recovery within the time required for safe recovery.

2.2.3.6.4 Use of data link will not impose undue competition for display or control resources. Systems will not preclude access to other functions or unduly conflict with higher priority functions.

2.2.3.7 Controller interface

2.2.3.7.1 The controller interface will contain the required tools for the composition of air-ground data link messages. Air traffic services providers will define and develop specific controller interfaces tailored to their particular needs. The human-machine interface will be left to the individual service provider. Similar to the pilot interface (see §2.2.3.2), the controller interface should be efficient, easy to operate and provide a rapid message input mechanism. The interface should also provide a means to display air-ground messages.

2.3 OPERATIONS

2.3.1 When operating the data link system, there will not be any increase in head-down time which would adversely affect the safe operation of the system.

[*Further material to be developed*]

2.4 PROCEDURES

2.4.1 **General procedures**

2.4.1.1 Data link communications will utilize standard pilot/controller message sets, with free text messages being used as required.

2.4.1.2 When a required response is not successfully delivered, the message initiator is responsible to query the state of the response via an appropriate medium.

2.4.1.3 Execution of a clearance received via data link may begin upon pilot initiation of the action which sends the acceptance message, except when the clearance specifies otherwise.

2.4.1.4 Messages are to be reviewed and responded to in a timely manner upon receipt. If messages are queued, they are to be reviewed sequentially in the order of receipt, with the exception that messages with a higher urgency should be reviewed first.

2.4.1.5 When a controller or pilot communicates via voice, the response should be via voice.

2.4.1.6 If a data link message which requires a closure response is subsequently negotiated via voice, an appropriate data link closure response for that message will still be initiated.

Note. – Even though a voice response may have been provided, a data link response is necessary to ensure proper synchronization of ground and aircraft systems.

2.4.1.7 Pilot-alerting devices may be suppressed during take-off, landing and approach inside the final approach fix, as required for a given aircraft. If a message requiring an alert is received during the suppression period and is still pending at the end of the period, the alert will be re-initiated when the suppression period is over.

2.4.1.8 Procedures should accommodate mixed data link and voice capability, and any potential failure modes, with no disruption of other tasks during critical times and with no more than minimal disruption in non-critical times.

2.4.1.9 Two-way data link-related pilot procedures should be consistent and independent of the flight phase or ATC facility.

2.4.2 Establishment, handover and termination of connection

2.4.2.1 After valid CPDLC addresses are exchanged, the appropriate ATS facility will be enabled to establish a connection with an aircraft. If the aircraft CPDLC capability is on, it will accept the connection request. At this point, normal message traffic may be conducted.

2.4.2.2 Normally, service termination is initiated by the ATS facility to end service or transfer service to the next ATS facility.

2.4.2.3 Only the ATS facility with a current active connection may initiate a connection transfer to the next ATS facility. To accomplish this, the current ATS facility provides the aircraft system with the facility name/type for the next ATS facility. Once this information is received, the aircraft system will only accept a connection request from this "next" ATS facility. However, once established, normal message traffic will not yet be conducted over this connection.

2.4.2.4 The current ATS facility will initiate the connection transfer by sending an "end service" message to the aircraft. Upon receipt, the aircraft system will begin to conduct normal message traffic over the second connection.

2.4.3 Communications failure

2.4.3.1 Complete communications failure will be in accordance with ICAO procedures. In the event that data link communications fail, voice communications will be utilized and an indication of data communication failure will be provided to the controlling authority.

2.5 IMPLEMENTATION

2.5.1 System implementation will adhere to recognized human factors practices and design criteria.

[*Further material to be developed*]

2.6 DATA LINK REQUIREMENTS FOR CPDLC

The following material is based extensively on *MOPS for Two-Way Data Link*, developed by RTCA SC-169.

2.6.1 Message attributes

Each message element presented in Section 2.7.1 and Section 2.7.2 has specific attributes for urgency, alert, response and recall. For a message containing multiple message elements, the attribute for the message element with the highest precedence (1 – highest) shall be assigned to the entire multiple element message.

2.6.1.1 Urgency

2.6.1.1.1 The urgency (URG) attribute delineates the relative relationship among messages when placed in a queue for operator access. Types are presented in Table 2.6.1.1-1 and are used for both uplink and downlink messages. Message urgency should not be confused with communication priority.

Type	Description	Precedence
D	Distress	1
U	Urgent	2
N	Normal	3
L	Low	4

Table 2.6.1.1-1. Urgency attribute (uplink and downlink)

2.6.1.2 Alert

The alert (ALRT) attribute delineates the type of operator-alerting required upon message receipt. Types are presented in Table 2.6.1.2-1 for uplink messages and Table 2.6.1.2-2 for downlink messages.

Type	Description	Precedence
A/D	Unique aural and visual indication of message presence	1
A	Aural and visual indication of message presence	2
V	Secondary field-of-view visual alert or aural and visual indication of message presence	3
N	No alerting required	4

Table 2.6.1.2-1. Alerting attribute (uplink)

Type	Description	Precedence
H	High	1
M	Medium	2
L	Low	3

Table 2.6.1.2-2. Alert attribute (downlink)

2.6.1.3 Response

The response (RESP) attribute delineates related operator response requirements for a given message element. Types are presented in Table 2.6.1.3-1 for uplink messages and Table 2.6.1.3-2 for downlink messages.

Type	Description	Precedence
W/U	WILCO, UNABLE, STANDBY	1
A/N	AFFIRM, NEGATIVE, STANDBY	2
R	ROGER, STANDBY	3
NE	WILCO, UNABLE, AFFIRM, NEGATIVE, ROGER, STANDBY, not enabled	4

Table 2.6.1.3-1. Response attribute (uplink)

Type	Description	Precedence
Y	Response required	1
N	Response not required	2

Table 2.6.1.3-2. Response attribute (downlink)

2.6.1.4 Recall

The recall (REC) attribute delineates specific categories concerning operator review of previously received messages. Types are presented in Table 2.6.1.4-1 for uplink messages. There are no required recall types for downlink messages.

Type	Description
VC	Vertical (level) clearance message
RC	Route clearance message
EC	Expected route clearance/level message

Table 2.6.1.4-1. Recall attribute (uplink)

2.6.2 **Connection management**

Requirements for connection management, namely, connection establishment and connection transfer/termination, are stated in Appendix B to this chapter.

2.6.3 **Message handling**

2.6.3.1 The presentation of messages is a local implementation. Recommendations for presenting messages are shown in Sections 2.7.1 and 2.7.2. The message structure and content shall conform to the abstract syntax in Appendix A to this chapter. The data structures glossary is also presented in Appendix A to this chapter.

2.6.3.2 Until specified by an appropriate body, it is recommended that ISO/IEC JTC 1/SC 21 Draft International Standard ISO/IEC DIS 8825-2, "Packed Encoding Rules (PER) – Basic Unaligned", dated June 1993, or a functionally equivalent means, be utilized to encode/decode the ASN.1 message structure and content. It is also recommended that encoded messages be padded with bits set to the zero value at the end of the message to achieve an integral number of octets.

2.6.3.3 A message identification number shall be assigned for each CPDLC message initiated for transmission. If the uplink message requires a response, the message identification number for that message shall not be utilized for another message until a response which closes the transaction has been received.

2.6.3.4 If a message which requires a response, and the response has not been received, is deleted, the message identification number for that message shall not be utilized for the duration of that connection.

2.6.3.5 If no message identification numbers are available for subsequent transmission of messages, the ATS facility shall send a "disconnect request" for the connection.

2.6.3.6 If received messages are queued for display, messages with the highest urgency type shall be placed at the beginning of the queue. Messages with the same urgency type shall be queued in order of receipt.

2.6.3.7 Message handling concerning alert type is considered to be a local implementation.

2.6.3.8 If a message has a "Y" response type, the message identification number of that message shall be used as the message reference number for the uplink message with the response message element(s).

2.6.4 **Communication system interface**

All CPDLC connections shall be established utilizing an internetwork protocol priority value using safety of flight priority. Priority is established per connection, and message urgency should be used to indicate message queuing over a priority. The set-up time required to acquire a higher priority channel will usually take longer than sending urgent messages on the previously established channel.

2.6.5 **Security**

2.6.5.1 A security mechanism shall be provided which ensures that only authorized users are allowed access to the CPDLC application.

2.6.5.2 The CPDLC application, in conjunction with the communication network, shall provide a security mechanism which ensures that only authorized CPDLC applications are allowed access to other authorized CPDLC applications via the communication network.

2.7 MESSAGES

The following material is based extensively on *MOPS for Two-Way Data Link*, developed by RTCA SC-69.

Appendix D to this chapter defines message data elements, ranges and resolution in detail. The abstract syntax notation (ASN.1) representation of the communications data structures is contained in Appendix A to this chapter.

Note. — Appendix C to this chapter contains sample messages showing the encoding scheme and resultant bits.

2.7.1 **Uplink messages**

Uplink messages for ATC two-way data link communications are presented in this section.

	Message Element	URG	ALRT	RESP	REC
0	UNABLE	N	V	NE	
1	STANDBY	N	V	NE	
2	REQUEST DEFERRED	N	V	NE	
3	ROGER	N	V	NE	
4	AFFIRM	N	V	NE	
5	NEGATIVE	N	V	NE	

Table 2.7.1-1. Responses/acknowledgements (uplink)

	Message Element	URG	ALRT	RESP	REC
6	EXPECT [level]	L	V	R	EC
7	EXPECT CLIMB AT [time]	L	V	R	EC
8	EXPECT CLIMB AT [position]	L	V	R	EC
9	EXPECT DESCENT AT [time]	L	V	R	EC
10	EXPECT DESCENT AT [position]	L	V	R	EC
11	EXPECT CRUISE CLIMB AT [time]	L	V	R	EC
12	EXPECT CRUISE CLIMB AT [position]	L	V	R	EC
13	AT [time] EXPECT CLIMB TO [level]	L	V	R	EC
14	AT [position] EXPECT CLIMB TO [level]	L	V	R	EC
15	AT [time] EXPECT DESCENT TO [level]	L	V	R	EC
16	AT [position] EXPECT DESCENT TO [level]	L	V	R	EC
17	AT [time] EXPECT CRUISE CLIMB TO [level]	L	V	R	EC
18	AT [position] EXPECT CRUISE CLIMB TO [level]	L	V	R	EC
19	MAINTAIN [level]	N	A	W/U	VC
20	CLIMB TO AND MAINTAIN [level]	N	A	W/U	VC
21	AT [time] CLIMB TO AND MAINTAIN [level]	N	A	W/U	VC
22	AT [position] CLIMB TO AND MAINTAIN [level]	N	A	W/U	VC
tbd 3	AFTER PASSING [position] CLIMB TO AND MAINTAIN [level]	N	A	W/U	VC
23	DESCEND TO AND MAINTAIN [level]	N	A	W/U	VC
24	AT [time] DESCEND TO AND MAINTAIN [level]	N	A	W/U	VC
25	AT [position] DESCEND TO AND MAINTAIN [level]	N	A	W/U	VC
tbd 4	AFTER PASSING [position] DESCEND TO AND MAINTAIN [level]	N	A	W/U	VC
26	CLIMB TO REACH [level] BY [time]	N	A	W/U	VC
27	CLIMB TO REACH [level] BY [position]	N	A	W/U	VC
28	DESCEND TO REACH [level] BY [time]	N	A	W/U	VC
29	DESCEND TO REACH [level] BY [position]	N	A	W/U	VC
30	MAINTAIN BLOCK [level] TO [level]	N	A	W/U	VC
31	CLIMB TO AND MAINTAIN BLOCK [level] TO [level]	N	A	W/U	VC
32	DESCEND TO AND MAINTAIN BLOCK [level] TO [level]	N	A	W/U	VC
33	CRUISE [level]	N	A	W/U	VC
34	CRUISE CLIMB TO [level]	N	A	W/U	VC
35	CRUISE CLIMB ABOVE [level]	N	A	W/U	VC
36	EXPEDITE CLIMB TO [level]	U	A	W/U	VC
37	EXPEDITE DESCENT TO [level]	U	A	W/U	VC
38	IMMEDIATELY CLIMB TO [level]	D	A/D	W/U	VC
39	IMMEDIATELY DESCEND TO [level]	D	A/D	W/U	VC
40	IMMEDIATELY STOP CLIMB AT [level]	D	A/D	W/U	VC
41	IMMEDIATELY STOP DESCENT AT [level]	D	A/D	W/U	VC
171	CLIMB AT [verticalrate] MINIMUM	N	A	W/U	
172	CLIMB AT [verticalrate] MAXIMUM	N	A	W/U	
173	DESCEND AT [verticalrate] MINIMUM	N	A	W/U	
174	DESCEND AT [verticalrate] MAXIMUM	N	A	W/U	

Table 2.7.1-2. Vertical clearances (uplink)

	Message Element	URG	ALRT	RESP	REC
42	EXPECT TO CROSS [position] AT [level]	L	V	R	EC
43	EXPECT TO CROSS [position] AT OR ABOVE [level]	L	V	R	EC
44	EXPECT TO CROSS [position] AT OR BELOW [level]	L	V	R	EC
45	EXPECT TO CROSS [position] AT AND MAINTAIN [level]	L	V	R	EC
46	CROSS [position] AT [level]	N	A	W/U	VC
47	CROSS [position] AT OR ABOVE [level]	N	A	W/U	VC
48	CROSS [position] AT OR BELOW [level]	N	A	W/U	VC
49	CROSS [position] AT AND MAINTAIN [level]	N	A	W/U	VC
50	CROSS [position] BETWEEN [level] AND [level]	N	A	W/U	VC
51	CROSS [position] AT [time]	N	A	W/U	
52	CROSS [position] AT OR BEFORE [time]	N	A	W/U	
53	CROSS [position] AT OR AFTER [time]	N	A	W/U	
54	CROSS [position] BETWEEN [time] AND [time]	N	A	W/U	
55	CROSS [position] AT [speed]	N	A	W/U	
56	CROSS [position] AT OR LESS THAN [speed]	N	A	W/U	
57	CROSS [position] AT OR GREATER THAN [speed]	N	A	W/U	
58	CROSS [position] AT [time] AT [level]	N	A	W/U	VC
59	CROSS [position] AT OR BEFORE [time] AT [level]	N	A	W/U	VC
60	CROSS [position] AT OR AFTER [time] AT [level]	N	A	W/U	VC
61	CROSS [position] AT AND MAINTAIN [level] AT [speed]	N	A	W/U	VC
62	AT [time] CROSS [position] AT AND MAINTAIN [level]	N	A	W/U	VC
63	AT [time] CROSS [position] AT AND MAINTAIN [level] AT [speed]	N	A	W/U	VC

Table 2.7.1-3. Crossing constraints (uplink)

	Message Element	URG	ALRT	RESP	REC
64	OFFSET [distanceoffset] [direction] OF ROUTE	N	A	W/U	
65	AT [position] OFFSET [distanceoffset] [direction] OF ROUTE	N	A	W/U	
66	AT [time] OFFSET [distanceoffset] [direction] OF ROUTE	N	A	W/U	
67	PROCEED BACK ON ROUTE	N	A	W/U	
68	REJOIN ROUTE BY [position]	N	A	W/U	
69	REJOIN ROUTE BY [time]	N	A	W/U	
70	EXPECT BACK ON ROUTE BY [position]	L	V	R	
71	EXPECT BACK ON ROUTE BY [time]	L	V	R	
72	RESUME OWN NAVIGATION	N	A	W/U	

Table 2.7.1-4. Lateral offsets (uplink)

	Message Element	URG	ALRT	RESP	REC
73	[predepartureclearance]	N	A	W/U	RC
74	PROCEED DIRECT TO [position]	N	A	W/U	
75	WHEN ABLE PROCEED DIRECT TO [position]	N	A	W/U	
76	AT [time] PROCEED DIRECT TO [position]	N	A	W/U	
77	AT [position] PROCEED DIRECT TO [position]	N	A	W/U	
78	AT [level] PROCEED DIRECT TO [position]	N	A	W/U	
79	CLEARED TO [position] VIA [routeclearance]	N	A	W/U	RC
80	CLEARED [routeclearance]	N	A	W/U	RC
178	[trackdetailmsg]	N	A	W/U	RC
81	CLEARED [procedurename]	N	A	W/U	RC
82	CLEARED TO DEVIATE UP TO [distanceoffset] [direction] OF ROUTE	N	A	W/U	
83	AT [position] CLEARED [routeclearance]	N	A	W/U	RC
84	AT [position] CLEARED [procedurename]	N	A	W/U	RC
85	EXPECT [routeclearance]	L	V	R	EC
86	AT [position] EXPECT [routeclearance]	L	V	R	EC
87	EXPECT DIRECT TO [position]	L	V	R	
88	AT [position] EXPECT DIRECT TO [position]	L	V	R	
89	AT [time] EXPECT DIRECT TO [position]	L	V	R	
90	AT [level] EXPECT DIRECT TO [position]	L	V	R	
91	HOLD AT [position] MAINTAIN [level] INBOUND TRACK [degrees] [direction] TURNS [legtype]	N	A	W/U	VC
92	HOLD AT [position] AS PUBLISHED MAINTAIN [level]	N	A	W/U	VC
93	EXPECT FURTHER CLEARANCE AT [time]	L	V	R	
94	TURN [direction] HEADING [degrees]	N	A	W/U	
95	TURN [direction] GROUND TRACK [degrees]	N	A	W/U	
96	FLY PRESENT HEADING	N	A	W/U	
97	AT [position] FLY HEADING [degrees]	N	A	W/U	
98	IMMEDIATELY TURN [direction] HEADING [degrees]	D	A/D	W/U	
99	EXPECT [procedurename]	L	V	R	EC

Table 2.7.1-5. Route modifications (uplink)

	Message Element	URG	ALRT	RESP	REC
100	AT [time] EXPECT [speed]	L	V	R	
101	AT [position] EXPECT [speed]	L	V	R	
102	AT [level] EXPECT [speed]	L	V	R	
103	AT [time] EXPECT [speed] TO [speed]	L	V	R	
104	AT [position] EXPECT [speed] TO [speed]	L	V	R	
105	AT [level] EXPECT [speed] TO [speed]	L	V	R	
106	MAINTAIN [speed]	N	A	W/U	
tbd6	AFTER PASSING [position] MAINTAIN [speed]	N	A	W/U	
107	MAINTAIN PRESENT SPEED	N	A	W/U	
108	MAINTAIN [speed] OR GREATER	N	A	W/U	
109	MAINTAIN [speed] OR LESS	N	A	W/U	
110	MAINTAIN [speed] TO [speed]	N	A	W/U	
111	INCREASE SPEED TO [speed]	N	A	W/U	
112	INCREASE SPEED TO [speed] OR GREATER	N	A	W/U	
113	REDUCE SPEED TO [speed]	N	A	W/U	
114	REDUCE SPEED TO [speed] OR LESS	N	A	W/U	
115	DO NOT EXCEED [speed]	N	A	W/U	
116	RESUME NORMAL SPEED	N	A	W/U	
tbd7	ADJUST SPEED	N	A	W/U	

Table 2.7.1-6. Speed changes (uplink)

	Message Element	URG	ALRT	RESP	REC
117	CONTACT [icaounitname] [frequency]	N	A	W/U	
118	AT [position] CONTACT [icaounitname] [frequency]	N	A	W/U	
119	AT [time] CONTACT [icaounitname] [frequency]	N	A	W/U	
120	MONITOR [icaounitname] [frequency]	N	A	W/U	
121	AT [position] MONITOR [icaounitname] [frequency]	N	A	W/U	
122	AT [time] MONITOR [icaounitname] [frequency]	N	A	W/U	
123	SQUAWK [beaconcode]	N	A	W/U	
124	STOP SQUAWK	N	A	W/U	
125	SQUAWK ALTITUDE	N	A	W/U	
126	STOP ALTITUDE SQUAWK	N	A	W/U	
179	SQUAWK IDENT	N	A	W/U	

Table 2.7.1-7. Contact/monitor/surveillance requests (uplink)

	Message Element	URG	ALRT	RESP	REC
127	REPORT BACK ON ROUTE	N	A	R	
128	REPORT LEAVING [level]	N	A	R	
129	REPORT LEVEL [level]	N	A	R	
175	REPORT REACHING [level]	N	A	R	
180	REPORT REACHING BLOCK [level] TO [level]	N	A	R	
tbd1	REPORT PASSING [level]	N	A	R	
130	REPORT PASSING [position]	N	A	R	
181	REPORT DISTANCE [tofrom] [position]	N	A	NE	
tbd2	AT [time] REPORT DISTANCE [tofrom] [position]	N	A	NE	
131	REPORT REMAINING FUEL AND SOULS ON BOARD	N	A	NE	
132	CONFIRM POSITION	N	A	NE	
133	CONFIRM LEVEL	N	A	NE	
134	CONFIRM SPEED	N	A	NE	
135	CONFIRM ASSIGNED LEVEL	N	A	NE	
136	CONFIRM ASSIGNED SPEED	N	A	NE	
137	CONFIRM ASSIGNED ROUTE	N	A	NE	
138	CONFIRM TIME OVER REPORTED WAYPOINT	N	A	NE	
139	CONFIRM REPORTED WAYPOINT	N	A	NE	
140	CONFIRM NEXT WAYPOINT	N	A	NE	
141	CONFIRM NEXT WAYPOINT ETA	N	A	NE	
142	CONFIRM ENSUING WAYPOINT	N	A	NE	
143	CONFIRM REQUEST	N	A	NE	
144	CONFIRM SQUAWK	N	A	NE	
145	CONFIRM HEADING	N	A	NE	
146	CONFIRM GROUND TRACK	N	A	NE	
182	CONFIRM ATIS CODE	N	A	NE	
147	REQUEST POSITION REPORT	N	A	NE	

Table 2.7.1-8. Report/confirmation requests (uplink)

	Message Element	URG	ALRT	RESP	REC
148	WHEN CAN YOU ACCEPT [level]	N	A	NE	
149	CAN YOU ACCEPT [level] AT [position]	N	A	A/N	
150	CAN YOU ACCEPT [level] AT [time]	N	A	A/N	
151	WHEN CAN YOU ACCEPT [speed]	N	A	NE	
152	WHEN CAN YOU ACCEPT [distanceoffset] [direction] OFFSET	N	A	NE	

Table 2.7.1-9. Negotiation requests (uplink)

	Message Element	URG	ALRT	RESP	REC
153	ALTIMETER [altimeter]	N	A	R	
154	RADAR SERVICES TERMINATED	N	A	R	
155	RADAR CONTACT [position]	N	A	R	
156	RADAR CONTACT LOST	N	A	R	
157	CHECK STUCK MICROPHONE [frequency]	U	A	R	
158	ATIS [atiscode]	N	A	R	

Table 2.7.1-10. Air traffic advisories (uplink)

	Message Element	URG	ALRT	RESP	REC
159	ERROR [errorinformation]	U	A	NE	
160	NEXT DATA AUTHORITY [icaofacilitydesignation]	L	N	NE	
161	END SERVICE	L	N	NE	
162	SERVICE UNAVAILABLE	L	V	NE	
163	[icaofacilitydesignation] [tp4table]	L	N	NE	

Table 2.7.1-11. System management messages (uplink)

	Message Element	URG	ALRT	RESP	REC
164	WHEN READY	L	N	NE	
165	THEN	L	N	NE	
166	DUE TO TRAFFIC	L	N	NE	
167	DUE TO AIRSPACE RESTRICTION	L	N	NE	
168	DISREGARD	N	A	R	
176	MAINTAIN OWN SEPARATION AND VMC	N	A	W/U	
177	AT PILOTS DISCRETION	L	L	N	
tbd5	RECLEARED	N	A	N	
169	[freetext]	N	V	R	
170	[freetext]	D	A/D	R	

Table 2.7.1-12. Additional messages (uplink)

2.7.2 Downlink messages

Down-link messages for ATC two-way data link communications are presented in this section.

	Message Element	URG	ALRT	RESP
0	WILCO	N	M	N
1	UNABLE	N	M	N
2	STANDBY	N	M	N
3	ROGER	N	M	N
4	AFFIRM	N	M	N
5	NEGATIVE	N	M	N

Table 2.7.2-1. Responses (downlink)

	Message Element	URG	ALRT	RESP
6	REQUEST [level]	N	L	Y
7	REQUEST BLOCK [level] TO [level]	N	L	Y
8	REQUEST CRUISE CLIMB TO [level]	N	L	Y
9	REQUEST CLIMB TO [level]	N	L	Y
10	REQUEST DESCENT TO [level]	N	L	Y
11	AT [position] REQUEST CLIMB TO [level]	N	L	Y
12	AT [position] REQUEST DESCENT TO [level]	N	L	Y
13	AT [time] REQUEST CLIMB TO [level]	N	L	Y
14	AT [time] REQUEST DESCENT TO [level]	N	L	Y
69	REQUEST VMC DESCENT	N	L	Y

Table 2.7.2-2. Vertical requests (downlink)

	Message Element	URG	ALRT	RESP
15	REQUEST OFFSET [distanceoffset] [direction] OF ROUTE	N	L	Y
16	AT [position] REQUEST OFFSET [distanceoffset] [direction] OF ROUTE	N	L	Y
17	AT [time] REQUEST OFFSET [distanceoffset] [direction] OF ROUTE	N	L	Y

Table 2.7.2-3. Lateral off-set requests (downlink)

	Message Element	URG	ALRT	RESP
18	REQUEST [speed]	N	L	Y
19	REQUEST [speed] TO [speed]	N	L	Y

Table 2.7.2-4. Speed requests (downlink)

	Message Element	URG	ALRT	RESP
20	REQUEST VOICE CONTACT	N	L	Y
21	REQUEST VOICE CONTACT [frequency]	N	L	Y

Table 2.7.2-5. Voice contact requests (downlink)

	Message Element	URG	ALRT	RESP
22	REQUEST DIRECT TO [position]	N	L	Y
23	REQUEST [procedurename]	N	L	Y
24	REQUEST [routeclearance]	N	L	Y
25	REQUEST CLEARANCE	N	L	Y
26	REQUEST WEATHER DEVIATION TO [position] VIA [routeclearance]	N	L	Y
27	REQUEST WEATHER DEVIATION UP TO [distanceoffset] [direction] OF ROUTE	N	L	Y
70	REQUEST HEADING [degrees]	N	L	Y
71	REQUEST GROUND TRACK [degrees]	N	L	Y

Table 2.7.2-6. Route modification requests (downlink)

	Message Element	URG	ALRT	RESP
28	LEAVING [level]	N	M	N
29	CLIMBING TO [level]	N	M	N
30	DESCENDING TO [level]	N	M	N
31	PASSING [position]	N	M	N
78	AT [time] [distance] [tofrom] [position]	N	M	N
32	PRESENT LEVEL [level]	N	M	N
33	PRESENT POSITION [position]	N	M	N
34	PRESENT SPEED [speed]	N	M	N
35	PRESENT HEADING [degrees]	N	M	N
36	PRESENT GROUND TRACK [degrees]	N	M	N
37	LEVEL [level]	N	M	N
72	REACHING [level]	N	M	N
76	REACHING BLOCK [level] TO [level]	N	M	N
38	ASSIGNED LEVEL [level]	N	M	N
77	ASSIGNED BLOCK [level] TO [level]	N	M	N
39	ASSIGNED SPEED [speed]	N	M	N
40	ASSIGNED ROUTE [routeclearance]	N	M	N
41	BACK ON ROUTE	N	M	N
42	NEXT WAYPOINT [position]	N	M	N
43	NEXT WAYPOINT ETA [time]	N	M	N
44	ENSUING WAYPOINT [position]	N	M	N
45	REPORTED WAYPOINT [position]	N	M	N
46	REPORTED WAYPOINT [time]	N	M	N
47	SQUAWKING [beaconcode]	N	M	N
48	POSITION REPORT [positionreport]	N	M	N
79	ATIS [atiscode]	N	M	N

Table 2.7.2-7. Reports (downlink)

	Message Element	URG	ALRT	RESP
49	WHEN CAN WE EXPECT [speed]	L	L	Y
50	WHEN CAN WE EXPECT [speed] TO [speed]	L	L	Y
51	WHEN CAN WE EXPECT BACK ON ROUTE	L	L	Y
52	WHEN CAN WE EXPECT LOWER LEVEL	L	L	Y
53	WHEN CAN WE EXPECT HIGHER LEVEL	L	L	Y
54	WHEN CAN WE EXPECT CRUISE CLIMB TO [level]	L	L	Y

Table 2.7.2-8. Negotiation requests (downlink)

	Message Element	URG	ALRT	RESP
55	PAN PAN PAN	U	H	N
56	MAYDAY MAYDAY MAYDAY	D	H	N
57	[remainingfuel] OF FUEL REMAINING AND [remainingsouls] SOULS ON BOARD	U	H	N
58	CANCEL EMERGENCY	U	M	N
59	DIVERTING TO [position] VIA [routeclearance]	U	H	N
60	OFFSETTING [distanceoffset] [direction] OF ROUTE	U	H	N
61	DESCENDING TO [level]	U	H	N

Table 2.7.2-9. Emergency messages (downlink)

	Message Element	URG	ALRT	RESP
62	ERROR [errorinformation]	U	L	N
63	NOT CURRENT DATA AUTHORITY	L	L	N
64	[icaofacilitydesignation]	L	L	N
73	[versionnumber]	L	L	N

Table 2.7.2-10. System management messages (downlink)

	Message Element	URG	ALRT	RESP
65	DUE TO WEATHER	L	L	N
66	DUE TO AIRCRAFT PERFORMANCE	L	L	N
74	MAINTAIN OWN SEPARATION AND VMC	L	L	N
75	AT PILOTS DISCRETION	L	L	N
67	[freetext]	N	L	N
68	[freetext]	D	H	Y

Table 2.7.2-11. Additional messages (downlink)

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APPENDIX A

TO PART II, CHAPTER 2

CPDLC MESSAGE STRUCTURE – ASN.1 REPRESENTATION AND GLOSSARY

A.1 Message structure and content

CPDLC message structure and content shall conform to the abstract syntax in this section.

```
ACTwoWayDataLinkCommunications  DEFINITIONS IMPLICIT TAGS ::=  BEGIN

ATCuplinkmessage ::=   SEQUENCE
      {
                                                ATCmessageheader,
                                                ATCuplinkmsgelementid,
            aTCuplinkmsgelementid-seqOf  SEQUENCE SIZE (1..4) OF ATCuplinkmsgelementid
                                                OPTIONAL
      }

      ATCmessageheader ::= SEQUENCE
            {
                  Msgidentificationnumber,
                  Msgreferencenumber             OPTIONAL
            }

            Msgidentificationnumber ::= INTEGER (0..63)

            Msgreferencenumber ::= INTEGER (0..63)

ATCuplinkmsgelementid ::= CHOICE
      {

-- UNABLE                                                    Urg(N)/Alr(V)/Resp(NE )/Rec( )
   uM0NULL                          [0] UM0NULL,

-- STANDBY                                                   Urg(N)/Alr(V)/Resp(NE )/Rec( )
   uM1NULL                          [1] UM1NULL,

-- REQUEST DEFERRED                                          Urg(N)/Alr(V)/Resp(NE )/Rec( )
   uM2NULL                          [2] UM2NULL,

-- ROGER                                                     Urg(N)/Alr(V)/Resp(NE )/Rec( )
   uM3NULL                          [3] UM3NULL,

-- AFFIRM                                                    Urg(N)/Alr(V)/Resp(NE )/Rec( )
   uM4NULL                          [4] UM4NULL,
```

-- NEGATIVE		Urg(N)/Alr(V)/Resp(NE)/Rec( )
uM5NULL	[5] UM5NULL,	
-- EXPECT [level]		Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM6Level	[6] UM6Level,	
-- EXPECT CLIMB AT [time]		Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM7Time	[7] UM7Time,	
-- EXPECT CLIMB AT [position]		Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM8Position	[8] UM8Position,	
-- EXPECT DESCENT AT [time]		Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM9Time	[9] UM9Time,	
-- EXPECT DESCENT AT [position]		Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM10Position	[10] UM10Position,	
-- EXPECT CRUISE CLIMB AT [time]		Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM11Time	[11] UM11Time,	
-- EXPECT CRUISE CLIMB AT [position]		Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM12Position	[12] UM12Position,	
-- AT [time] EXPECT CLIMB TO [level]		Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM13TimeLevel	[13] UM13TimeLevel,	
-- AT [position] EXPECT CLIMB TO [level]		Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM14PositionLevel	[14] UM14PositionLevel,	
-- AT [time] EXPECT DESCENT TO [level]		Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM15TimeLevel	[15] UM15TimeLevel,	
-- AT [position] EXPECT DESCENT TO [level]		Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM16PositionLevel	[16] UM16PositionLevel,	
-- AT [time] EXPECT CRUISE CLIMB TO [level]		Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM17TimeLevel	[17] UM17TimeLevel,	
-- AT [position] EXPECT CRUISE CLIMB TO [level]		Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM18PositionLevel	[18] UM18PositionLevel,	
-- MAINTAIN [level]		Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
uM19Level	[19] UM19Level,	
-- CLIMB TO AND MAINTAIN [level]		Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
uM20Level	[20] UM20Level,	
-- AT [time] CLIMB TO AND MAINTAIN [level]		Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
uM21TimeLevel	[21] UM21TimeLevel,	
-- AT [position] CLIMB TO AND MAINTAIN [level]		Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
uM22PositionLevel	[22] UM22PositionLevel,	

-- DESCEND TO AND MAINTAIN [level] uM23Level	[23] UM23Level,	Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
-- AT [time] DESCEND TO AND MAINTAIN [level] uM24TimeLevel	[24] UM24TimeLevel,	Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
-- AT [position] DESCEND TO AND MAINTAIN [level] uM25PositionLevel	[25] UM25PositionLevel,	Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
-- CLIMB TO REACH [level] BY [time] uM26LevelTime	[26] UM26LevelTime,	Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
-- CLIMB TO REACH [level] BY [position] uM27LevelPosition	[27] UM27LevelPosition,	Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
-- DESCEND TO REACH [level] BY [time] uM28LevelTime	[28] UM28LevelTime,	Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
-- DESCEND TO REACH [level] BY [position] uM29LevelPosition	[29] UM29LevelPosition,	Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
-- MAINTAIN BLOCK [level] TO [level] uM30LevelLevel	[30] UM30LevelLevel,	Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
-- CLIMB TO AND MAINTAIN BLOCK -- [level] TO [level] uM31LevelLevel	[31] UM31LevelLevel,	Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
-- DESCEND TO AND MAINTAIN BLOCK -- [level] TO [level] uM32LevelLevel	[32] UM32LevelLevel,	Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
-- CRUISE [level] uM33Level	[33] UM33Level,	Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
-- CRUISE CLIMB TO [level] uM34Level	[34] UM34Level,	Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
-- CRUISE CLIMB ABOVE [level] uM35Level	[35] UM35Level,	Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
-- EXPEDITE CLIMB TO [level] uM36Level	[36] UM36Level,	Urg(U)/Alr(A)/Resp(W/U)/Rec(VC)
-- EXPEDITE DESCENT TO [level] uM37Level	[37] UM37Level,	Urg(U)/Alr(A)/Resp(W/U)/Rec(VC)
-- IMMEDIATELY CLIMB TO [level] uM38Level	[38] UM38Level,	Urg(D)/Alr(A/D)/Resp(W/U)/Rec(VC)
-- IMMEDIATELY DESCEND TO [level] uM39Level	[39] UM39Level,	Urg(D)/Alr(A/D)/Resp(W/U)/Rec(VC)
-- IMMEDIATELY STOP CLIMB AT [level] uM40Level	[40] UM40Level,	Urg(D)/Alr(A/D)/Resp(W/U)/Rec(VC)

```
-- IMMEDIATELY STOP DESCENT AT [level]                    Urg(D)/Alr(A/D)/Resp(W/U)/Rec(VC)
   uM41Level                          [41] UM41Level,

-- EXPECT TO CROSS [position] AT [level]                  Urg(L)/Alr(V)/Resp( R )/Rec(EC)
   uM42PositionLevel                  [42] UM42PositionLevel,

-- EXPECT TO CROSS [position] AT OR ABOVE [level]         Urg(L)/Alr(V)/Resp( R )/Rec(EC)
   uM43PositionLevel                  [43] UM43PositionLevel,

-- EXPECT TO CROSS [position] AT OR BELOW [level]         Urg(L)/Alr(V)/Resp( R )/Rec(EC)
   uM44PositionLevel                  [44] UM44PositionLevel,

-- EXPECT TO CROSS [position] AT
-- AND MAINTAIN [level]                                   Urg(L)/Alr(V)/Resp( R )/Rec(EC)
   uM45PositionLevel                  [45] UM45PositionLevel,

-- CROSS [position] AT [level]                            Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
   uM46PositionLevel                  [46] UM46PositionLevel,

-- CROSS [position] AT OR ABOVE [level]                   Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
   uM47PositionLevel                  [47] UM47PositionLevel,

-- CROSS [position] AT OR BELOW [level]                   Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
   uM48PositionLevel                  [48] UM48PositionLevel,

-- CROSS [position] AT AND MAINTAIN [level]               Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
   uM49PositionLevel                  [49] UM49PositionLevel,

-- CROSS [position] BETWEEN [level] AND [level]           Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
   uM50PositionLevelLevel             [50] UM50PositionLevelLevel,

-- CROSS [position] AT [time]                             Urg(N)/Alr(A)/Resp(W/U)/Rec( )
   uM51PositionTime                   [51] UM51PositionTime,

-- CROSS [position] AT OR BEFORE [time]                   Urg(N)/Alr(A)/Resp(W/U)/Rec( )
   uM52PositionTime                   [52] UM52PositionTime,

-- CROSS [position] AT OR AFTER [time]                    Urg(N)/Alr(A)/Resp(W/U)/Rec( )
   uM53PositionTime                   [53] UM53PositionTime,

-- CROSS [position] BETWEEN [time] AND [time]             Urg(N)/Alr(A)/Resp(W/U)/Rec( )
   uM54PositionTimeTime               [54] UM54PositionTimeTime,

-- CROSS [position] AT [speed]                            Urg(N)/Alr(A)/Resp(W/U)/Rec( )
   uM55PositionSpeed                  [55] UM55PositionSpeed,

-- CROSS [position] AT OR LESS THAN [speed]               Urg(N)/Alr(A)/Resp(W/U)/Rec( )
   uM56PositionSpeed                  [56] UM56PositionSpeed,

-- CROSS [position] AT OR GREATER THAN [speed]            Urg(N)/Alr(A)/Resp(W/U)/Rec( )
   uM57PositionSpeed                  [57] UM57PositionSpeed,

-- CROSS [position] AT [time] AT [level]                  Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
   uM58PositionTimeLevel              [58] UM58PositionTimeLevel,
```

-- CROSS [position] AT OR BEFORE [time] AT [level] Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
uM59PositionTimeLevel [59] UM59PositionTimeLevel,

-- CROSS [position] AT OR AFTER [time] AT [level] Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
uM60PositionTimeLevel [60] UM60PositionTimeLevel,

-- CROSS [position] AT AND MAINTAIN [level] AT [speed] Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
uM61PositionLevelSpeed [61] UM61PositionLevelSpeed,

-- AT [time] CROSS [position] AT AND MAINTAIN [level] Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
uM62TimePositionLevel [62] UM62TimePositionLevel,

-- AT [time] CROSS [position] AT AND MAINTAIN [level] AT [speed] Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
uM63TimePositionLevelSpeed [63] UM63TimePositionLevelSpeed,

-- OFFSET [distanceoffset] [direction] OF ROUTE Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM64DistanceoffsetDirection [64] UM64DistanceoffsetDirection,

-- AT [position] OFFSET [distanceoffset] [direction] OF ROUTE Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM65PositionDistanceoffsetDirection [65] UM65PositionDistanceoffsetDirection,

-- AT [time] OFFSET [distanceoffset] [direction] OF ROUTE Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM66TimeDistanceoffsetDirection [66] UM66TimeDistanceoffsetDirection,

-- PROCEED BACK ON ROUTE Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM67NULL [67] UM67NULL,

-- REJOIN ROUTE BY [position] Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM68Position [68] UM68Position,

-- REJOIN ROUTE BY [time] Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM69Time [69] UM69Time,

-- EXPECT BACK ON ROUTE BY [position] Urg(L)/Alr(V)/Resp(R)/Rec( )
uM70Position [70] UM70Position,

-- EXPECT BACK ON ROUTE BY [time] Urg(L)/Alr(V)/Resp(R)/Rec( )
uM71Time [71] UM71Time,

-- RESUME OWN NAVIGATION Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM72NULL [72] UM72NULL,

-- [predepartureclearance] Urg(N)/Alr(A)/Resp(W/U)/Rec(RC)
uM73Predepartureclearance [73] UM73Predepartureclearance,

-- PROCEED DIRECT TO [position] Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM74Position [74] UM74Position,

-- WHEN ABLE PROCEED DIRECT TO [position] Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM75Position [75] UM75Position,

-- AT [time] PROCEED DIRECT TO [position] Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM76TimePosition [76] UM76TimePosition,

-- AT [position] PROCEED DIRECT TO [position] Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM77PositionPosition [77] UM77PositionPosition,

-- AT [level] PROCEED DIRECT TO [position] Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM78LevelPosition [78] UM78LevelPosition,

-- CLEARED TO [position] VIA [routeclearance] Urg(N)/Alr(A)/Resp(W/U)/Rec(RC)
uM79PositionRouteclearance [79] UM79PositionRouteclearance,

-- CLEARED [routeclearance] Urg(N)/Alr(A)/Resp(W/U)/Rec(RC)
uM80Routeclearance [80] UM80Routeclearance,

-- CLEARED [procedurename] Urg(N)/Alr(A)/Resp(W/U)/Rec(RC)
uM81Procedurename [81] UM81Procedurename,

-- CLEARED TO DEVIATE UP TO [distanceoffset] [direction] OF ROUTE Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM82DistanceoffsetDirection [82] UM82DistanceoffsetDirection,

-- AT [position] CLEARED [routeclearance] Urg(N)/Alr(A)/Resp(W/U)/Rec(RC)
uM83PositionRouteclearance [83] UM83PositionRouteclearance,

-- AT [position] CLEARED [procedurename] Urg(N)/Alr(A)/Resp(W/U)/Rec(RC)
uM84PositionProcedurename [84] UM84PositionProcedurename,

-- EXPECT [routeclearance] Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM85Routeclearance [85] UM85Routeclearance,

-- AT [position] EXPECT [routeclearance] Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM86PositionRouteclearance [86] UM86PositionRouteclearance,

-- EXPECT DIRECT TO [position] Urg(L)/Alr(V)/Resp(R)/Rec( )
uM87Position [87] UM87Position,

-- AT [position] EXPECT DIRECT TO [position] Urg(L)/Alr(V)/Resp(R)/Rec( )
uM88PositionPosition [88] UM88PositionPosition,

-- AT [time] EXPECT DIRECT TO [position] Urg(L)/Alr(V)/Resp(R)/Rec( )
uM89TimePosition [89] UM89TimePosition,

-- AT [level] EXPECT DIRECT TO [position] Urg(L)/Alr(V)/Resp(R)/Rec( )
uM90LevelPosition [90] UM90LevelPosition,

-- HOLD AT [position] MAINTAIN [level] INBOUND
-- TRACK [degrees] [direction] TURNS [legtype] Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
uM91Holdclearance [91] UM91Holdclearance,

-- HOLD AT [position] AS PUBLISHED MAINTAIN [level] Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
uM92PositionLevel [92] UM92PositionLevel,

-- EXPECT FURTHER CLEARANCE AT [time] Urg(L)/Alr(V)/Resp(R)/Rec( )
uM93Time [93] UM93Time,

-- TURN [direction] HEADING [degrees] Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM94DirectionDegrees [94] UM94DirectionDegrees,

-- TURN [direction] GROUND TRACK [degrees] Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM95DirectionDegrees [95] UM95DirectionDegrees,

-- FLY PRESENT HEADING Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM96NULL [96] UM96NULL,

-- AT [position] FLY HEADING [degrees] Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM97PositionDegrees [97] UM97PositionDegrees,

-- IMMEDIATELY TURN [direction] HEADING [degrees] Urg(D)/Alr(A/D)/Resp(W/U)/Rec( )
uM98DirectionDegrees [98] UM98DirectionDegrees,

-- EXPECT [procedurename] Urg(L)/Alr(V)/Resp(R)/Rec(EC)
uM99Procedurename [99] UM99Procedurename,

-- AT [time] EXPECT [speed] Urg(L)/Alr(V)/Resp(R)/Rec( )
uM100TimeSpeed [100] UM100TimeSpeed,

-- AT [position] EXPECT [speed] Urg(L)/Alr(V)/Resp(R)/Rec( )
uM101PositionSpeed [101] UM101PositionSpeed,

-- AT [level] EXPECT [speed] Urg(L)/Alr(V)/Resp(R)/Rec( )
uM102LevelSpeed [102] UM102LevelSpeed,

-- AT [time] EXPECT [speed] TO [speed] Urg(L)/Alr(V)/Resp(R)/Rec( )
uM103TimeSpeedSpeed [103] UM103TimeSpeedSpeed,

-- AT [position] EXPECT [speed] TO [speed] Urg(L)/Alr(V)/Resp(R)/Rec( )
uM104PositionSpeedSpeed [104] UM104PositionSpeedSpeed,

-- AT [level] EXPECT [speed] TO [speed] Urg(L)/Alr(V)/Resp(R)/Rec( )
uM105LevelSpeedSpeed [105] UM105LevelSpeedSpeed,

-- MAINTAIN [speed] Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM106Speed [106] UM106Speed,

-- MAINTAIN PRESENT SPEED Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM107NULL [107] UM107NULL,

-- MAINTAIN [speed] OR GREATER Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM108Speed [108] UM108Speed,

-- MAINTAIN [speed] OR LESS Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM109Speed [109] UM109Speed,

-- MAINTAIN [speed] TO [speed] Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM110SpeedSpeed [110] UM110SpeedSpeed,

-- INCREASE SPEED TO [speed] Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM111Speed [111] UM111Speed,

-- INCREASE SPEED TO [speed] OR GREATER Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM112Speed [112] UM112Speed,

-- REDUCE SPEED TO [speed]		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM113Speed	[113] UM113Speed,	
-- REDUCE SPEED TO [speed] OR LESS		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM114Speed	[114] UM114Speed,	
-- DO NOT EXCEED [speed]		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM115Speed	[115] UM115Speed,	
-- RESUME NORMAL SPEED		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM116NULL	[116] UM116NULL,	
-- CONTACT [icaounitname] [frequency]		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM117ICAOunitnameFrequency	[117] UM117ICAOunitnameFrequency,	
-- AT [position] CONTACT [icaounitname] [frequency]		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM118PositionICAOunitnameFrequency	[118] UM118PositionICAOunitnameFrequency,	
-- AT [time] CONTACT [icaounitname] [frequency]		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM119TimeICAOunitnameFrequency	[119] UM119TimeICAOunitnameFrequency,	
-- MONITOR [icaounitname] [frequency]		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM120ICAOunitnameFrequency	[120] UM120ICAOunitnameFrequency,	
-- AT [position] MONITOR [icaounitname] [frequency]		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM121PositionICAOunitnameFrequency	[121] UM121PositionICAOunitnameFrequency,	
-- AT [time] MONITOR [icaounitname] [frequency]		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM122TimeICAOunitnameFrequency	[122] UM122TimeICAOunitnameFrequency,	
-- SQUAWK [beaconcode]		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM123Beaconcode	[123] UM123Beaconcode,	
-- STOP SQUAWK		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM124NULL	[124] UM124NULL,	
-- SQUAWK ALTITUDE		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM125NULL	[125] UM125NULL,	
-- STOP ALTITUDE SQUAWK		Urg(N)/Alr(A)/Resp(W/U)/Rec( )
uM126NULL	[126] UM126NULL,	
-- REPORT BACK ON ROUTE		Urg(N)/Alr(A)/Resp(R)/Rec( )
uM127NULL	[127] UM127NULL,	
-- REPORT LEAVING [level]		Urg(N)/Alr(A)/Resp(R)/Rec( )
uM128Level	[128] UM128Level,	
-- REPORT LEVEL [level]		Urg(N)/Alr(A)/Resp(R)/Rec( )
uM129Level	[129] UM129Level,	
-- REPORT PASSING [position]		Urg(N)/Alr(A)/Resp(R)/Rec( )
uM130Position	[130] UM130Position,	

-- REPORT REMAINING FUEL AND SOULS ON BOARD Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM131NULL [131] UM131NULL,

-- CONFIRM POSITION Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM132NULL [132] UM132NULL,

-- CONFIRM LEVEL Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM133NULL [133] UM133NULL,

-- CONFIRM SPEED Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM134NULL [134] UM134NULL,

-- CONFIRM ASSIGNED LEVEL Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM135NULL [135] UM135NULL,

-- CONFIRM ASSIGNED SPEED Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM136NULL [136] UM136NULL,

-- CONFIRM ASSIGNED ROUTE Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM137NULL [137] UM137NULL,

-- CONFIRM TIME OVER REPORTED WAYPOINT Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM138NULL [138] UM138NULL,

-- CONFIRM REPORTED WAYPOINT Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM139NULL [139] UM139NULL,

-- CONFIRM NEXT WAYPOINT Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM140NULL [140] UM140NULL,

-- CONFIRM NEXT WAYPOINT ETA Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM141NULL [141] UM141NULL,

-- CONFIRM ENSUING WAYPOINT Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM142NULL [142] UM142NULL,

-- CONFIRM REQUEST Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM143NULL [143] UM143NULL,

-- CONFIRM SQUAWK Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM144NULL [144] UM144NULL,

-- CONFIRM HEADING Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM145NULL [145] UM145NULL,

-- CONFIRM GROUND TRACK Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM146NULL [146] UM146NULL,

-- REQUEST POSITION REPORT Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM147NULL [147] UM147NULL,

-- WHEN CAN YOU ACCEPT [level] Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM148Level [148] UM148Level,

-- CAN YOU ACCEPT [level] AT [position] Urg(N)/Alr(A)/Resp(A/N)/Rec( )
uM149LevelPosition [149] UM149LevelPosition,

-- CAN YOU ACCEPT [level] AT [time] Urg(N)/Alr(A)/Resp(A/N)/Rec( )
uM150LevelTime [150] UM150LevelTime,

-- WHEN CAN YOU ACCEPT [speed] Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM151Speed [151] UM151Speed,

-- WHEN CAN YOU ACCEPT [distanceoffset] [direction] OFFSET Urg(N)/Alr(A)/Resp(NE)/Rec( )
uM152DistanceoffsetDirection [152] UM152DistanceoffsetDirection,

-- ALTIMETER [altimeter] Urg(N)/Alr(A)/Resp(R)/Rec( )
uM153Altimeter [153] UM153Altimeter,

-- RADAR SERVICES TERMINATED Urg(N)/Alr(A)/Resp(R)/Rec( )
uM154NULL [154] UM154NULL,

-- RADAR CONTACT [position] Urg(N)/Alr(A)/Resp(R)/Rec( )
uM155Position [155] UM155Position,

-- RADAR CONTACT LOST Urg(N)/Alr(A)/Resp(R)/Rec( )
uM156NULL [156] UM156NULL,

-- CHECK STUCK MICROPHONE [frequency] Urg(U)/Alr(A)/Resp(R)/Rec( )
uM157Frequency [157] UM157Frequency,

-- ATIS [atiscode] Urg(N)/Alr(A)/Resp(R)/Rec( )
uM158Atiscode [158] UM158Atiscode,

-- ERROR [errorinformation] Urg(U)/Alr(A)/Resp(NE)/Rec( )
uM159Errorinformation [159] UM159Errorinformation,

-- NEXT DATA AUTHORITY [icaofacilitydesignation] Urg(L)/Alr(N)/Resp(NE)/Rec( )
uM160ICAOfacilitydesignation [160] UM160ICAOfacilitydesignation,

-- END SERVICE Urg(L)/Alr(N)/Resp(NE)/Rec( )
uM161NULL [161] UM161NULL,

-- SERVICE UNAVAILABLE Urg(L)/Alr(V)/Resp(NE)/Rec( )
uM162NULL [162] UM162NULL,

-- [icaofacilitydesignation] [tp4table] Urg(L)/Alr(N)/Resp(NE)/Rec( )
uM163ICAOfacilitydesignationTp4table [163] UM163ICAOfacilitydesignationTp4table,

-- WHEN READY Urg(L)/Alr(N)/Resp(NE)/Rec( )
uM164NULL [164] UM164NULL,

-- THEN Urg(L)/Alr(N)/Resp(NE)/Rec( )
uM165NULL [165] UM165NULL,

-- DUE TO TRAFFIC Urg(L)/Alr(N)/Resp(NE)/Rec( )
uM166NULL [166] UM166NULL,

-- DUE TO AIRSPACE RESTRICTION uM167NULL	[167] UM167NULL,	Urg(L)/Alr(N)/Resp(NE)/Rec( )
-- DISREGARD uM168NULL	[168] UM168NULL,	Urg(N)/Alr(A)/Resp(R)/Rec( )
-- [freetext] uM169Freetext	[169] UM169Freetext,	Urg(N)/Alr(V)/Resp(R)/Rec( )
-- [freetext] uM170Freetext	[170] UM170Freetext,	Urg(D)/Alr(A/D)/Resp(R)/Rec( )
-- CLIMB AT [verticalrate] MINIMUM uM171Verticalrate	[171] UM171Verticalrate,	Urg(N)/Alr(A)/Resp(W/U)/Rec( )
-- CLIMB AT [verticalrate] MAXIMUM uM172Verticalrate	[172] UM172Verticalrate,	Urg(N)/Alr(A)/Resp(W/U)/Rec( )
-- DESCEND AT [verticalrate] MINIMUM uM173Verticalrate	[173] UM173Verticalrate,	Urg(N)/Alr(A)/Resp(W/U)/Rec( )
-- DESCEND AT [verticalrate] MAXIMUM uM174Verticalrate	[174] UM174Verticalrate,	Urg(N)/Alr(A)/Resp(W/U)/Rec( )
-- REPORT REACHING [level] uM175Level	[175] UM175Level,	Urg(N)/Alr(A)/Resp(R)/Rec( )
-- MAINTAIN OWN SEPARATION AND VMC uM176NULL	[176] UM176NULL,	Urg(N)/Alr(A)/Resp(W/U)/Rec( )
-- AT PILOTS DISCRETION uM177NULL	[177] UM177NULL,	Urg(L)/Alr(L)/Resp(N)/Rec( )
-- [trackdetailmsg] uM178Trackdetailmsg	[178] UM178Trackdetailmsg,	Urg(N)/Alr(A)/Resp(W/U)/Rec(RC)
-- SQUAWK IDENT uM179NULL	[179] UM179NULL,	Urg(N)/Alr(A)/Resp(W/U)/Rec( )
-- REPORT REACHING BLOCK [level] TO [level] uM180LevelLevel	[180] UM180LevelLevel,	Urg(N)/Alr(A)/Resp(R)/Rec( )
-- REPORT DISTANCE [tofrom] [position] uM181TofromPosition	[181] UM181TofromPosition,	Urg(N)/Alr(A)/Resp(NE)/Rec( )
-- CONFIRM ATIS CODE uM182NULL	[182] UM182NULL	Urg(N)/Alr(A)/Resp(NE)/Rec( )
-- REPORT PASSING [level] uM?1?Level	[?1?] UM?1?Level,	Urg(N)/Alr(A)/Resp(R)/Rec( )
-- AT [time] REPORT DISTANCE [tofrom] [position] uM?2?TofromPosition	[?2?] UM?2?TofromPosition,	Urg(N)/Alr(A)/Resp(NE)/Rec( )

```
-- AFTER PASSING [position] CLIMB TO AND MAINTAIN [level]      Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
   uM?3?PositionLevel                  [?3?]UM?3?PositionLevel

-- AFTER PASSING [position] DESCEND TO AND MAINTAIN [level]    Urg(N)/Alr(A)/Resp(W/U)/Rec(VC)
   uM?4?PositionLevel                  [?4?]UM?4?PositionLevel

-- RECLEARED                                                   Urg(N)/Alr(A)/Resp(W/U)
   uM?5?NULL                           [?5?]UM?5?NULL,

-- AFTER PASSITION [position] MAINTAIN [speed]                 Urg(N)/Alr(A)/Resp(W/U)
   uM?6?PositionSpeed                  [?6?]PositionSpeed,

-- ADJUST SPEED                                                Urg(N)/Alr(A)/Resp(W/U)
   uM?7?NULL                           [?7?]NULL

        }
-- Note: End of ATCuplinkmsgelementid CHOICE Data Structure

-- Note: Unique data structure names are specified for each of the up-link
--       CHOICE selections. This simplifies implementations which choose to
--       utilize a compiler to generate the data structures.

UM0NULL ::= NULL
UM1NULL ::= NULL
UM2NULL ::= NULL
UM3NULL ::= NULL
UM4NULL ::= NULL
UM5NULL ::= NULL
UM6Level ::= Level
UM7Time ::= Time
UM8Position ::= Position
UM9Time ::= Time
UM10Position ::= Position
UM11Time ::= Time
UM12Position ::= Position
UM13TimeLevel ::= TimeLevel
UM14PositionLevel ::= PositionLevel
UM15TimeLevel ::= TimeLevel
UM16PositionLevel ::= PositionLevel
UM17TimeLevel ::= TimeLevel
UM18PositionLevel ::= PositionLevel
UM19Level ::= Level
UM20Level ::= Level
UM21TimeLevel ::= TimeLevel
UM22PositionLevel ::= PositionLevel
UM23Level ::= Level
UM24TimeLevel ::= TimeLevel
UM25PositionLevel ::= PositionLevel
UM26LevelTime ::= LevelTime
UM27LevelPosition ::= LevelPosition
UM28LevelTime ::= LevelTime
```

UM29LevelPosition ::= LevelPosition
UM30LevelLevel ::= SEQUENCE SIZE (2) OF Level
UM31LevelLevel ::= SEQUENCE SIZE (2) OF Level
UM32LevelLevel ::= SEQUENCE SIZE (2) OF Level
UM33Level ::= Level
UM34Level ::= Level
UM35Level ::= Level
UM36Level ::= Level
UM37Level ::= Level
UM38Level ::= Level
UM39Level ::= Level
UM40Level ::= Level
UM41Level ::= Level
UM42PositionLevel ::= PositionLevel
UM43PositionLevel ::= PositionLevel
UM44PositionLevel ::= PositionLevel
UM45PositionLevel ::= PositionLevel
UM46PositionLevel ::= PositionLevel
UM47PositionLevel ::= PositionLevel
UM48PositionLevel ::= PositionLevel
UM49PositionLevel ::= PositionLevel
UM50PositionLevelLevel ::= PositionLevelLevel
UM51PositionTime ::= PositionTime
UM52PositionTime ::= PositionTime
UM53PositionTime ::= PositionTime
UM54PositionTimeTime ::= PositionTimeTime
UM55PositionSpeed ::= PositionSpeed
UM56PositionSpeed ::= PositionSpeed
UM57PositionSpeed ::= PositionSpeed
UM58PositionTimeLevel ::= PositionTimeLevel
UM59PositionTimeLevel ::= PositionTimeLevel
UM60PositionTimeLevel ::= PositionTimeLevel
UM61PositionLevelSpeed ::= PositionLevelSpeed
UM62TimePositionLevel ::= TimePositionLevel
UM63TimePositionLevelSpeed ::= TimePositionLevelSpeed
UM64DistanceoffsetDirection ::= DistanceoffsetDirection
UM65PositionDistanceoffsetDirection ::= PositionDistanceoffsetDirection
UM66TimeDistanceoffsetDirection ::= TimeDistanceoffsetDirection
UM67NULL ::= NULL
UM68Position ::= Position
UM69Time ::= Time
UM70Position ::= Position
UM71Time ::= Time
UM72NULL ::= NULL
UM73Predepartureclearance ::= Predepartureclearance
UM74Position ::= Position
UM75Position ::= Position
UM76TimePosition ::= TimePosition

UM77PositionPosition ::= SEQUENCE SIZE (2) OF Position
UM78LevelPosition ::= LevelPosition
UM79PositionRouteclearance ::= PositionRouteclearance
UM80Routeclearance ::= Routeclearance
UM81Procedurename ::= Procedurename
UM82DistanceoffsetDirection ::= DistanceoffsetDirection
UM83PositionRouteclearance ::= PositionRouteclearance
UM84PositionProcedurename ::= PositionProcedurename
UM85Routeclearance ::= Routeclearance
UM86PositionRouteclearance ::= PositionRouteclearance
UM87Position ::= Position
UM88PositionPosition ::= SEQUENCE SIZE (2) OF Position
UM89TimePosition ::= TimePosition
UM90LevelPosition ::= LevelPosition
UM91Holdclearance ::= Holdclearance
UM92PositionLevel ::= PositionLevel
UM93Time ::= Time
UM94DirectionDegrees ::= DirectionDegrees
UM95DirectionDegrees ::= DirectionDegrees
UM96NULL ::= NULL
UM97PositionDegrees ::= PositionDegrees
UM98DirectionDegrees ::= DirectionDegrees
UM99Procedurename ::= Procedurename
UM100TimeSpeed ::= TimeSpeed
UM101PositionSpeed ::= PositionSpeed
UM102LevelSpeed ::= LevelSpeed
UM103TimeSpeedSpeed ::= TimeSpeedSpeed
UM104PositionSpeedSpeed ::= PositionSpeedSpeed
UM105LevelSpeedSpeed ::= LevelSpeedSpeed
UM106Speed ::= Speed
UM107NULL ::= NULL
UM108Speed ::= Speed
UM109Speed ::= Speed
UM110SpeedSpeed ::= SEQUENCE SIZE (2) OF Speed
UM111Speed ::= Speed
UM112Speed ::= Speed
UM113Speed ::= Speed
UM114Speed ::= Speed
UM115Speed ::= Speed
UM116NULL ::= NULL
UM117ICAOunitnameFrequency ::= ICAOunitnameFrequency
UM118PositionICAOunitnameFrequency ::= PositionICAOunitnameFrequency
UM119TimeICAOunitnameFrequency ::= TimeICAOunitnameFrequency
UM120ICAOunitnameFrequency ::= ICAOunitnameFrequency
UM121PositionICAOunitnameFrequency ::= PositionICAOunitnameFrequency
UM122TimeICAOunitnameFrequency ::= TimeICAOunitnameFrequency
UM123Beaconcode ::= Beaconcode
UM124NULL ::= NULL

UM125NULL ::= NULL
UM126NULL ::= NULL
UM127NULL ::= NULL
UM128Level ::= Level
UM129Level ::= Level
UM130Position ::= Position
UM131NULL ::= NULL
UM132NULL ::= NULL
UM133NULL ::= NULL
UM134NULL ::= NULL
UM135NULL ::= NULL
UM136NULL ::= NULL
UM137NULL ::= NULL
UM138NULL ::= NULL
UM139NULL ::= NULL
UM140NULL ::= NULL
UM141NULL ::= NULL
UM142NULL ::= NULL
UM143NULL ::= NULL
UM144NULL ::= NULL
UM145NULL ::= NULL
UM146NULL ::= NULL
UM147NULL ::= NULL
UM148Level ::= Level
UM149LevelPosition ::= LevelPosition
UM150LevelTime ::= LevelTime
UM151Speed ::= Speed
UM152DistanceoffsetDirection ::= DistanceoffsetDirection
UM153Altimeter ::= Altimeter
UM154NULL ::= NULL
UM155Position ::= Position
UM156NULL ::= NULL
UM157Frequency ::= Frequency
UM158Atiscode ::= Atiscode
UM159Errorinformation ::= Errorinformation
UM160ICAOfacilitydesignation ::= ICAOfacilitydesignation
UM161NULL ::= NULL
UM162NULL ::= NULL
UM163ICAOfacilitydesignationTp4table ::= ICAOfacilitydesignationTp4table
UM164NULL ::= NULL
UM165NULL ::= NULL
UM166NULL ::= NULL
UM167NULL ::= NULL
UM168NULL ::= NULL
UM169Freetext ::= Freetext
UM170Freetext ::= Freetext
UM171Verticalrate ::= Verticalrate
UM172Verticalrate ::= Verticalrate

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  UM173Verticalrate ::= Verticalrate
  UM174Verticalrate ::= Verticalrate
  UM175Level ::= Level
  UM176NULL ::= NULL
  UM177NULL ::= NULL
  UM178Trackdetailmsg ::= Trackdetailmsg
  UM179NULL ::= NULL
  UM180LevelLevel ::= SEQUENCE SIZE (2) OF Level
  UM181TofromPosition ::= TofromPosition
  UM182NULL ::= NULL
  UM?1?Level ::= Level
  UM?2?TimeTofromPosition ::= TimeTofromPosition

ATCdownlinkmessage ::=  SEQUENCE
  {
   ATCmessageheader,
     ATCdownlinkmsgelementid,
     aTCdownlinkmsgelementid-seqOf    SEQUENCE SIZE (1..4) OF ATCdownlinkmsgelementid

   OPTIONAL
  }

ATCdownlinkmsgelementid ::= CHOICE
  {

-- WILCO                                                          Resp ( N )
  dM0NULL                          [0] DM0NULL,

-- UNABLE                                                         Resp ( N )
  dM1NULL                          [1] DM1NULL,

-- STANDBY                                                        Resp ( N )
  dM2NULL                          [2] DM2NULL,

-- ROGER                                                          Resp ( N )
  dM3NULL                          [3] DM3NULL,

-- AFFIRM                                                         Resp ( N )
  dM4NULL                          [4] DM4NULL,

-- NEGATIVE                                                       Resp ( N )
  dM5NULL                          [5] DM5NULL,

-- REQUEST [level]                                                Resp ( Y )
  dM6Level                         [6] DM6Level,

-- REQUEST BLOCK [level] TO [level]                               Resp ( Y )
  dM7LevelLevel                    [7] DM7LevelLevel,
```

```
-- REQUEST CRUISE CLIMB TO [level]                                    Resp ( Y )
dM8Level                        [8] DM8Level,

-- REQUEST CLIMB TO [level]                                           Resp ( Y )
dM9Level                        [9] DM9Level,

-- REQUEST DESCENT TO [level]                                         Resp ( Y )
dM10Level                       [10] DM10Level,

-- AT [position] REQUEST CLIMB TO [level]                             Resp ( Y )
dM11PositionLevel               [11] DM11PositionLevel,

-- AT [position] REQUEST DESCENT TO [level]                           Resp ( Y )
dM12PositionLevel               [12] DM12PositionLevel,

-- AT [time] REQUEST CLIMB TO [level]                                 Resp ( Y )
dM13TimeLevel                   [13] DM13TimeLevel,

-- AT [time] REQUEST DESCENT TO [level]                               Resp ( Y )
dM14TimeLevel                   [14] DM14TimeLevel,

-- REQUEST OFFSET [distanceoffset] [direction] OF ROUTE               Resp ( Y )
dM15DistanceoffsetDirection     [15] DM15DistanceoffsetDirection,

-- AT [position] REQUEST OFFSET
-- [distanceoffset] [direction] OF ROUTE                              Resp ( Y )
dM16PositionDistanceoffsetDirection     [16] DM16PositionDistanceoffsetDirection,

-- AT [time] REQUEST OFFSET
-- [distanceoffset] [direction] OF ROUTE                              Resp ( Y )
dM17TimeDistanceoffsetDirection [17] DM17TimeDistanceoffsetDirection,

-- REQUEST [speed]                                                    Resp ( Y )
dM18Speed                       [18] DM18Speed,

-- REQUEST [speed] TO [speed]                                         Resp ( Y )
dM19SpeedSpeed                  [19] DM19SpeedSpeed,

-- REQUEST VOICE CONTACT                                              Resp ( Y )
dM20NULL                        [20] DM20NULL,

-- REQUEST VOICE CONTACT [frequency]                                  Resp ( Y )
dM21Frequency                   [21] DM21Frequency,

-- REQUEST DIRECT TO [position]                                       Resp ( Y )
dM22Position                    [22] DM22Position,
```

-- REQUEST [procedurename]		Resp (Y)
dM23Procedurename	[23] DM23Procedurename,	
-- REQUEST [routeclearance]		Resp (Y)
dM24Routeclearance	[24] DM24Routeclearance,	
-- REQUEST CLEARANCE		Resp (Y)
dM25NULL	[25] DM25NULL,	
-- REQUEST WEATHER DEVIATION TO		
-- [position] VIA [routeclearance]		Resp (Y)
dM26PositionRouteclearance	[26] DM26PositionRouteclearance,	
-- REQUEST WEATHER DEVIATION UP		
-- TO [distanceoffset] [direction] OF ROUTE		Resp (Y)
dM27DistanceoffsetDirection	[27] DM27DistanceoffsetDirection,	
-- LEAVING [level]		Resp (N)
dM28Level	[28] DM28Level,	
-- CLIMBING TO [level]		Resp (N)
dM29Level	[29] DM29Level,	
-- DESCENDING TO [level]		Resp (N)
dM30Level	[30] DM30Level,	
-- PASSING [position]		Resp (N)
dM31Position	[31] DM31Position,	
-- PRESENT LEVEL [level]		Resp (N)
dM32Level	[32] DM32Level,	
-- PRESENT POSITION [position]		Resp (N)
dM33Position	[33] DM33Position,	
-- PRESENT SPEED [speed]		Resp (N)
dM34Speed	[34] DM34Speed,	
-- PRESENT HEADING [degrees]		Resp (N)
dM35Degrees	[35] DM35Degrees,	
-- PRESENT GROUND TRACK [degrees]		Resp (N)
dM36Degrees	[36] DM36Degrees,	
-- LEVEL [level]		Resp (N)
dM37Level	[37] DM37Level,	

```
-- ASSIGNED LEVEL [level]                                          Resp ( N )
   dM38Level                       [38] DM38Level,

-- ASSIGNED SPEED [speed]                                          Resp ( N )
   dM39Speed                       [39] DM39Speed,

-- ASSIGNED ROUTE [routeclearance]                                 Resp ( N )
   dM40Routeclearance              [40] DM40Routeclearance,

-- BACK ON ROUTE                                                   Resp ( N )
   dM41NULL                        [41] DM41NULL,

-- NEXT WAYPOINT [position]                                        Resp ( N )
   dM42Position                    [42] DM42Position,

-- NEXT WAYPOINT ETA [time]                                        Resp ( N )
   dM43Time                        [43] DM43Time,

-- ENSUING WAYPOINT [position]                                     Resp ( N )
   dM44Position                    [44] DM44Position,

-- REPORTED WAYPOINT [position]                                    Resp ( N )
   dM45Position                    [45] DM45Position,

-- REPORTED WAYPOINT [time]                                        Resp ( N )
   dM46Time                        [46] DM46Time,

-- SQUAWKING [beaconcode]                                          Resp ( N )
   dM47Beaconcode                  [47] DM47Beaconcode,

-- POSITION REPORT [positionreport]                                Resp ( N )
   dM48Positionreport              [48] DM48Positionreport,

-- WHEN CAN WE EXPECT [speed]                                      Resp ( Y )
   dM49Speed                       [49] DM49Speed,

-- WHEN CAN WE EXPECT [speed] TO [speed]                           Resp ( Y )
   dM50SpeedSpeed                  [50] DM50SpeedSpeed,

-- WHEN CAN WE EXPECT BACK ON ROUTE                                Resp ( Y )
   dM51NULL                        [51] DM51NULL,

-- WHEN CAN WE EXPECT LOWER LEVEL                                  Resp ( Y )
   dM52NULL                        [52] DM52NULL,

-- WHEN CAN WE EXPECT HIGHER LEVEL                                 Resp ( Y )
   dM53NULL                        [53] DM53NULL,
```

-- WHEN CAN WE EXPECT CRUISE CLIMB TO [level] Resp (Y)
dM54Level [54] DM54Level,

-- PAN PAN PAN Resp (N)
dM55NULL [55] DM55NULL,

-- MAYDAY MAYDAY MAYDAY Resp (N)
dM56NULL [56] DM56NULL,

-- [remainingfuel] OF FUEL REMAINING AND
-- [remainingsouls] SOULS ON BOARD Resp (N)
dM57RemainingfuelRemainingsouls [57] DM57RemainingfuelRemainingsouls,

-- CANCEL EMERGENCY Resp (N)
dM58NULL [58] DM58NULL,

-- DIVERTING TO [position] VIA [routeclearance] Resp (N)
dM59PositionRouteclearance [59] DM59PositionRouteclearance,

-- OFFSETTING [distanceoffset] [direction] OF ROUTE Resp (N)
dM60DistanceoffsetDirection [60] DM60DistanceoffsetDirection,

-- DESCENDING TO [level] Resp (N)
dM61Level [61] DM61Level,

-- ERROR [errorinformation] Resp (N)
dM62Errorinformation [62] DM62Errorinformation,

-- NOT CURRENT DATA AUTHORITY Resp (N)
dM63NULL [63] DM63NULL,

-- [icaofacilitydesignation] Resp (N)
dM64ICAOfacilitydesignation [64] DM64ICAOfacilitydesignation,

-- DUE TO WEATHER Resp (N)
dM65NULL [65] DM65NULL,

-- DUE TO AIRCRAFT PERFORMANCE Resp (N)
dM66NULL [66] DM66NULL,

-- Note: The ATC Ground System peer will assign an Urgency of Low for message element [67].
-- [freetext] Resp (N)
dM67Freetext [67] DM67Freetext,

-- Note: The ATC Ground System peer will assign an Urgency of Distress for message element [68].
-- [freetext] Resp (Y)
dM68Freetext [68] DM68Freetext,

```
-- REQUEST VMC DESCENT                                                Resp ( Y )
   dM69NULL                          [69] DM69NULL,

-- REQUEST HEADING [degrees]                                          Resp ( Y )
   dM70Degrees                       [70] DM70Degrees,

-- REQUEST GROUND TRACK [degrees]                                     Resp ( Y )
   dM71Degrees                       [71] DM71Degrees,

-- REACHING [level]                                                   Resp ( N )
   dM72Level                         [72] DM72Level,

-- [versionnumber]                                                    Resp ( N )
   dM73Versionnumber                 [73] DM73Versionnumber,

-- MAINTAIN OWN SEPARATION AND VMC                                    Resp ( N )
   dM74NULL                          [74] DM74NULL,

-- AT PILOTS DISCRETION                                               Resp ( N )
   dM75NULL                          [75] DM75NULL,

-- REACHING BLOCK [level] TO [level]                                  Resp ( N )
   dM76LevelLevel                    [76] DM76LevelLevel,

-- ASSIGNED BLOCK [level] TO [level]                                  Resp ( N )
   dM77LevelLevel                    [77] DM77LevelLevel,

-- AT [time] [distance] [tofrom] [position]                           Resp ( N )
   dM78TimeDistanceTofromPosition    [78] DM78TimeDistanceTofromPosition,

-- ATIS [atiscode]                                                    Resp ( N )
   dM79Atiscode                      [79] DM79Atiscode,

-- reserved to ensure eight bit message element identification field.
   dM128NULL                         [128] DM128NULL

   }
-- Note:  End of ATCdownlinkmsgelementid CHOICE Data Structure

-- Note:  Unique data structure names are specified for each of the uplink
--     CHOICE selections.  This simplifies implementations which choose to
--     utilize a compiler to generate the data structures.

   DM0NULL ::= NULL
   DM1NULL ::= NULL
   DM2NULL ::= NULL
   DM3NULL ::= NULL
   DM4NULL ::= NULL
```

DM5NULL ::= NULL
DM6Level ::= Level
DM7LevelLevel ::= SEQUENCE SIZE (2) OF Level
DM8Level ::= Level
DM9Level ::= Level
DM10Level ::= Level
DM11PositionLevel ::= PositionLevel
DM12PositionLevel ::= PositionLevel
DM13TimeLevel ::= TimeLevel
DM14TimeLevel ::= TimeLevel
DM15DistanceoffsetDirection ::= DistanceoffsetDirection
DM16PositionDistanceoffsetDirection ::= PositionDistanceoffsetDirection
DM17TimeDistanceoffsetDirection ::= TimeDistanceoffsetDirection
DM18Speed ::= Speed
DM19SpeedSpeed ::= SEQUENCE SIZE (2) OF Speed
DM20NULL ::= NULL
DM21Frequency ::= Frequency
DM22Position ::= Position
DM23Procedurename ::= Procedurename
DM24Routeclearance ::= Routeclearance
DM25NULL ::= NULL
DM26PositionRouteclearance ::= PositionRouteclearance
DM27DistanceoffsetDirection ::= DistanceoffsetDirection
DM28Level ::= Level
DM29Level ::= Level
DM30Level ::= Level
DM31Position ::= Position
DM32Level ::= Level
DM33Position ::= Position
DM34Speed ::= Speed
DM35Degrees ::= Degrees
DM36Degrees ::= Degrees
DM37Level ::= Level
DM38Level ::= Level
DM39Speed ::= Speed
DM40Routeclearance ::= Routeclearance
DM41NULL ::= NULL
DM42Position ::= Position
DM43Time ::= Time
DM44Position ::= Position
DM45Position ::= Position
DM46Time ::= Time
DM47Beaconcode ::= Beaconcode
DM48Positionreport ::= Positionreport
DM49Speed ::= Speed
DM50SpeedSpeed ::= SEQUENCE SIZE (2) OF Speed
DM51NULL ::= NULL
DM52NULL ::= NULL

```
DM53NULL ::= NULL
DM54Level ::= Level
DM55NULL ::= NULL
DM56NULL ::= NULL
DM57RemainingfuelRemainingsouls ::= RemainingfuelRemainingsouls
DM58NULL ::= NULL
DM59PositionRouteclearance ::= PositionRouteclearance
DM60DistanceoffsetDirection ::= DistanceoffsetDirection
DM61Level ::= Level
DM62Errorinformation ::= Errorinformation
DM63NULL ::= NULL
DM64ICAOfacilitydesignation ::= ICAOfacilitydesignation
DM65NULL ::= NULL
DM66NULL ::= NULL
DM67Freetext ::= Freetext
DM68Freetext ::= Freetext
DM69NULL ::= NULL
DM70Degrees ::= Degrees
DM71Degrees ::= Degrees
DM72Level ::= Level
DM73Versionnumber ::= Versionnumber
DM74NULL ::= NULL
DM75NULL ::= NULL
DM76LevelLevel ::= SEQUENCE SIZE (2) OF Level
DM77LevelLevel ::= SEQUENCE SIZE (2) OF Level
DM78TimeDistanceTofromPosition ::= TimeDistanceTofromPosition
DM79Atiscode ::= Atiscode
DM128NULL ::= NULL

-- Note:  Data Structures referenced within the Uplink and Downlink Messages
--        those used frequently within other data structures are listed
--        in alphabetical order.  Otherwise, the primitives are defined
--        the first time they are used.

Airport ::= IA5String (SIZE (4))

Altimeter ::= CHOICE
  {
    altimeterenglish          [0] Altimeterenglish,
    altimetermetric           [1] Altimetermetric
  }

    Altimeterenglish ::= INTEGER (2200..3200)
    --  Units = .01 Inchs Mercury, Range (22.00 .. 32.00)

    Altimetermetric ::= INTEGER  (7500..12500)
    --  Units = .1 HectoPascal, Range (750.0..1250.0)
```

```
Level::= CHOICE
   {
     levelqnh                        [0] Levelqnh,
     levelqnhmeters                  [1] Levelqnhmeters,
     levelqfe                        [2] Levelqfe,
     levelqfemeters                  [3] Levelqfemeters,
     levelgnssfeet                   [4] Levelgnssfeet,
     levelgnssmeters                 [5] Levelgnssmeters,
     levelflightlevel                [6] Levelflightlevel,
     levelflightlevelmetric          [7] Levelflightlevelmetric
   }

   Levelqnh ::= INTEGER (0..2500)
   -- Units = 10 Feet, Range (0..25000)

   Levelqnhmeters ::= INTEGER (0..16000)
   -- Units = 1 Meter, Range (0..16000)

   Levelqfe ::= INTEGER (0..2100)
   -- Units = 10 Feet, Range (0..21000)

   Levelqfemeters ::= INTEGER (0..7000)
   -- Units = 1 Meter, Range (0..7000)

   Levelgnssfeet ::= INTEGER (0..150000)
   -- Units = 1 Foot, Range (0..150000)

   Levelgnssmeters ::= INTEGER (0..50000)
   -- Units = 1 Meter, Range (0..50000)

   Levelflightlevel ::= INTEGER (30..600)
   -- Units = 1 Level (100 Feet), Range (030..600)

   Levelflightlevelmetric ::= INTEGER (100..2000)
   -- Units = 1 Level (10 Meters), Range (100..2000)

LevelPosition ::= SEQUENCE
   {
     Level,
     Position
   }

LevelSpeed ::= SEQUENCE
   {
     Level,
     Speed
   }
```

```
LevelSpeedSpeed ::= SEQUENCE
  {
    Level,
    speed-seqOf                SEQUENCE SIZE (2) OF Speed
  }

LevelTime ::= SEQUENCE
  {
    Level,
    Time
  }

Atiscode ::= IA5String (SIZE (1))

ATWlevel ::= SEQUENCE
  {
    ATWleveltolerance,
    Level
  }

  ATWleveltolerance ::= ENUMERATED
    {
      at                       (0),
      atorabove                (1),
      atorbelow                (2)
    }

Beaconcode ::= SEQUENCE SIZE (4) OF Beaconcodeoctaldigit

  Beaconcodeoctaldigit ::= INTEGER (0..7)

Degrees ::= CHOICE
  {
    degreesmagnetic            [0] Degreesmagnetic,
    degreestrue                [1] Degreestrue
  }

  Degreesmagnetic ::= INTEGER (1..360)
  -- Units = 1 degree, Range (1..360)

  Degreestrue ::= INTEGER (1..360)
  -- Units = 1 degree, Range (1..360)
```

```
Direction ::= ENUMERATED
   {
     left              (0),
     right             (1),
     eitherSide        (2),
     north             (3),
     south             (4),
     east              (5),
     west              (6),
     northEast         (7),
     northWest         (8),
     southEast         (9),
     southWest         (10)
   }

DirectionDegrees ::= SEQUENCE
   {
     Direction,
     Degrees
   }

Distanceoffset ::= CHOICE
   {
     distanceoffsetnm      [0] Distanceoffsetnm,
     distanceoffsetkm      [1] Distanceoffsetkm
   }

   Distanceoffsetnm ::= INTEGER (1..128)
   -- Units = 1 Nautical Mile, Range (1..128)

   Distanceoffsetkm ::= INTEGER (1..256)
   -- Units = 1 Kilometer, Range (1..256)

DistanceoffsetDirection ::= SEQUENCE
   {
     Distanceoffset,
     Direction
   }
```

```
Errorinformation ::= ENUMERATED
    {
      applicationError                      (0),
      duplicateMsgIdentificationNumber      (1),
      unrecognizedMsgReferenceNumber        (2),
      endServiceWithPendingMsgs             (3),
      endServiceWithNoValidResponse         (4),
      insufficientMsgStorageCapacity        (5),
      noAvailableMsgIdentificationNumber    (6),
      commandedTermination                  (7),
      insufficientData                      (8),
      unexpectedData                        (9),
      invalidData                           (10),
      reservedErrorMsg                      (16)
-- reservedErrorMsg to ensure 5 bit Errorinformation field for additional errror messages
    }

Fixname ::= IA5String (SIZE (1..5))

Freetext ::= IA5String (SIZE (1..256))

Frequency ::= CHOICE
    {
      frequencyhf           [0] Frequencyhf,
      frequencyvhf          [1] Frequencyvhf,
      frequencyuhf          [2] Frequencyuhf,
      frequencysatchannel   [3] Frequencysatchannel
      frequencyvhffine      [4] Frequency vhffine
    }

    Frequencyhf ::= INTEGER (2850..28000)
    -- Units = 1 Kilohertz, Range (2850..28000)

    Frequencyuhffine ::= INTEGER (117000..138000)

    Frequencyvhf  ::= INTEGER (117000..138000)
    -- Units = .025 Megahertz, Range (117.000..138.000)

    Frequencyuhf  ::= INTEGER  (225000..399975)
    -- Units = .025 Megahertz, Range (225.000..399.975)

    Frequencysatchannel ::= NumericString (SIZE (12))
    -- Frequencysatchannel corresponds to a 12 digit telephone number
```

```
Holdclearance ::= SEQUENCE
   {
     Position,
     Level,
     Degrees,
     Direction,
     Legtype              OPTIONAL
   }

ICAOunitname ::=   SEQUENCE
   {
     ICAOfacilityidentification,
     ICAOfacilityfunction
   }

   ICAOfacilityidentification ::=  CHOICE
     {
      iCAOfacilitydesignation        [0] ICAOfacilitydesignation,
      iCAOfacilityname   [1] ICAOfacilityname
     }

     ICAOfacilitydesignation ::= IA5String (SIZE (4))

     ICAOfacilityname ::= IA5String (SIZE (3..18))

   ICAOfacilityfunction ::=   ENUMERATED
     {
      center                   (0),
      approach                 (1),
      tower                    (2),
      final                    (3),
      groundControl            (4),
      clearanceDelivery  (5),
      departure                (6),
      control                  (7)
     }

ICAOunitnameFrequency ::= SEQUENCE
   {
     ICAOunitname,
     Frequency
   }

ICAOfacilitydesignationTp4table ::=   SEQUENCE
   {
     ICAOfacilitydesignation,
     Tp4table
   }
```

```
LatitudeLongitude ::=  SEQUENCE
   {
     Latitude,
     Longitude
   }

   Latitude ::= SEQUENCE
     {
      Latitudedegrees,
      Minuteslatlon               OPTIONAL,
      Latitudedirection
     }

     Latitudedegrees  ::= INTEGER (0..90)
     -- Units = 1 Degree, Range (0..90)

     Minuteslatlon ::= INTEGER (0..599)
     -- Units = .1 Minute, Range (0.. 59.9)

     Latitudedirection ::= ENUMERATED
      {
        north          (0),
        south          (1)
      }

   Longitude ::= SEQUENCE
     {
      Longitudedegrees,
      Minuteslatlon               OPTIONAL,
      Longitudedirection
     }

     Longitudedegrees ::= INTEGER (0..180)
     -- Units = 1 Degree, Range (0..180)

     Longitudedirection ::= ENUMERATED
      {
        east           (0),
        west           (1)
      }

Legtype ::= CHOICE
   {
     legdistance         [0] Legdistance,
     legtime             [1] Legtime
   }
```

```
    Legdistance ::= CHOICE
      {
       legdistanceenglish  [0] Legdistanceenglish ,
       legdistancemetric   [1] Legdistancemetric
      }

      Legdistanceenglish ::= INTEGER (1..999)
      -- Units = .1 Nautical Mile, Range (.1..99.9)

      Legdistancemetric ::= INTEGER (1..128)
      -- Units = 1 Kilometer, Range (1..128)

    Legtime ::= INTEGER (1..99)
    -- Units = .1 Minute, Range (.1..9.9)

Placebearingdistance ::= SEQUENCE
    {
      Fixname,
      LatitudeLongitude            OPTIONAL,
      Degrees                      OPTIONAL,
      Distance
    }

    Distance ::= CHOICE
      {
       distancenm                  [0] Distancenm,
       distancekm                  [1] Distancekm
      }

      Distancenm ::= INTEGER (0..9999)
      -- Units = .1 Nautical Mile, Range (0..999.9)

      Distancekm ::= INTEGER (1..1024)
      -- Units = 1 Kilometer, Range (1..1024)

Position ::= CHOICE
    {
      fixname                      [0] Fixname,
      navaid                       [1] Navaid,
      airport                      [2] Airport,
      latitudeLongitude            [3] LatitudeLongitude,
      placebearingdistance         [4] Placebearingdistance
    }

      Navaid ::=  IA5String (SIZE (1..4) )
```

```
PositionLevel ::=   SEQUENCE
    {
      Position,
      Level
    }

PositionLevelLevel ::= SEQUENCE
    {
      Position,
      level-seqOf            SEQUENCE SIZE (2) OF Level
    }

PositionLevelSpeed ::=   SEQUENCE
    {
      Position,
      Level,
      Speed
    }

PositionDegrees ::= SEQUENCE
    {
      Position,
      Degrees
    }

PositionDistanceoffsetDirection ::= SEQUENCE
    {
      Position,
      Distanceoffset,
      Direction
    }

PositionICAOunitnameFrequency ::= SEQUENCE
    {
      Position,
      ICAOunitname,
      Frequency
    }

PositionProcedurename::= SEQUENCE
    {
      Position,
      Procedurename
    }
```

```
Positionreport ::= SEQUENCE
  {
    positioncurrent              [0] Positioncurrent,
    timeatpositioncurrent        [1] Timeatpositioncurrent,
    level                        [2] Level,
    fixnext                      [3] Fixnext                    OPTIONAL,
    timeetaatfixnext             [4] Timeetaatfixnext           OPTIONAL,
    fixnextplusone               [5] Fixnextplusone             OPTIONAL,
    timeetadestination           [6] Timeetadestination         OPTIONAL,
    remainingfuel                [7] Remainingfuel              OPTIONAL,
    temperature                  [8] Temperature                OPTIONAL,
    winds                        [9] Winds                      OPTIONAL,
    turbulence                   [10] Turbulence                OPTIONAL,
    humidity                     [11] Humidity                  OPTIONAL,
    speed                        [12] Speed                     OPTIONAL,
    speedground                  [13] Speedground               OPTIONAL,
    verticalchange               [14] Verticalchange            OPTIONAL,
    trackangle                   [15] Trackangle                OPTIONAL,
    trueheading                  [16] Trueheading               OPTIONAL,
    distance                     [17] Distance                  OPTIONAL,
    supplementaryinformation     [18] SupplementaryinformationOPTIONAL
  }

  Positioncurrent ::= Position

  Timeatpositioncurrent ::= Time

  Fixnext ::= Position

  Timeetaatfixnext ::= Time

  Fixnextplusone ::= Position

  Timeetadestination ::= Time

  Temperature ::= CHOICE
    {
     temperaturec [0] Temperaturec,
     temperaturef [1] Temperaturef
    }

    Temperaturec ::= INTEGER (-80..47)
    -- Units = 1 Degree Centigrade, Range (-80..47)

    Temperaturef ::= INTEGER (-105..150)
    -- Units = 1 Degree Fahrenheit, Range (-105..150)
```

```
Winds ::= SEQUENCE
  {
   Winddirection,
   Windspeed
  }

  Winddirection ::= INTEGER (1..360)
  -- Units = 1 Degree, Range (1..360)

  Windspeed ::= CHOICE
   {
     windspeedenglish          [0] Windspeedenglish,
     windspeedmetric           [1] Windspeedmetric
   }

   Windspeedenglish ::= INTEGER (0..255)
   -- Units = 1 Knot, Range (0..255)

   Windspeedmetric ::= INTEGER (0..511)
   --Units = 1 Kilometer/Hour, Range (0..511)

Turbulence ::= ENUMERATED
  {
   light           (0),
   moderate        (1),
   severe          (2)
  }

Humidity ::= ?TBD?

Verticalchange ::= SEQUENCE
  {
   Verticaldirection,
   Verticalrate
  }

Verticaldirection ::= ENUMERATED
  {
   up              (0),
   down            (1)
  }

  Trackangle ::= Degrees

  Trueheading ::= Degrees
```

```
PositionRouteclearance ::= SEQUENCE
    {
      Position,
      Routeclearance
    }

PositionSpeed ::= SEQUENCE
    {
      Position,
      Speed
    }

PositionSpeedSpeed ::= SEQUENCE
    {
      Position,
      speed-seqOf          SEQUENCE SIZE (2) OF Speed
    }

PositionTime ::= SEQUENCE
    {
      Position,
      Time
    }

PositionTimeLevel ::= SEQUENCE
    {
      Position,
      Time,
      Level
    }

PositionTimeTime::= SEQUENCE
    {
      Position,
      time-seqOf           SEQUENCE SIZE (2) OF Time
    }

Predepartureclearance ::= SEQUENCE
    {
      aircraftflightidentification   [0] Aircraftflightidentification,
      aircrafttype                   [1] Aircrafttype             OPTIONAL,
      aircraftequipmentcode          [2] Aircraftequipmentcode    OPTIONAL,
      timedepartureedct              [3] Timedepartureedct,
      routeclearance                 [4] Routeclearance,
      levelrestriction               [5] Levelrestriction         OPTIONAL,
```

```
    frequencydeparture              [6] Frequencydeparture,
    beaconcode                      [7] Beaconcode,
    pDCrevision                     [8] PDCrevision
}

Aircraftflightidentification ::= IA5String (SIZE (2..7))

Aircrafttype ::= IA5String (SIZE (2..5))

Aircraftequipmentcode ::= SEQUENCE
  {
                                    COMNAVapproachequipmentavailable,
    cOMNAVequipmentstatus-seqOf     SEQUENCE SIZE (1..16) OF COMNAVequipmentstatus
                                    OPTIONAL,
                                    SSRequipmentavailable
  }

  COMNAVapproachequipmentavailable ::= BOOLEAN

  COMNAVequipmentstatus ::= ENUMERATED
   {
      aloranA                  (0),
      cloranC                  (1),
      ddme                     (2),
      edecca                   (3),
      fadf                     (4),
      ggnss                    (5),
      hhfRTF                   (6),
      iinertialNavigation      (7),
      lils                     (8),
      momega                   (9),
      ovor                     (10),
      pdoppler                 (11),
      rrnavRouteEquipment      (12),
      ttacan                   (13),
      uuhfRTF                  (14),
      vvhfRTF                  (15)
   }
```

```
        SSRequipmentavailable ::= ENUMERATED
          {
            nnil                        (0),
            atransponderModeA           (1),
            ctransponderModeAandC       (2),
            xtransponderModeS           (3),
            ptransponderModeSPA         (4),
            itransponderModeSID         (5),
            stransponderModeSPAID       (6)
          }

        -- Note: PL; Pressure Level, ID; Aircraft Identification

      Timedepartureedct ::= Time

      Levelrestriction ::= Level

      Frequencydeparture ::= Frequencyvhf

      PDCrevision ::= INTEGER (1..16)

Procedurename ::= SEQUENCE
    {
      Proceduretype,
      Procedure,
      Proceduretransition   OPTIONAL
    }

    Proceduretype ::= ENUMERATED
      {
        arrival                 (0),
        approach       (1),
        departure      (2)
      }

    Procedure ::= IA5String (SIZE (1..6))

    Proceduretransition ::= IA5String (SIZE (1..5))

RemainingfuelRemainingsouls ::= SEQUENCE
    {
      Remainingfuel,
      Remainingsouls
    }
```

```
    Remainingfuel ::= SEQUENCE
      {
        Timehours,
        Timeminutes
      }

    Remainingsouls ::= INTEGER (1..1024)

Routeclearance ::= SEQUENCE
    {
      airportdeparture              [0] Airportdeparture            OPTIONAL,
      airportdestination            [1] Airportdestination          OPTIONAL,
      runwaydeparture               [2] Runwaydeparture             OPTIONAL,
      proceduredeparture            [3] Proceduredeparture          OPTIONAL,
      runwayarrival                 [4] Runwayarrival               OPTIONAL,
      procedureapproach             [5] Procedureapproach           OPTIONAL,
      procedurearrival              [6] Procedurearrival            OPTIONAL,
      airwayintercept               [7] Airwayintercept             OPTIONAL,
      routeinformation-seqOf        [8] SEQUENCE SIZE (1..128)
                                    OF Routeinformation             OPTIONAL,
      routeinformationadditional    [9] Routeinformationadditional  OPTIONAL
    }

    Airportdeparture ::= Airport

    Airportdestination ::= Airport

    Runwaydeparture ::= Runway

      Runway ::=  SEQUENCE
        {
          Runwaydirection,
          Runwayconfiguration
        }

        Runwaydirection ::= INTEGER (1..36)

        Runwayconfiguration ::= ENUMERATED
          {
            left          (0),
            right         (1),
            center        (2),
            none          (3)
          }

    Proceduredeparture ::= Procedurename

    Runwayarrival ::= Runway
```

```
Procedureapproach ::= Procedurename

Procedurearrival ::= Procedurename

Airwayintercept ::= IA5String (SIZE (1..5))

Routeinformation ::= CHOICE
  {
    publishedidentifier          [0] Publishedidentifier,
    latitudeLongitude            [1] LatitudeLongitude,
    placebearingplacebearing     [2] Placebearingplacebearing,
    placebearingdistance         [3] Placebearingdistance,
    airwayidentifier             [4] Airwayidentifier,
    trackdetail                  [5] Trackdetail
  }

  Publishedidentifier ::= SEQUENCE
    {
      Fixname,
      LatitudeLongitude          OPTIONAL
    }

  Placebearing ::= SEQUENCE
    {
      Fixname,
      LatitudeLongitude          OPTIONAL,
      Degrees
    }

  Placebearingplacebearing ::= SEQUENCE SIZE (2) OF Placebearing

  Airwayidentifier ::= IA5String (SIZE (1..5))

  Trackdetail ::= SEQUENCE
    {
      Trackname,
      latitudeLongitude-seqOf    SEQUENCE SIZE (1..128) OF LatitudeLongitude
    }

    Trackname ::= IA5String (SIZE (3..6))

ATWalongtrackwaypointsequence ::= SEQUENCE SIZE (1..8) OF ATWalongtrackwaypoint

Interceptcoursefromsequence ::= SEQUENCE SIZE (1..4) OF Interceptcoursefrom

Holdatwaypointsequence ::= SEQUENCE SIZE (1..8) OF Holdatwaypoint

Waypointspeedlevelsequence ::= SEQUENCE SIZE (1..32) OF Waypointspeedlevel
```

```
RTArequiredtimearrivalsequence ::= SEQUENCE SIZE (1..32) OF RTArequiredtimearrival

Routeinformationadditional ::= SEQUENCE
  {
    aTWalongtrackwaypointsequence    [0] ATWalongtrackwaypointsequence    OPTIONAL,
    reportingpoints                  [1] Reportingpoints                  OPTIONAL,
    interceptcoursefromsequence      [2] Interceptcoursefromsequence      OPTIONAL,
    holdatwaypointsequence           [3] Holdatwaypointsequence           OPTIONAL,
    waypointspeedlevelsequence       [4] Waypointspeedlevelsequence       OPTIONAL,
    rTArequiredtimearrivalsequenc    [5] RTArequiredtimearrivalsequence   OPTIONAL
  }

ATWlevelsequence ::= SEQUENCE SIZE (1..2) OF ATWlevel

   ATWalongtrackwaypoint ::= SEQUENCE
     {
      position                       [0] Position,
      aTWdistance                    [1] ATWdistance,
      speed                          [2] Speed              OPTIONAL,
      aTWlevelsequence               [3] ATWlevelsequence   OPTIONAL
     }

     ATWdistance ::= SEQUENCE
       {
         ATWDistancetolerance,
         Distance
       }

       ATWDistancetolerance ::= ENUMERATED
         {
           plus      (0),
           minus     (1)
         }

   Reportingpoints ::= SEQUENCE
     {
      Latlonreportingpoints,
      Degreeincrement              OPTIONAL
     }

     Latlonreportingpoints ::= CHOICE
       {
         latitudereportingpoints     [0] Latitudereportingpoints,
         longitudereportingpoints    [1] Longitudereportingpoints
       }
```

```
    Latitudereportingpoints ::= SEQUENCE
      {
        Latitudedirection,
        Latitudedegrees
      }

    Longitudereportingpoints ::= SEQUENCE
      {
        Longitudedirection,
        Longitudedegrees
      }

  Degreeincrement ::= INTEGER (1..20)
  -- Units = 1 Degree, Range (1..20)

Interceptcoursefrom ::= SEQUENCE
  {
   Interceptcoursefromselection,
   Degrees
  }

  Interceptcoursefromselection ::= CHOICE
   {
     publishedidentifier          [0] Publishedidentifier,
     latitudeLongitude            [1] LatitudeLongitude,
     placebearingplacebearing     [2] Placebearingplacebearing,
     placebearingdistance         [3] Placebearingdistance
   }

  Holdatwaypointspeedlow ::= Speed

  Holdatwaypointspeedhigh ::= Speed

  EFCtime ::= Time

  Holdatwaypoint ::= SEQUENCE
   {
     position                     [0] Position,
     holdatwaypointspeedlow       [1] Holdatwaypointspeedlow     OPTIONAL,
     aTWlevel                     [2] ATWlevel                   OPTIONAL,
     holdatwaypointspeedhigh      [3] Holdatwaypointspeedhigh    OPTIONAL,
     direction                    [4] Direction                  OPTIONAL,
     degrees                      [5] Degrees                    OPTIONAL,
     eFCtime                      [6] EFCtime                    OPTIONAL,
     legtype                      [7] Legtype                    OPTIONAL
   }
```

```
    Waypointspeedlevel ::= SEQUENCE
      {
       position          [0] Position,
       speed             [1] Speed              OPTIONAL,
       aTWlevelsequence  [2] ATWlevelsequence OPTIONAL
      }

    RTArequiredtimearrival ::= SEQUENCE
      {
       Position,
       RTAtime,
       RTAtolerance   OPTIONAL
      }

      RTAtime ::= SEQUENCE
        {
         Time,
         Timetolerance
        }

        Timetolerance ::= ENUMERATED
          {
            at            (0),
            atorafter     (1),
            atorbefore    (2)
          }

      RTAtolerance ::= INTEGER (1..150)
      -- Units=.1 Minute, Range (.1..15.0)

Speed ::= CHOICE
    {
      speedindicated                  [0] Speedindicated,
      speedindicatedmetric            [1] Speedindicatedmetric,
      speedtrue                       [2] Speedtrue,
      speedtruemetric                 [3] Speedtruemetric,
      speedground                     [4] Speedground,
      speedgroundmetric               [5] Speedgroundmetric,
      speedmach                       [6] Speedmach,
      speedmachlarge                  [7] Speedmachlarge
    }

    Speedindicated ::= INTEGER (7..38)
    -- Units = 10 Knots, Range (70..380)

    Speedindicatedmetric ::= INTEGER (10..137)
    -- Units = 10 Kilometers/Hour, Range (100..1370)
```

```
    Speedtrue ::= INTEGER (7..70)
    -- Units = 10 Knots, Range (70..700)

    Speedtruemetric ::= INTEGER (10..137)
    -- Units = 10 Kilometers/Hour, Range (100..1370)

    Speedground ::= INTEGER (7..70)
    -- Units = 10 Knots, Range (70..700)

    Speedgroundmetric ::= INTEGER (10..265)
    -- Units = 10 Kilometers/Hour, Range (100..2650)

    Speedmach ::= INTEGER (61..92)
    -- Units = .01 Mach; Range (.61 to .92)

    Speedmachlarge ::= INTEGER (93..604)
    -- Units = .01 Mach; Range (.93 to 6.04)

Time ::= SEQUENCE
    {
      Timehours,
      Timeminutes
    }

    Timehours ::= INTEGER (0..23)
    -- Units = 1 Hour, Range (0..23)

    Timeminutes ::= INTEGER (0..59)
    -- Units = 1 Minute, Range (0..59)

TimeLevel ::= SEQUENCE
    {
      Time,
      Level
    }

TimeDistanceoffsetDirection ::= SEQUENCE
    {
      Time,
      Distanceoffset,
      Direction
    }
```

```
TimeDistanceTofromPosition ::= SEQUENCE
    {
      time              [0] Time,
      distance          [1] Distance,
      tofrom            [2] Tofrom,
      position          [3] Position
    }

    Tofrom ::= ENUMERATED
      {
        to              (0),
        from            (1)
      }

TimeICAOunitnameFrequency ::= SEQUENCE
    {
      Time,
      ICAOunitname,
      Frequency
    }

TimePosition ::= SEQUENCE
    {
      Time,
      Position
    }

TimePositionLevel ::= SEQUENCE
    {
      Time,
      Position,
      Level
    }

TimePositionLevelSpeed ::=  SEQUENCE
    {
      Time,
      Position,
      Level,
      Speed
    }

TimeSpeed ::= SEQUENCE
    {
      Time,
      Speed
    }
```

```
TimeSpeedSpeed ::= SEQUENCE
  {
    Time,
    speed-seqOf          SEQUENCE SIZE (2) OF Speed
  }

TimeTofromPosition ::= SEQUENCE
  {
    Time,
    Tofrom,
    Position
  }

TofromPosition ::= SEQUENCE
  {
    Tofrom,
    Position
  }

Tp4table ::= ENUMERATED
  {
    labelA              (0),
    labelB              (1)
  }

Trackdetailmsg ::= SEQUENCE
  {
    trackname                   [0] Trackname,
    datetimetrackgenerated      [1] Datetimetrackgenerated,
    trackdetailmsgtype          [2] Trackdetailmsgtype,
    datetimetrackstart          [3] Datetimetrackstart,
    datetimetrackstop           [4] Datetimetrackstop,
    airportdeparture            [5] Airportdeparture,
    pointdetailsequence         [6] Pointdetailsequence,
    airportdestination          [7] Airportdestination,
    remarks                     [8] Remarks
  }

  Datetimetrackgenerated ::= Datetimegroup

    Datetimegroup ::= SEQUENCE
     {
       Date,
       Time
     }
```

```
    Date ::= SEQUENCE
      {
        Year,
        Month,
        Day
      }

      Year ::= INTEGER (0..99)
      -- Units = 1 Year, Range (0..99)

      Month ::= INTEGER (1..12)
      -- Units = 1 Month, Range (1..12)

      Day ::= INTEGER (1..31)
      -- Units = 1 Day, Range (1..31)

Trackdetailmsgtype ::= ENUMERATED
  {
    provisional        (0),
    final              (1)
  }

Datetimetrackstart ::= Datetimegroup

Datetimetrackstop ::= Datetimegroup

Pointdetailsequence ::= SEQUENCE SIZE (1..32) OF Pointdetail

  Pointdetail ::= SEQUENCE
    {
      latitudeLongitude       [0] LatitudeLongitude,
      fixname                 [1] Fixname                 OPTIONAL,
      truetrackangle          [2] Truetrackangle          OPTIONAL,
      distancetonextpoint     [3] Distancetonextpoint     OPTIONAL,
      pointlevel              [4] Pointlevel              OPTIONAL,
      pointlevelblock         [5] Pointlevelblock         OPTIONAL
    }

    Truetrackangle ::= Degreestrue

    Distancetonextpoint ::= CHOICE
      {
        distancetonextpointenglish     [0] Distancetonextpointenglish,
        distancetonextpointmetric      [1] Distancetonextpointmetric
      }

      Distancetonextpointenglish ::= INTEGER (1..1024)
      -- Units = 1 Nautical Mile, Range (1..1024)
```

```
        Distancetonextpointmetric ::= INTEGER (1..2048)
        -- Units = 1 Kilometer, Range (1..2048)

      Pointlevel ::= SEQUENCE
        {
          Levelflightlevel,
          ATWleveltolerance          OPTIONAL
        }

      Pointlevelblock ::= SEQUENCE SIZE (2) OF Levelflightlevel

   Remarks ::= Freetext

Versionnumber ::= INTEGER (0..15)

Verticalrate ::= CHOICE
   {
     verticalrateenglish   [0] Verticalrateenglish,
     verticalratemetric    [1] Verticalratemetric
   }

   Verticalrateenglish ::= INTEGER (0..60)
   -- Units = 100 Feet/Minute, Range (0..6000)

   Verticalratemetric ::= INTEGER (0..200)
   -- Units = 10 Meters/Minute, Range (0..2000)

END
```

A.2 ASN glossary

The following data structures are used in the CPDLC abstract syntax and are shown in alphabetical order:

Aircraftequipmentcode. A sequence of data structures used to indicate the type of communication, navigation and approach aid equipment on an aircraft as defined in the *Procedures for Air Navigation Services — Rules of the Air and Air Traffic Services* (PANS-RAC, ICAO Doc 4444).

Aircraftflightidentification. A variable-length character string used to identify an aircraft flight number.

Aircrafttype. A variable-length character string used to identify the aircraft type as defined in *Aircraft Type Designators* (ICAO Doc 8643). This data structure also includes 1 character used to specify the turbulence category.

Airport. Specifies the ICAO four-letter identifier for the airport.

Airportdeparture. Specifies the departure airport.

Airportdestination. Specifies the destination airport.

Airwayidentifier. Specifies the particular airway to be used within the route of the aircraft.

Airwayintercept. Specifies the airway which will be intercepted and followed in the aircraft route of flight.

Altimeter. Choice to indicate whether the aircraft altimeter setting is specified in metric or English measurement units.

Altimeterenglish. Specifies the aircraft altimeter setting in English measurement units.

Altimetermetric. Specifies the aircraft altimeter setting in metric measurement units.

Level. Choice to indicate the type of level specification.

Levelcurrent. Specifies the current aircraft level using the Level data structure.

Levelflightlevel. Specifies the altitude above mean sea level, obtained by setting the aircraft altimeter to 29.92 inches of mercury, expressed in levels of flight in 100-foot increments.

Levelflightlevelmetric. Specifies the altitude above mean sea level, obtained by setting the aircraft altimeter to 1 013.2 hectopascals, expressed in levels of flight in 10-metre increments.

Levelgnssfeet. Specifies the altitude above GNSS zero altitude reference, obtained from GPS/GNSS position data, expressed in feet.

Levelgnssmeters. Specifies the altitude above GNSS zero altitude reference, obtained from GPS/GNSS position data, expressed in metres.

Levelqfe. Specifies the altitude with a "Queen's Field Elevation" altimeter setting expressed in feet.

Levelqfemeters. Specifies the altitude with a "Queen's Field Elevation" altimeter setting expressed in metres.

Levelqnh. Specifies the altitude with a "Queen's Natural Height" altimeter setting expressed in feet.

Levelqnhmeters. Specifies the altitude with a "Queen's Natural Height" altimeter setting expressed in metres.

Levelrestriction. Specifies any departure level restrictions.

Leveltolerance. Choice to indicate at, at or above, or at or below, concerning the related level value.

ATCdownlinkmessage. Sequence of ATCmessageheader and ATCdownlinkmsgelementid. This data structure is the complete message sent from the ATCComm to the ATC Data Authority. The message consists of a message header, message element identifiers and any applicable data structures.

ATCdownlinkmsgelementid. Choice to indicate a unique number (CHOICE tag) used by the application to define the context of the downlink message.

ATCmessageheader. Sequence of Msgidentificationnumber (the message identification number) and Msgreferencenumber (the message reference number, optional). Header information is used to uniquely identify messages and to correlate responses with previously received messages. The ATCmessageheader applies to both uplink and downlink messages.

ATCuplinkmessage. Sequence of ATCmessageheader and ATCUplinkmsgelementid data structures. This data structure is the complete message sent from the ATC authority to the ATCComm. The message consists of a message header, message element identifiers and any applicable data structures.

ATCuplinkmsgelementid. Choice to indicate a unique number used to define the context of the ATC uplink message.

Atiscode. Specifies the alphanumeric value for the current version of the automatic terminal information service (ATIS) in effect at a given location.

ATWalongtrackwaypoint. Sequence of data structures used to compute additional way-points to an aircraft's route of flight.

ATWalongtrackwaypointsequence. Sequence of ATWalongtrackwaypoint data structures.

ATWlevel. Sequence of ATWleveltolerance and Level data structures.

ATWlevelsequence. Sequence of ATWlevels.

ATWleveltolerance. Indicates the vertical tolerance factor for level clearances. Used in level clearances to indicate the acceptable vertical clearance of an aircraft relative to a particular level.

ATWdistance. Sequence of ATWDistancetolerance and Distance data structures. Used to specify the distance along a route of flight at which point to add the fix.

ATWDistancetolerance. Indicates whether a distance can be plus or minus.

Beaconcode. Specifies the Mode A value (beacon code) for the aircraft.

Beaconcodeoctaldigit. Specifies the value of each of the octal digits which comprise the aircraft Mode A beacon code.

COMNAVapproachequipmentavailable. Indicates the presence or absence of communication, navigation and approach aid equipment.

COMNAVequipmentstatus. Indicates which communication, navigation and approach aid equipment is available for use as defined in the *Procedures for Air Navigation Services – Rules of the Air and Air Traffic Services* (PANS-RAC, ICAO Doc 4444).

Date. Sequence of Year, Month, and Day data structures.

Datetimetrackgenerated. Date and time of the creation of a track.

Datetimegroup. Sequence of the Date and Time data structures.

Datetimetrackstart. Date and time of the track activation.

Datetimetrackstop. Date and time of the track termination.

Day. Day of the month, given as an integer from 1 to 31.

Degreeincrement. Specifies the number of degrees (of latitude or longitude) separating reporting points.

Degrees. Choice to indicate whether degrees are specified in reference to magnetic north or true north.

Degreesmagnetic. Degrees specified in reference to magnetic north.

Degreestrue. Degrees specified in reference to true north.

Direction. Indicates the horizontal direction specified in terms of the current direction (left, right, etc.) relative to the aircraft or in terms of the cardinal points of the compass.

Distance. Choice to indicate whether distance is specified in metric or English measurement units.

Distancekm. Distance specified in kilometres.

Distancenm. Distance specified in nautical miles.

DistanceoffsetDirection. Sequence of Distanceoffset and Direction data structures.

Distanceoffset. Choice to indicate whether the offset distance from the aircraft's route is specified in metric or English measurement units.

Distanceoffsetnm. Specifies the offset distance from the aircraft's route in nautical miles.

Distanceoffsetkm. Specifies the offset distance from the aircraft's route in kilometres.

Distancetonextpoint. Choice of English or metric units for the Distancetonextpoint data structure.

Distancetonextpointenglish. Distance to next way-point given in nautical miles.

Distancetonextpointmetric. Distance to next way-point given in kilometres.

DM1NULL through DM128NULL. Data structures created for compliance with the ASN.1 requirement for each selection of a choice to have a distinct name. DM means downlink message, the number is the message element ID, and the rest is the data structure contained in the message element.

Errorinformation. Indicates the possible error conditions which can be reported.

EFCTime. Specifies the Expect Further Clearance time.

Fixname. Specifies the ICAO identifier for a given fix.

Fixnext. Indicates the next point in the aircraft's route.

Fixnextplusone. Specifies the point after the next point in the aircraft's route.

Flightplanseqment. Choice to indicate the type of information used to define a particular point in the aircraft route of flight.

Flightplanseqmentsequence. Sequence of up to 16 Flightplansegment data structures.

Freetext. A variable-length character string used to convey unstructured information.

Frequency. Choice to indicate the RF spectrum used for the given frequency: HF, VHF, UHF or satellite.

Frequencydeparture. Specifies the departure frequency.

Frequencyhf. HF frequency in KHz units.

Frequencyvhf. VHF frequency in MHz units.

Frequencyuhf. UHF frequency in MHz units.

Frequencysatchannel. Specifies the appropriate address for use with a satellite voice system.

Holdatwaypoint. Sequence of data structures used to define the holding procedure to be used at a particular point.

Holdatwaypointsequence. Sequence of Holdatwaypoint data structures.

HoldatwaypointSpeedlow. Specifies holding speed. When used with HoldatwaypointSpeedhigh, specifies the lower value for a holding speed range.

HoldatwaypointSpeedhigh. Specifies the upper value for a holding speed range.

Holdclearance. Sequence of data structures necessary to provide a holding clearance to the aircraft.

Humidity. Specifies the per cent humidity.

ICAOfacilitydesignation. Specifies the ICAO four-letter location indicator for the facility.

ICAOfacilityidentification. Choice to indicate whether an ICAO facility is identified using the four-character ICAO facility designation or the actual ICAO facility name expressed as a variable-length character string.

ICAOfacilityfunction. Indicates the ATC function performed by the ICAO facility.

ICAOfacilityname. Specifies the ICAO facility name expressed as a variable-length character string.

ICAOunitname. Sequence of ICAOfacilityidentification and ICAOfacilityfunction data structures.

ICAOunitnameFrequency. Sequence of ICAOunitname and Frequency data structures.

ICAOunitnameTp4table. Sequence of ICAOunitname and Tp4table data structures.

Interceptcoursefrom. Sequence of Interceptcoursefromselection and Degrees data structures. The Interceptcoursefrom data structure is used to specify a fix and a bearing from that fix needed to intercept a route.

Interceptcoursefromselection. Choice to indicate the type of fix used to specify the point from which the intercept course originates.

Interceptcoursefromsequence. Sequence of Interceptcoursefrom data structures.

LatitudeLongitude. Sequence of Latitude and Longitude data structures.

Latitude. Sequence of Latitudedegrees, Minuteslatlon and Latitudedirection data structures.

Latitudedegrees. Degrees of latitude.

Latitudedirection. Indicates whether north or south latitude is specified.

Latitudereportingpoints. Indicates the latitude on which to base incremental reporting points.

Latlonreportingpoints. Choice to indicate whether latitude or longitude reporting points will be indicated.

Legdistance. Choice to indicate whether English or metric units are used to specify the distance of a leg for an aircraft hold clearance.

Legdistanceenglish. Specifies aircraft leg clearance in terms of nautical miles.

Legdistancemetric. Specifies aircraft leg clearance in terms of kilometres.

Legtime. Specifies aircraft leg clearance in terms of minutes.

Legtype. Choice to indicate whether the holding pattern legs are defined in terms of distance or time.

Longitude. Sequence of Longitudedegrees, Minuteslatlon and Longitudedirection data structures.

Longitudedegrees. Degrees of longitude.

Longitudedirection. Indicates whether east or west longitude is specified.

Longitudereportingpoints. Indicates the longitude on which to base incremental reporting points.

Minuteslatlon. Minutes of latitude or longitude.

Month. Month of the year given as an integer from 1 (corresponding to January) to 12 (corresponding to December).

Msgidentificationnumber. Specifies the message identification number (refer to generic description).

Msgreferencenumber. Specifies the message reference number (refer to generic description).

Navaid. Specifies a particular navigation aid.

PDCrevision. Specifies the revision number of the pre-departure clearance. Used to differentiate different revisions of the pre-departure clearance for a given aircraft flight.

Placebearing. Sequence of Fixname, LatitudeLongitude and Degrees.

Placebearingdistance. Sequence of Fixname, LatitudeLongitude, Degrees and Distance data structures. Used to indicate a location based on the degrees and distance from a known point.

Placebearingplacebearing. Sequence of data structures used to define a point as the intersection formed by two bearings from two known points.

Pointlevel.. Specifies level related details concerning a given point.

Pointlevelblock. Sequence of two Levelflightlevel data structures.

Position. Choice to indicate the type of information used to specify a location: Fixname, Navaid, Airport, LatitudeLongitude or Placebearingdistance.

Positioncurrent. Specifies the current location of the aircraft.

Positionreport. Sequence of the data structures necessary to provide an aircraft position report to the ICAO facility.

Predepartureclearance. Sequence of data structures necessary to provide a pre-departure clearance.

Procedure. Specifies the name of the procedure.

Procedureapproach. Specifies a procedure as an approach procedure.

Procedurearrival. Specifies a procedure as an arrival procedure.

Proceduredeparture. Specifies a procedure as a departure procedure.

Procedurename. Sequence used to uniquely identify the standard arrival, approach or departure procedure.

Proceduretype. Specifies the type of procedure, i.e. arrival, approach or departure.

Proceduretransition. Specifies the name of the procedure transition.

Publishedidentifier. Sequence of Fixname and LatitudeLongitude. The LatitudeLongitude is the location of the Fixname.

RemainingfuelRemainingsouls. Sequence of Remainingfuel and RemainingSouls data structures.

Remainingfuel. Sequence to specify the amount of fuel remaining on the aircraft expressed in hours and minutes.

Remainingsouls. Specifies the number of persons on the aircraft.

Remarks. Free text notes.

Reportingpoints. Sequence of Latlonreportingpoints and Degreeincrement data structures. Used to indicate reporting points along a route of flight based on a specific Latitude and/or Longitude increment expressed in degrees.

Routeclearance. Sequence of data structures necessary to provide a route clearance. The route clearance data structure is based on the message and data structures defined in the AEEC 702 Characteristic "Flight Management Computer System".

Routeinformation. Choice to indicate the method used to define the aircraft route of flight. The actual aircraft route of flight will probably consist of multiple Routeinformation data structures.

Routeinformationadditional. Sequence of data structures used to further specify a route clearance.

RTArequiredtimearrival. Sequence of data structures used to associate an estimated time of arrival with a specific point along a route of flight.

RTArequiredtimearrivalsequence. Sequence of Requiredtimearrival data structures.

RTAtime. Sequence of Time and Timetolerance data structures. Used to specify the required time of arrival for an aircraft at a specific point.

RTAtolerance. Specifies the possible tolerance expressed in minutes in the RTAtime used in the RTArequiredtimearrival data structure.

Runway. Sequence of the Runwaydirection and Runwayconfiguration data structures.

Runwayarrival. Specifies the arrival runway.

Runwayconfiguration. Used to specifically identify one runway in a group of parallel runways.

Runwaydeparture. Specifies the departure runway.

Runwaydirection. Specifies the direction of the runway.

Speed. Choice to indicate the type of speed specified.

Speedground. Aircraft groundspeed specified in knots.

Speedgroundmetric. Aircraft groundspeed specified in kilometres per hour.

Speedindicated. Indicated aircraft speed specified in knots.

Speedindicatedmetric. Indicated aircraft speed specified in kilometres per hour.

Speedmach. Aircraft speed specified as a Mach value.

Speedmachlarge. Aircraft speed specified as a Mach value with an extended range of values to cover anticipated high-speed aircraft.

Speedtrue. Aircraft true speed specified in knots.

Speedtruemetric. Aircraft true speed specified in kilometres per hour.

SSRequipmentavailable. Indicates which surveillance equipment is available for use as defined in the *Procedures for Air Navigation Services – Rules of the Air and Air Traffic Services* (PANS-RAC, ICAO Doc 4444).

Temperature. Indicates whether temperature is specified in centigrade or Fahrenheit.

Temperaturec. Temperature expressed as degrees centigrade.

Temperaturef. Temperature expressed as degrees Fahrenheit.

Time. Sequence of Timehours and Timeminutes data structures used to specify time.

Timeatpositioncurrent. Specifies the time that the current location of the aircraft was indicated.

Timeetadestination. Specifies the time an aircraft is expecting to land at the destination airport.

Timedepartureedct. Specifies the estimated departure time.

TimeDistanceTofromPosition. Sequence of Time, Distance, Tofrom and Position data structures.

Timeetaatfixnext. Specifies the time an aircraft is expecting to cross the next point in the route.

Timehours. Specifies the hour in 24-hour notation.

Timeminutes. Specifies the minutes.

Timetolerance. Used in the RTAtime data structure to indicate the direction of the RTAtolerance data structure relative to a specific time. The tolerance can be expressed as "at", "at or before", or "at or after".

Tofrom. Used to indicate "to" or "from" relative to a position.

Tp4table. Indicates which of the transport layer timer value tables should be used.

Trackangle. Specifies the aircraft ground track.

Trueheading. Specifies the aircraft true heading.

Trackdetail. Sequence of the Trackname data structure and associated points in the route of the aircraft, defined using the LatitudeLongitude data structure. This data structure is used to associate a sequence of fixes with a particular track name.

Trackdetailmsg. Specifies the Track Detail Message.

Trackdetailmessagetype. Specifies whether the track is provisional or final.

Trackname. Specifies the name of an identified group of points which make up a section of a route.

Truetrackangle. Specifies true track angle to the next way-point (degrees relative to true north).

Turbulence. Specifies the severity of turbulence.

UM1NULL through UM182NULL. Data structures created for compliance with the ASN.1 requirement for each selection of a choice to have a distinct name. UM means uplink message, the number is the message element ID, and the rest is the data structure contained in the message element.

Verticalchange. Sequence of the Verticaldirection and Verticalrate data structures.

Versionnumber. Specifies the versionnumber of ATCComm.

Verticaldirection. Specifies whether the rate of vertical change is in the upward or downward direction.

Verticalrate. Choice of English or metric units for the vertical rate.

Verticalrateenglish. Specifies a rate of vertical change in feet per minute.

Verticalratemetric. Specifies a rate of vertical change in metres per minute.

Waypointspeedlevel. Sequence of data structures used to associate levels and speeds with particular points in a route clearance.

Waypointspeedlevelsequence. Sequence of Waypointspeedlevel data structures.

Winds. Sequence of wind direction and windspeed data structures.

Winddirection. Specifies the direction of the wind.

Windspeed. Indicates whether the wind speed is specified in metric or English measurement units.

Windspeedenglish. Wind speed specified in knots.

Windspeedmetric. Wind speed specified in kilometres per hour.

Year. Last two digits of a year, given as an integer from 0 to 99.

— — — — — — — —

APPENDIX B

TO PART II, CHAPTER 2

CPDLC SERVICE DESCRIPTIONS

B.1 Introduction

Service descriptions are defined for the CPDLC application in terms of the management of connections.

B.2 Connection initiation

The message flow diagram for connection initiation is shown in Figure B-1. The messages are identified as follows:

1: FPL
2: "Connection Request" (ATN protocol)
3: "Connection Confirm" (ATN protocol)
4: any CPDLC message

The transmission of message 2 shall require receipt of message 1.

The transmission of message 3 shall require receipt of message 2.

The transmission of message 4 shall require receipt of message 3.

A method shall be employed to disseminate aircraft CPDLC application addresses to ATC facilities.

Any ATC facility may initiate a connection with a given aircraft provided that the aircraft does not have any current CPDLC connections with any other ATC facility. Procedures shall be established to ensure that only the proper ATC facility initiates a connection with a given aircraft.

When establishing a connection, the ATC facility shall provide a message with the [icaofacilitydesignation][tp4table] message element only as user data in the "Connection Request". The [icaofacilitydesignation] variable shall reflect the appropriate ATC facility information and the [tp4table] shall reflect the level of required performance.

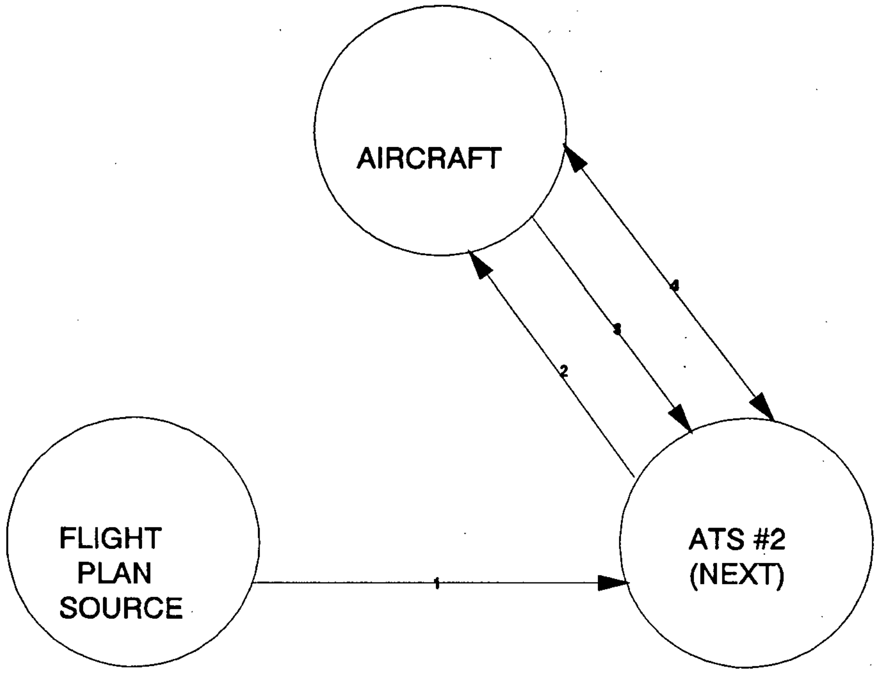

Figure B-1. CPDLC connection initiation

B.3 Connection transfer/termination

The message flow diagrams for connection transfer/termination are shown in the following figures:

Figure B-2: ATC facility with CPDLC capability to ATC facility with CPDLC capability

Figure B-3: ATC facility with CPDLC capability to ATC facility without CPDLC capability

Figure B-4: ATC facility without CPDLC capability to ATC facility with CPDLC capability

The messages are identified as follows:

1: NEXT DATA AUTHORITY [icaofacilitydesignation] (uplink message element 160)

2: Ground-ground co-ordination messages as per the PANS-RAC (Doc 4444), whereby the last message is an ACP

3: "Connection Request" (ATN protocol)

4: "Connection Confirm" (ATN protocol)

5: END SERVICE (uplink message element 161) + optional message element(s)

6: WILCO (downlink message element 0)

7: TOC (ground-ground message)

8: AOC (ground-ground message)

9: any CPDLC message.

The [icaofacilitydesignation] variable shall reflect values for the next ATS facility concerning transfer of control for the given aircraft. The transmission of message 1 authorizes the aircraft to accept a connection from ATS facility #2.

The same requirements as specified in Section B.2 shall apply for messages 3 and 4.

The transmission of message 5 shall not be initiated until the conditions necessary to initiate the transmission of message 7 have been met. Message 5 shall be sent before message 7 if ATS facility #1 has a current CPDLC connection. The controller action used to initiate the transmission may be utilized to initiate the transmission of message 5.

ATS facility #1 shall ensure that a response has been provided for all uplink messages which require a response before sending message 5.

If message 5 is sent with an optional message element, at least one of the message elements shall indicate a transfer of control to another controller and the message shall have a "W/U" response attribute.

Message 6 will only be sent if message 5 is sent with an optional message element which has a "W/U" response attribute.

The transmission of message 7 shall only be accomplished after the completion of the message 2 sequence (ACP received).

The transmission of message 8 shall require the receipt of message 7.

The transmission of message 9 shall require the receipt of message 8 and message 4.

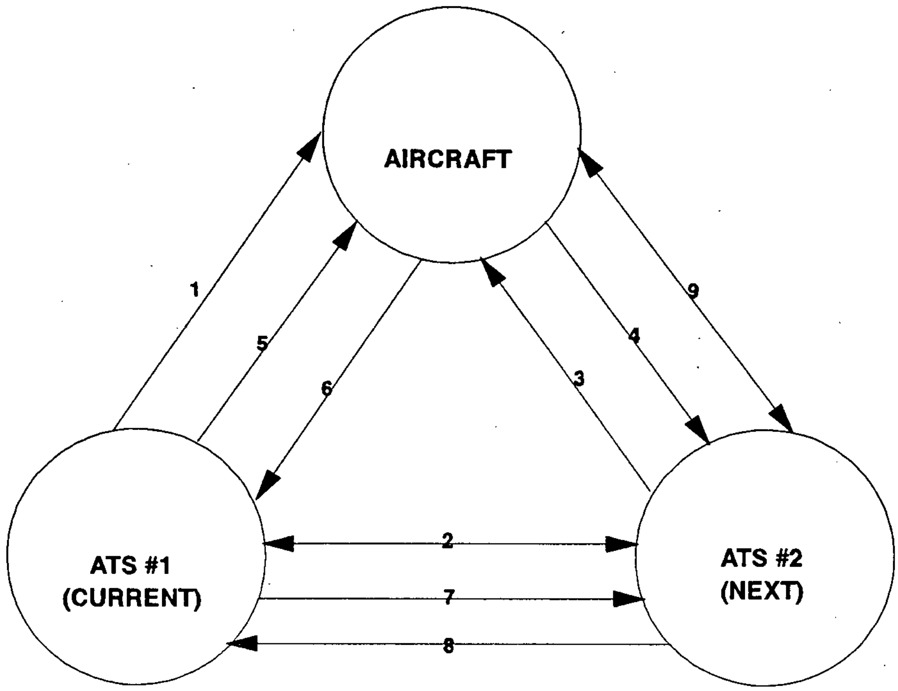

Figure B-2. CPDLC connection transfer – CPDLC to CPDLC

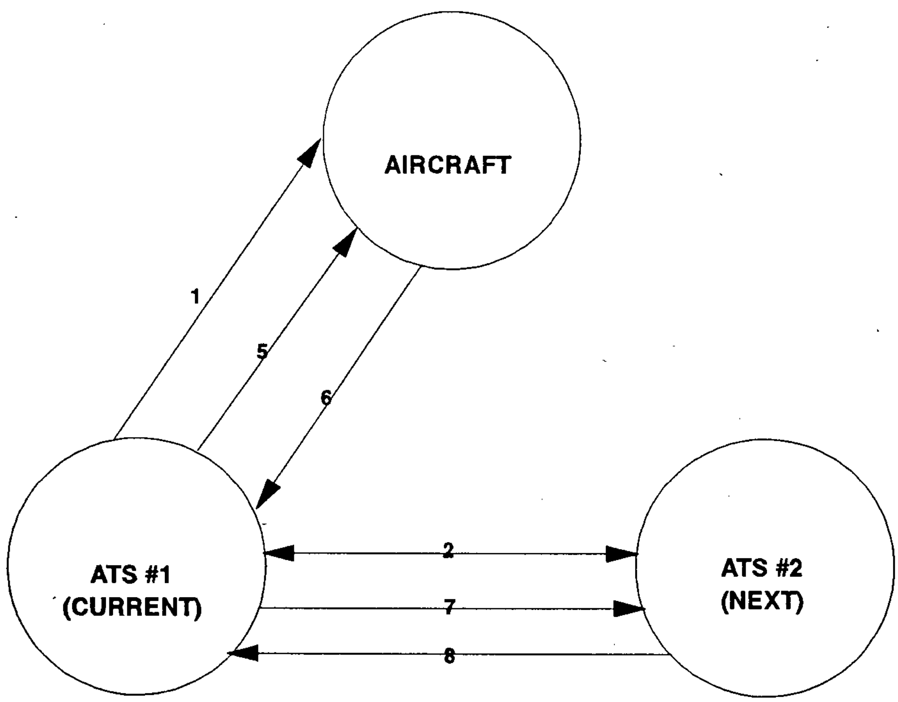

Figure B-3. CPDLC connection transfer – CPDLC to non-CPDLC

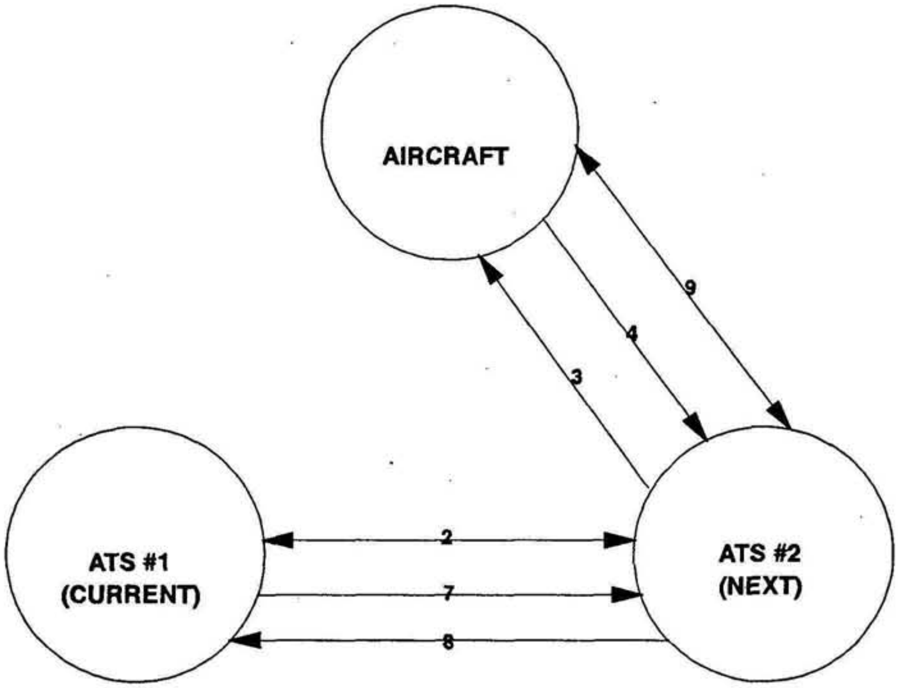

Figure B-4. CPDLC connection transfer – Non-CPDLC to CPDLC

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APPENDIX C

TO PART II, CHAPTER 2

CONTROLLER-PILOT DATA LINK COMMUNICATIONS

SAMPLE MESSAGES

C.1 Messages are displayed in accordance with Appendix A to Part II, Chapter 2.

Notes:

a. Preamble as used in the data structures column indicates the data structure has one or more OPTIONAL fields. The presence of an optional field is indicated by a "1" (a "0" indicates the field is not used).

b. Commas are used to separate the different message elements shown in the local display. Actual display is a local issue. The commas were not included in the character length counts.

c. The actual value encoded is derived from subtracting the low-end of the variable range (e.g. 30 for levelflightlevel) from the desired value.

DOWNLINK {Message Element ID: 0}

LOCAL DISPLAY: WILCO

DATA STRUCTURES (ENCODED SEQUENCE)	VALUE	ENCODED BIT STREAM	NUMBER OF BITS
ATCdownlinkmessage SEQUENCE	Not encoded		
Preamble ATCdownlinkmessage		0	1
ATCmessageheader SEQUENCE	Not encoded		
Preamble ATCmessageheader		1	1
Msgidentificationnumber	2	00 0010	6
Msgreferencenumber	6	00 0110	6
ATCdownlinkmsgelementid	0	0000	8
SEQUENCE of ATCdownlinkmsgelementid	OPTIONAL-Unused		
		Total # bits:	**22**

Free text message length would be 5 characters or 40 bits

UPLINK {Message Element ID: 46, 165, 20, 175}

LOCAL DISPLAY: CROSS SLATN AT F270, THEN, CLIMB TO AND MAINTAIN F290, REPORT REACHING F290

DATA STRUCTURES (ENCODED SEQUENCE)	VALUE	ENCODED BIT STREAM	NUMBER OF BITS
ATCuplinkmessage SEQUENCE	Not encoded		
Preamble ATCuplinkmessage		1	1
ATCmessageheader SEQUENCE	Not encoded		
Preamble ATCmessageheader		0	1
Msgidentificationnumber	8	00 1000	6
Msgreferencenumber	OPTIONAL–Unused		
ATCuplinkmsgelementid	46	0010 1110	8
PositionLevel SEQUENCE	Not encoded		
Position CHOICE	[0] Fixname	000	3
Fixname Length	5-1=4	100	3
	S	101 0011	7
	L	100 1100	7
	A	100 0001	7
	T	101 0100	7
	N	100 1110	7
Level CHOICE	[6] levelflightlevel	110	3
Levelflightlevel	270-30=240	00 1111 0000	10
SEQUENCE Length, ATCuplinkmsgelementid	3-1=2	10	2
ATCuplinkmsgelementid	165	1010 0101	8
ATCuplinkmsgelementid	20	0001 0100	8
Level CHOICE	[6] levelflightlevel	110	3
Levelflightlevel	290-30=260	01 0000 0100	10
ATCuplinkmsgelementid	175	1010 1111	8
Level CHOICE	[6] levelflightlevel	110	3
Levelflightlevel	290-30=260	01 0000 0100	10
		Total # bits:	**122**

Free text message length would be 72 characters or 576 bits

DOWNLINK {Message Element ID: 72}

LOCAL DISPLAY: REACHING F290

DATA STRUCTURES (ENCODED SEQUENCE)	VALUE	ENCODED BIT STREAM	NUMBER OF BITS
ATCdownlinkmessage SEQUENCE	Not encoded		
Preamble ATCdownlinkmessage		0	1
ATCmessageheader SEQUENCE	Not encoded		
Preamble ATCmessageheader		0	1
Msgidentificationnumber	5	00 0101	6
Msgreferencenumber	OPTIONAL–Unused		
ATCdownlinkmsgelementid	72	0100 1000	8
Level CHOICE	[6] Levelflightlevel	110	3
Levelflightlevel	290-30=260	01 0000 0100	10
SEQUENCE of ATCdownlinkmsgelementid	OPTIONAL–Unused		
		Total # bits:	**29**

Free text message length would be 10 characters or 80 bits

DOWNLINK {Message Element ID: 3}

LOCAL DISPLAY: ROGER

DATA STRUCTURES (ENCODED SEQUENCE)	VALUE	ENCODED BIT STREAM	NUMBER OF BITS
ATCdownlinkmessage SEQUENCE	Not encoded		
Preamble ATCdownlinkmessage		0	1
ATCmessageheader SEQUENCE	Not encoded		
Preamble ATCmessageheader		1	1
Msgidentificationnumber	7	00 0111	6
Msgreferencenumber	3	00 0011	6
ATCdownlinkmsgelementid	3	0000 0011	8
SEQUENCE of ATCdownlinkmsgelementid	OPTIONAL–Unused		
		Total # bits:	**22**

Free text message length would be 5 characters or 40 bits

UPLINK {Message Element ID: 20}

LOCAL DISPLAY: CLIMB TO AND MAINTAIN F310

DATA STRUCTURES (ENCODED SEQUENCE)	VALUE	ENCODED BIT STREAM	NUMBER OF BITS
ATCuplinkmessage SEQUENCE	Not encoded		
Preamble ATCuplinkmessage		0	1
ATCMessageheader SEQUENCE	Not encoded		
Preamble ATCmessageheader		0	1
Msgidentificationnumber	4	00 0100	6
Msgreferencenumber	OPTIONAL-Unused		
ATCuplinkmsgelementid	20	0001 0100	8
Level CHOICE	[6] Levelflightlevel	110	3
Levelflightlevel	310-30=280	01 0001 1000	10
SEQUENCE of ATCuplinkmsgelementid	OPTIONAL-Unused		
		Total # bits:	**29**

Free text message length would be 26 characters or 208 bits

— — — — — — — —

APPENDIX D

TO PART II, CHAPTER 2

D-1 Data structure presentation

Data structures referenced in message elements listed in Sections 2.7.1 and 2.7.2 are shown in Table D-1 in alphabetical order. The following information applies:

a) do not display leading zeroes within numeric values unless specifically noted in the comments;

b) character strings should be left justified;

c) "A" refers to alphanumeric characters; and

d) "n" refers to numeric (0, 1, 2, 3, 4, 5, 6, 7, 8, 9).

Data Structure	Display Format	Comments
Airport	AAAA	
Altimeter CHOICE		
Altimeterenglish	nn.nn	
Altimetermetric	nnnn.n HPA	
Level CHOICE		
Levelqnh	nn,nn0 FT	
Levelqnhmeters	nn,nnn M	
Levelqfe	QFE nn,nn0 FT	
Levelqfemeters	QFE nn,nnn M	
Levelgnssfeet	GNSS nnn,nnn FT	
Levelgnssmeters	GNSS nn,nnn M	
Levelflightlevel	Fnnn	display leading zeroes
Levelflightlevelmetric	Snnnn	display leading zeroes
Atiscode	A	
ATWlevel SEQUENCE		
ATWleveltolerance ENUMERATED		
at	AT	
atorabove	AT OR ABOVE	
atorbelow	AT OR BELOW	
Level		defined variable
Beaconcode SEQUENCE		(sequence of 4)
Beaconcodeoctaldigit	n	
Degrees CHOICE		
Degreesmagnetic	nnn	display leading zeroes
Degreestrue	nnn T	display leading zeroes

Table D-1. Data structure presentation

Data Structure	Display Format	Comments
Direction ENUMERATED		
left	L	
right	R	
eitherSide	L or R	
north	N	
south	S	
east	E	
west	W	
northEast	NE	
northWest	NW	
southEast	SE	
southWest	SW	
Distanceoffset CHOICE		
Distanceoffsetnm	nnn NM	
Distanceoffsetkm	nnn KM	
Errorinformation ENUMERATED		
applicationerror	ERROR	
duplicateMsgIdentificationNumber	ERROR	
unrecognizedMsgReferenceNumber	ERROR	
endServiceWithPendingMsgs	ERROR	
endServiceWithNoValidResponse	ERROR	
insufficientMsgStorageCapacity	ERROR	
noAvailableMsgIdentificationNumbers	ERROR	
commandedTermination	ERROR	
insufficientData	ERROR	
unexpectedData	ERROR	
invalidData	ERROR	
reservedErrorMsg	ERROR	
Fixname	AAAAA	
Freetext	AAAAA...AAA	(up to 256 characters)
Frequency CHOICE		
Frequencyhf	nnnnn	
Frequencyvhf	nnn.nnn	
Frequencyuhf	nnn.nnn	
Frequencysatchannel	nnnnnnnnnnnn	
ICAOunitname SEQUENCE		
ICAOfacilityidentification CHOICE		
ICAOfacilitydesignation	AAAA	
ICAOfacilityname	AAAA...AAA	(up to 18 characters)
ICAOfacilityfunction ENUMERATED		
center	CENTER	
approach	APPROACH	
tower	TOWER	
final	FINAL	
groundControl	GROUND CONTROL	
clearanceDelivery	CLEARANCE DELIVERY	
departure	DEPARTURE	
control	CONTROL	

Table D-1. Data structure presentation (Continued)

Data Structure	Display Format	Comments
LatitudeLongitude SEQUENCE		
Latitude SEQUENCE		
Latitudedegrees	nn	
Minuteslatlon	nn.n	
Latitudedirection ENUMERATED		
north	N	
south	S	
Longitude SEQUENCE		
Longitudedegrees	nnn	
Minuteslatlon		defined variable
Longitudedirection ENUMERATED		
east	E	
west	W	
Legtype CHOICE		
Legdistance CHOICE		
Legdistanceenglish	nn.n NM	
Legdistancemetric	nnn KM	
Legtime	n.n MIN	
Placebearingdistance SEQUENCE		
Fixname		defined variable
LatitudeLongitude		defined variable
Degrees		defined variable
Distance CHOICE		
Distancenm	nnn.n NM	
Distancekm	nnnn KM	
Position CHOICE		
Fixname		defined variable
Navaid	AAAA	
Airport		defined variable
LatitudeLongitude		defined variable
Placebearingdistance		defined variable

Table D-1. Data structure presentation (Continued)

Data Structure	Display Format	Comments
Positionreport SEQUENCE		
Positioncurrent		defined as Position
Timeatpositioncurrent		defined as Time
Level		defined variable
Fixnext		defined as Position
Timeetaatfixnext		defined as Time
Fixnextplusone		defined as Position
Timeetadestination		defined as Time
Remainingfuel		defined variable
Temperature CHOICE		
Temperaturec	nn C	may be preceded by "–"
Temperaturef	nnn F	may be preceded by ""
Winds SEQUENCE		
Winddirection	nnn	
Windspeed CHOICE		
Windspeedenglish	nnn	
Windspeedmetric	nnn KM/HR	
Turbulence ENUMERATED		
light	LIGHT	
moderate	MODERATE	
severe	SEVERE	
Humidity - definition & use are TBD	nn %	
Speed		
Speedground		
Verticalchange SEQUENCE		
Verticaldirection ENUMERATED		
up	UP	defined variable
down	DOWN	defined variable
Verticalrate		defined variable
Trackangle		defined variable
Trueheading		defined as Degrees
Distance		defined as Degrees
		defined variable

Table D-1. Data structure presentation (Continued)

Data Structure	Display Format	Comments
Predepartureclearance SEQUENCE		
Aircraftflightidentification	AAAAAAA	
Aircrafttype	AAAAA	
Aircraftequipmentcode SEQUENCE		
COMNAVapproachequipmentavailable	A	
COMNAVequimentstatus ENUMERATED		
aloranA	A	
cloranC	C	
ddme	D	
edecca	E	
fadf	F	
gother	G	
hhfRTF	H	
iinertialNavigation	I	
lils	L	
momega	M	
ovor	O	
pdoppler	P	
rrnavRouteEquipment	R	
ttacan	T	
uuhfRTF	U	
vvhfRTF	V	
SSREquipmentavailable ENUMERATED		
nnil	N	
atransponderModeA	A	
ctransponderModeAandC	C	
xtransponderModeS	X	
ptransponderModeSPA	P	
itransponderModeSID	I	
stransponderModeSPAID	S	
Timedepartureedct		defined as Time
Routeclearance		defined variable
Levelrestriction		defined as Level
Frequencydeparture		defined as Frequencyvhf
Beaconcode		defined variable
PDCrevision	nn	
Procedurename SEQUENCE		
Proceduretype ENUMERATED		
arrival	ARRIVAL	
approach	APPROACH	
departure	DEPARTURE	
Procedure	AAAAAA	
Proceduretransition	AAAAA	
RemainingfuelRemainingsouls SEQUENCE		
Remainingfuel SEQUENCE		
Timehours		defined variable
Timeminutes		defined variable
Remainingsouls	nnnn	

Table D-1. Data structure presentation (Continued)

Data Structure	Display Format	Comments
Routeclearance SEQUENCE		
Airportdeparture		defined as Airport
Airportdestination		defined as Airport
Runwaydeparture		defined as Runway
Runway SEQUENCE		
Runwaydirection	nn	
Runwayconfiguration ENUMERATED		
left	L	
right	R	
center	C	
none		(no display)
Proceduredeparture		defined as Procedurename
Runwayarrival		defined as Runway
Procedureapproach		defined as Procedurename
Procedurearrival		defined as Procedurename
Airwayintercept	AAAAA	
Routeinformation CHOICE		
Publishedidentifier SEQUENCE		
Fixname		defined variable
LatitudeLongitude		defined variable
LatitudeLongitude		defined variable
Placebearingplacebearing SEQUENCE		
Placebearing SEQUENCE		
Fixname		defined variable
LatitudeLongitude		defined variable
Degrees		defined variable
Placebearing		defined variable
Placebearingdistance		defined variable
Airwayidentifier	AAAAA	
Trackdetail SEQUENCE		
Trackname	AAAAAA	
LatitudeLongitude		defined variable
Routeinformationadditional		defined variable

Table D-1. Data structure presentation (Continued)

Data Structure	Display Format	Comments
Routeinformationadditional SEQUENCE		
ATWalongtrackwaypointsequence SEQUENCE		
ATWalongtrackwaypoint SEQUENCE		
Position		defined variable
ATWdistance SEQUENCE		
ATWDistancetolerance ENUMERATED		
plus	+	
minus	-	
Distance		defined variable
Speed		defined variable
ATWlevelsequence SEQUENCE		
ATWlevel		defined variable
ATWlevel		defined variable
Reportingpoints SEQUENCE		
Latlonreportingpoints CHOICE		
Latitudereportingpoints SEQUENCE		
Latitudedirection		defined variable
Latitudedegrees		defined variable
Longitudereportingpoints SEQUENCE		
Longitudedirection		defined variable
Longitudedegrees		defined variable
Degreeincrement	nn	
Interceptcoursefromsequence SEQUENCE		
Interceptcoursefrom SEQUENCE		
Interceptcoursefromselection CHOICE		
Publishedidentifier		defined variable
LatitudeLongitude		defined variable
Placebearingplacebearing		defined variable
Placebearingdistance		defined variable
Degrees		defined variable
Holdatwaypointsequence SEQUENCE		
Holdatwaypoint SEQUENCE		
Position		defined variable
Holdatwaypointspeedlow		defined as Speed
ATWlevel		defined variable
Holdatwaypointspeedhigh		defined as Speed
Direction		defined variable
Degrees		defined variable
EFCTime		defined as Time
Legtype		defined variable
Waypointspeedlevelsequence SEQUENCE		
Waypointspeedlevel SEQUENCE		
Position		defined variable
Speed		defined variable
ATWlevelsequence SEQUENCE		
ATWlevel		defined variable
ATWlevel		defined variable
RTArequiredtimearrivalsequence		defined variable

Table D-1. Data structure presentation (Continued)

Data Structure	Display Format	Comments
RTArequiredtimearrivalsequence SEQUENCE		
RTArequiredtimearrival SEQUENCE		
Position		defined variable
RTAtime SEQUENCE		
Time		defined variable
Timetolorance ENUMERATED		
at	AT	
atorafter	AT OR AFTER	
atorbefore	AT OR BEFORE	
RTAtolorance	nn.n MIN	
Speed CHOICE		
Speedindicated	nn0 IAS	
Speedindicatedmetric	nnn0 KM/HR IAS	
Speedtrue	nn0 TAS	
Speedtruemetric	nnn0 KM/HR TAS	
Speedground	nn0 GS	
Speedgroundmetric	nnn0 KM/HR GS	
Speedmach	.nnM	
Speedmachlarge	n.nnM	
Time SEQUENCE		
Timehours	nn	
Timeminutes	nn	
TimeDistanceTofromPosition SEQUENCE		
Time		defined variable
Distance		defined variable
Tofrom ENUMERATED		
to	TO	
from	FROM	
Position		defined variable
Tp4table ENUMERATED		
labelA		(no display)
labelB		(no display)

Table D-1. Data structure presentation (Continued)

Data Structure	Display Format	Comments
Trackdetailmsg SEQUENCE		
Trackname		defined variable
Datetimetrackgenerated		defined as Datetimegroup
Datetimegroup SEQUENCE		
Date SEQUENCE		
Year	nn	
Month	nn	
Day	nn	
Time		defined variable
Trackdetailmsgtype ENUMERATED		
provisional	PROVISIONAL	
final	FINAL	
Datetimetrackstart		defined as Datetimegroup
Datetimetrackstop		defined as Datetimegroup
Airportdeparture		defined as Airport
Pointdetailsequence SEQUENCE		
Pointdetail SEQUENCE		
LatitudeLongitude		defined variable
Fixname		defined variable
Truetrackangle		defined as Degreestrue
Distancetonextpoint CHOICE		
Distancetonextpointenglish	nnnn NM	
Distancetonextpointmetric	nnnn KM	
Pointlevel SEQUENCE		
Levelflightlevel		defined variable
Leveltolerance		defined variable
Pointlevelblock SEQUENCE		
Levelflightlevel		defined variable
Levelflightlevel		defined variable
Airportdestination		defined as Airport
Remarks		defined as Freetext
Versionnumber		(no display)
Verticalrate CHOICE		
Verticalrateenglish	nn00 FT/MIN	
Verticalratemetric	nnn0 M/MIN	

**Note.*— *Y (yes) implies standard COM/NAV/approach and equipment for the route to be flown is carried and servicable. Standard equipment is considered to be VHF RTF, ADF, VOR, and ILS, unless another combination is prescribed by the appropriate ATS authority.*

Table D-1. Data structure presentation (Continued)

Variable	Parameters	Units	Range
Airport			4 characters
Altimeter			
	altimeter english	0.01 inches Hg	22.00 – 32.00
	altimeter metric	0.1 Hecto Pascal	750.0 – 1 250.0

Table D-2. CPDLC ranges and resolutions

Variable	Parameters	Units	Range
Level			
	levelqnh	10 feet	0 – 25 000
	levelqnh meters	1 metre	0 – 16 000
	levelqfe	10 feet	0 – 21 000
	levelqfe meters	1 metre	0 – 7 000
	levelgnss feet	1 foot	0 – 150 000
	levelgnss meters	1 metre	0 – 50 000
	level flight level	1 level (100 feet)	30 – 600
	level flight level metric	1 level (10 metres)	100 – 2 000
Atiscode			1 character
Beaconcode			4 octal digits
Degrees			
	degrees magnetic	1 degree	1 – 360
	degrees true	1 degree	1 – 360
Distance offset			
	Distance offsetnm	1 nautical mile	1 – 128
	Distance offsetkm	1 kilometre	1 – 256
Fixname			5 characters
Freetext			256 characters

Table D-2. CPDLC ranges and resolutions (Continued)

Variable	Parameters	Units	Range
Frequency			
	Frequency hf	1 kilohertz	2 850 – 28 000
	Frequency vhf	0.025 megahertz	117.000 – 138.000
	Frequency uhf	0.025 megahertz	225.000 – 399.975
	Frequency satchannel		12-digit numeric string
	Frequency VHF (fine-resolutin)	0.001 megahertz	117.000 – 138.000
ICAOfacility identification			
	ICAO facility designation		4-character string
	ICAO facility name		3 – 18-character string
Latitude Longitude			
	Latitude degrees	1 degree	0 – 90
	Longitude degrees	1 degree	0 – 180
	minutes latlon	0.1 minute	0 – 59.9
Legdistance			
	Leg distance english	0.1 nautical mile	0.1 – 99.9
	Leg distance metric	1 kilometre	1 – 128
	Legtime	0.1 minute	0.1 – 9.9
Distance			
	Distancenm	0.1 nautical mile	0 – 999.9
	Distancekm	1 kilometre	1 – 1 024
Navaid			4-character string

Table D-2. CPDLC ranges and resolutions (Continued)

Variable	Parameters	Units	Range
Temperature			
	Temperature c	1 degree Centigrade	- 80 – + 47
	Temperature f	1 degree Fahrenheit	- 105 – + 150
Winds			
	Wind direction	1 degree	1 – 360
	Wind speed english	1 knot	0 – 255
	Wind speed metric	1 kilometre/hour	0 – 511
PDCrevision		1 (integer)	1 – 16
Procedure			1 – 6 characters
Procedure transition			1 – 5 characters
Airway intercept			1 - 5 characters
Airway identifier			1 – 5 characters
	Degree increment	1 degree	1 – 20
	RTA tolerance	0.1 minute	0.1 – 15.0
Speed			
	speed indicated	10 knots	70 – 380
	speed indicated metric	10 kilometres/hour	100 – 137
	speed true	10 knots	70 – 700
	speed true metric	10 kilometres/hour	100 – 1370

Table D-2. CPDLC ranges and resolutions (Continued)

Variable	Parameters	Units	Range
	speed ground	10 knots	70 – 700
	speed ground metric	10 kilometres/hour	100 – 2 650
	speed mach	0.01 Mach	0.93 – 6.04
Time			
	time hours	1 hour	0 – 23
	time minutes	1 minute	0 – 59
Date			
	year	1 year	0 – 99
	month	1 month	1 – 12
	day	1 day	1-31
Distancetonextpoint			
	distanceto nextpoint english	1 nautical mile	1 – 1 024
	distanceto nextpoint metric	1 kilometre	1 – 2 048
Versionnumber		integer	0 – 15
Verticalrate			
	vertical rate english	100 feet /minute	0 – 6 000
	vertical rate metric	10 metres /minute	0 – 2000

Table D-2. CPDLC ranges and resolutions (Continued)

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PART II – AIR TRAFFIC SERVICES DATA LINK APPLICATIONS

CHAPTER 3. ATS INTERFACILITY DATA COMMUNICATION (AIDC)

3.1 GENERAL

3.1.1 The AIDC application will utilize the protocol suite defined as part of the aeronautical telecommunications network (ATN) concept.

3.1.2 The AIDC application exchanges information between ATS units for support of critical ATC functions, such as notification of flights approaching an FIR boundary, co-ordination of hand-offs and transfer of control.

3.1.3 **Network architecture**

3.1.3.1 The AIDC application utilizes the services of the ATN to provide efficient digital data communications among ATS facilities.

Note.— AIDC is strictly an ATC application for exchanging tactical control information between ATS units, not with MET offices or carrier facilities. Other, to be defined, ATN data link applications will support data exchange with MET offices and carrier facilities.

3.2 OPERATIONAL CONCEPT

[*To be developed*]

3.3 OPERATIONS

3.3.1 **Functions**

3.3.1.1 AIDC is an ATN data link application which can be employed by two ATS units to exchange ATC information. This information includes advanced flight notification, clearances, transfer of control, surveillance data and free (i.e. unstructured) text data. In addition, acknowledgment messages and application status monitoring capabilities are provided.

3.4 PROCEDURES

(The following procedures are assumed to be implemented for the operation of the voice and data link based air traffic control system.)

3.4.1 Data link communications between facilities will utilize standard message sets, with free text messages being used as required.

3.4.2 When a required response is not successfully delivered, the message initiator is responsible for querying the state of the response via an appropriate medium.

3.4.3 Messages should be reviewed and responded to, if appropriate, in a timely manner upon receipt. If messages are queued, they are to be reviewed sequentially in the order of receipt, with the exception that messages with a higher priority should be reviewed first.

3.5 IMPLEMENTATION

[*To be developed*]

3.6 DATA LINK REQUIREMENTS FOR AIDC

3.6.1 **Application name**

3.6.1.1 ATS interfacility data communications.

3.6.2 **Scope and objectives**

3.6.2.1 This application encompasses the information exchanges between ATS units needed to support ATC functions, including notification (of flights approaching an airspace boundary), co-ordination and transfer of control. The exchanges are between ATC application processes residing within ATC automation systems located at different ATS units, and will occur over an ATN G/G subnetwork.

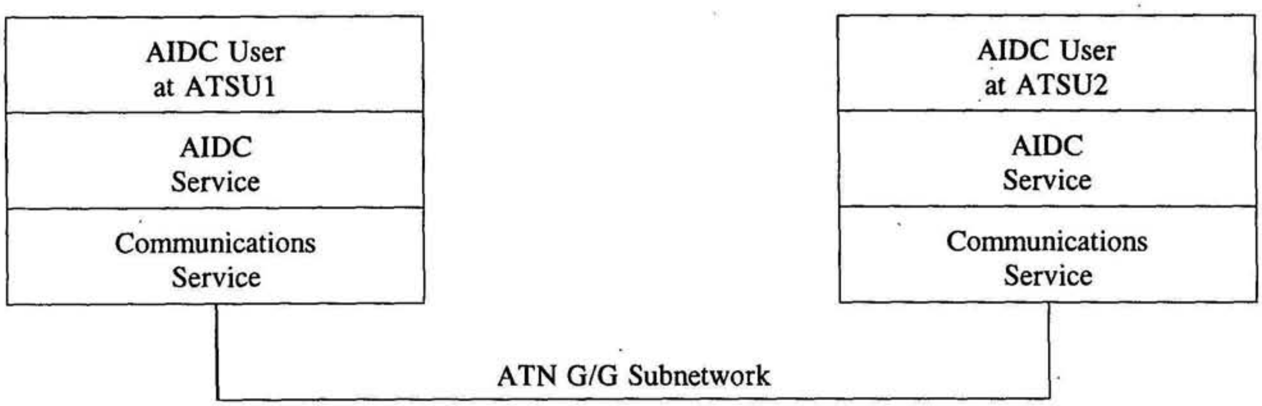

Figure 3.6.1. The AIDC service and its relationship with other modules

3.6.3 **Operating method**

3.6.3.1 An exchange is typically initiated when one of several events, such as the following, occurs:

a) proximity to an airspace boundary;

b) controller-initiated dialog;

c) a change in a flight's cleared profile (altitude, route or speed);

d) surveillance data update; or

e) lack of communications activity between air traffic services units (ATSUs).

3.6.3.2 Message exchanges between ATSUs utilize AIDC services. These describe the type of communications functions that are supported by the AIDC data link application. The following services have been defined:

AIDC Service Class	AIDC Service
Flight planning services	Flight plan request
	Flight plan transfer
	Flight plan cancellation
	Flight plan modification
	Delay notification
	Departure notification
Notification services	Advanced flight notification
Co-ordination services	Initial co-ordination
	Co-ordination negotiation
	Co-ordination acceptance
	Co-ordination rejection
	Co-ordination cancellation
	Co-ordination ready
	Co-ordination commit
	Co-ordination rollback
	Co-ordination update
	Co-ordination standby
Transfer of control services	Transfer initiation
	Transfer hand-off proposal
	Transfer acceptance
	Relinquish control
	Assumption of control
	Rejection of control
	Transfer executive data
Surveillance data transfer services	ADS report transfer
	General surveillance report transfer

Airspace management services	Dynamic track transfer
	Track system transfer
	Restricted airspace transfer
Miscellaneous services	Emergency free text messaging
	General free text messaging
	Application status monitoring
	Version number

Each service typically consists of one ATSU (e.g. ATSU1) transferring an AIDC message to another ATSU (e.g. ATSU2). ATSU2 then responds with Accept (AppAccept) or Error (AppError). Figure 3.6.2 illustrates this service procedure. Further detailed information on AIDC services, including sequencing rules, can be found in Appendix B to this chapter.

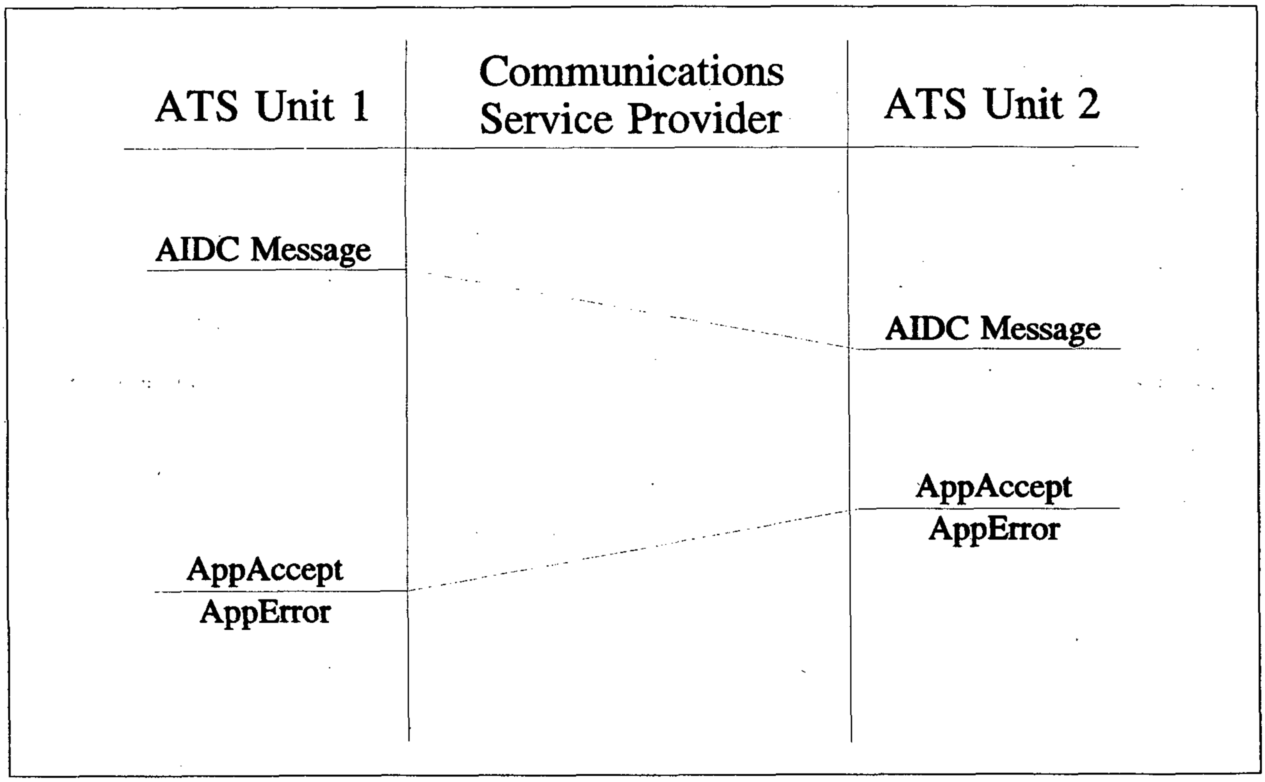

Figure 3.6.2. AIDC confirmed service procedure

3.6.4 **Information exchanges**

3.6.4.1 The following abbreviations are used in the tables below:

C-ATSU The ATS unit currently responsible for control (i.e. the controlling ATS unit).

D-ATSU A downstream ATS unit is defined as an ATS unit responsible for control of an airspace region through or near which the aircraft will progress at some future time.

R-ATSU The ATS unit that will assume control responsibility (i.e. the receiving ATS unit).

ATSU1 Used to denote an arbitrary ATS unit.

ATSU2 Used to denote an arbitrary ATS unit, other than ATSU1.

Note.— In the table below, the Transfer times and Comm Failure Notification times are very rough estimates. These values must be refined based on operational requirements. The transfer times refer to the 90th percentile. Note that the Comm Failure Notification times are also dependent on ATN transport layer timer values.

AIDC Message	Purpose	Event Trigger	Source/ Destination	Transfer Time (seconds)	Comm Failure Notification (seconds)
Flight plan request	Used by one ATSU to request a flight plan from another ATSU.	When ATSU1 determines that it does not possess information for a specified flight.	ATSU1/ ATSU2	60	60
Flight plan filed	Contains all the standard information available for the specified flight.	Presentation of flight plan data to ATSU1.	ATSU1/ ATSU2	60	60
Flight plan cancel	Cancels a previously issued flight plan.	The flight plan originator determines it is no longer valid.	ATSU1/ ATSU2	60	60
Flight plan modify	Modifies the information contained in a previously issued flight plan.	Change in flight information or profile.	ATSU1/ ATSU2	60	60
Flight plan delay	Notifies an ATSU of a delay in a flight's departure.	Anticipated departure time has been delayed	ATSU1/ ATSU2	60	60
Flight plan depart	Notifies an ATSU of a flight's departure time.	Flight has departed	ATSU1/ ATSU2	60	60

Table 3.6.1. AIDC flight planning messages

AIDC Message	Purpose	Event Trigger	Source/ Destination	Transfer Time (seconds)	Comm Failure Notification (seconds)
Notify	Updates the information a downstream ATS unit maintains on a flight that is expected to enter its area of interest at some future time.	Defined time from transfer of control point, or change in flight profile.	C-ATSU/ D-ATSU	15	90

Table 3.6.2. AIDC notification messages

AIDC Message	Purpose	Event Trigger	Source/ Destination	Transfer Time (seconds)	Comm Failure Notification (seconds)
Coordinate initial	Begins an initial co-ordination dialogue between ATS units.	Proximity to an FIR boundary	C-ATSU/ D-ATSU	10	60
Coordinate negotiate	Used to negotiate the co-ordination conditions.	Existing co-ordination conditions must be changed for some reason.	ATSU1/ ATSU2	10	60
Coordinate accept	Signifies acceptance of the proposed co-ordination conditions.	Co-ordination conditions are acceptable	ATSU1/ ATSU2	10	60
Coordinate reject	Immediately terminates a co-ordination dialogue, with the co-ordination conditions remaining as previously agreed.	Proposed modification to agreed co-ordination conditions is unacceptable	ATSU1/ ATSU2	10	60
Coordinate ready	Part of reliable, fail-safe, two-phase commit co-ordination protocol.	D-ATSU is ready to accept proposed co-ordination conditions.	D-ATSU/ C-ATSU	10	60
Coordinate commit	Part of reliable, fail-safe, two-phase commit co-ordination protocol.	C-ATSU has agreement from all affected D-ATSUs on co-ordination conditions.	C-ATSU/ D-ATSU	10	60
Coordinate rollback	Part of reliable, fail-safe, two-phase commit co-ordination protocol.	A D-ATSU was unable to successfully update its flight data base.	C-ATSU/ D-ATSU	10	60
Coordinate update	Used to initiate the re-negotiation of co-ordination conditions, after the initial co-ordination dialogue has been completed.	Existing co-ordination conditions must be changed.	ATSU1/ ATSU2	10	60

Table 3.6.3 AIDC co-ordination messages

AIDC Message	Purpose	Event Trigger	Source/ Destination	Transfer Time (seconds)	Comm Failure Notification (seconds)
Coordinate standby	Resets co-ordination timeout timer values.	Co-ordination with one or more downstream ATSUs must be completed before continuing the current co-ordination dialogue.	ATSU1/ ATSU2	10	60
Coordinate cancel	Notifies a downstream ATS unit that a flight previously expected to enter its area of interest will no longer do so.	Change in flight profile	C-ATSU/ D-ATSU	10	60

Table 3.6.3. AIDC co-ordination messages (Continued)

AIDC Message	Purpose	Event Trigger	Source/ Destination	Transfer Time (seconds)	Comm Failure Notification (seconds)
Transfer initiate	Initiate a transfer of control.	Flight is near an airspace boundary.	C-ATSU/ R-ATSU	10	60
Transfer proposal	Offer control responsibility to an adjacent ATSU.	Manual or automatic handoff initiation at C-ATSU.	C-ATSU/ R-ATSU	5	15
Transfer accept	Indicates willingness to accept control responsibility.	Manual acceptance of transfer proposal at R-ATSU, or manual request for transfer at R-ATSU.	R-ATSU/ C-ATSU	5	15
Transfer control	Indicates that the C-ATSU is relinquishing control.	Manual relinquishing of control at C-ATSU.	C-ATSU/ R-ATSU	5	15
Transfer assume	Assume control responsibility for a flight.	Manual or automatic assumption of control at R-ATSU.	R-ATSU/ C-ATSU	5	15
Transfer rejection	Refuse to accept control responsibility for a flight.	Manual rejection of control at R-ATSU.	R-ATSU/ C-ATSU	5	15
Transfer data	Transfer executive control data to an adjacent ATSU	A change in executive control data	ATSU1/ ATSU2	10	60

Table 3.6.4. AIDC transfer of control messages

AIDC Message	Purpose	Event Trigger	Source/ Destination	Transfer Time (seconds)	Comm Failure Notification (seconds)
Surveillance – ADS	Transfer ADS data over G/G ATN links.	ADS A/G message received	ATSU1/ ATSU2	15	60
Surveillance – General	Transfer track data (a flight's position, groundspeed and track angle) to an adjacent ATS unit.	Track update calculated.	ATSU1/ ATSU2	5	15

Table 3.6.5. AIDC surveillance messages

AIDC Message	Purpose	Event Trigger	Source/ Destination	Transfer Time (seconds)	Comm Failure Notification (seconds)
Dynamic track	Co-ordinate a dynamic track with an adjacent ATSU.	Dynamic track has been proposed.	ATSU1/ ATSU2	15	60
Track system	Disseminate a track system to an adjacent ATSU.	Reception of track system data at ATSU1	ATSU1/ ATSU2	15	60
Restricted airspace	Transfer a restricted airspace definition to an adjacent ATSU.	Restricted airspace has been defined.	ATSU1/ ATSU2	15	60

Table 3.6.6. AIDC airspace management messages

AIDC Message	Purpose	Event Trigger	Source/ Destination	Transfer Time (seconds)	Comm Failure Notification (seconds)
Emergency free text	Support free text message exchange in an emergency condition.	Emergency condition	ATSU1/ ATSU2	5	60
General free text	Exchange general free text information.	Controller action	ATSU1/ ATSU2	15	60
Application status monitoring	Determine if the ATC application within an adjacent ATSU is operational.	No message has been received within a VSP time period from an adjacent ATSU.	ATSU1/ ATSU2	15	60
Version number	Notify an adjacent ATSU2 of the AIDC Message Set being used by ATSU1	As determined by ATSU1.	ATSU1/ ATSU2	15	60
Application accept	Acknowledge receipt of a valid (syntactically correct) message by the ATC application at ATSU1.	Receipt of valid message by the ATC application at ATSU1	ATSU1/ ATSU2	10	60
Application error	Acknowledge receipt of an invalid (syntactically incorrect) message by the ATC application at ATSU1.	Receipt of an invalid message by the ATC application at ATSU1	ATSU1/ ATSU2	10	60

Table 3.6.7. AIDC miscellaneous messages

3.6.5 Message content

3.6.5.1 The tables below describe the general contents of the AIDC messages. Refer to Appendix A to this chapter for a detailed description of all AIDC messages.

Message	Message Contents
Flight plan request	Flight identification Departure aerodrome and estimated departure time Destination aerodrome
Flight plan filed	Flight identification Departure aerodrome and estimated departure time Destination aerodrome and total estimated elapsed time Alternate aerodrome Flight rules Type of flight Aircraft model Wake turbulence category CNS equipment, including data link equipage Route Other information
Flight plan modify	Flight identification Departure aerodrome Destination aerodrome Flight rules (optional) Type of flight (optional) Aircraft model (optional) Wake turbulence category (optional) CNS equipment, including data link equipage (optional) Route (optional) Other information (optional)
Flight plan delay	Flight identification Departure aerodrome and estimated departure time Destination aerodrome
Flight plan depart	Flight identification Departure aerodrome and actual departure time Destination aerodrome
Flight plan cancel	Flight identification Departure aerodrome Destination aerodrome

Table 3.6.8. AIDC flight planning message contents

Message	Message Contents
Notify	Flight identification Departure aerodrome Destination aerodrome Flight rules Type of flight Aircraft model Wake turbulence category CNS equipment, including data link equipage Boundary estimate data (boundary fix, crossing time, crossing altitude) Route Other information

Table 3.6.9. AIDC notification message contents

Message	Message Contents
Coordinate initial	Flight identification Departure aerodrome Destination aerodrome Flight rules Type of flight Aircraft model Wake turbulence category CNS equipment, including data link equipage Boundary estimate data (boundary fix, crossing time, crossing altitude) Route Other information
Coordinate negotiate	Flight identification Departure aerodrome Destination aerodrome Boundary estimate data (boundary fix, crossing time, crossing altitude), and/or Route
Coordinate accept	Flight identification Departure aerodrome Destination aerodrome
Coordinate reject	Flight identification Departure aerodrome Destination aerodrome
Coordinate ready	Flight identification Departure aerodrome Destination aerodrome
Coordinate commit	Flight identification Departure aerodrome Destination aerodrome
Coordinate update	Flight identification Departure aerodrome Destination aerodrome Boundary estimate data (boundary fix, crossing time, crossing altitude), and/or Route
Coordinate rollback	Flight identification Departure aerodrome Destination aerodrome
Coordinate standby	Flight identification Departure aerodrome Destination aerodrome
Coordinate cancel	Flight identification Departure aerodrome Destination aerodrome

Message	Message Contents
Transfer initiate	Flight identification Departure aerodrome Destination aerodrome Executive control data, including clearance restrictions Track data (position, time, altitude)
Transfer proposal	Flight identification Departure aerodrome Destination aerodrome Executive control data, including clearance restrictions
Transfer accept	Flight identification Departure aerodrome Destination aerodrome Frequency
Transfer control	Flight identification Departure aerodrome Destination aerodrome Executive data Release indicator
Transfer assume	Flight identification Departure aerodrome Destination aerodrome
Transfer reject	Flight identification Departure aerodrome Destination aerodrome
Transfer data	Flight identification Departure aerodrome Destination aerodrome Executive control data, including clearance restrictions Frequency

Table 3.6.11. AIDC transfer of control message contents

Message	Message Contents
Surveillance – ADS	Flight identification Departure aerodrome Destination aerodrome ADS data (any of the ADS downlink report blocks)
Surveillance – General	Flight identification Departure aerodrome Destination aerodrome Track data (position, time, altitude and, if known, groundspeed and true track angle)

Table 3.6.12. AIDC surveillance message contents

Message	Message Contents
Dynamic track	Track name Date and time the track was generated Track type: provisional or final Track start time Track stop time Departure airport Track details, i.e. profile Destination aerodrome Other information, i.e. remarks
Track system	Track system name Track system generation time Track system start time Track system end time Set of tracks comprising the track system Other information, i.e. remarks
Restricted airspace	Airspace name Restriction start and stop times Restriction floor and ceiling altitudes Airspace perimeter

Table 3.6.13. AIDC airspace management message contents

Message	Message Contents
Emergency free text	Flight identification or functional address Free text
General free text	Flight identification or functional address Free text
Application status monitoring	Nil
VersionNumber	AIDC Message Set version number, 0 to 255
Application accept	Nil
Application error	Message type Component type Error code Error data

Table 3.6.14. AIDC miscellaneous message contents

3.6.6 **Communication system interface**

3.6.6.1 All ATSU connections shall be established utilizing an inter-network protocol priority value of 10, representative of flight safety communications. The transport priority value shall be 4.

3.6.7 **Information handling**

3.6.7.1 Emergency (EMG) messages are critical communications.

3.6.7.2 Surveillance messages are urgent communications.

3.6.7.3 All other messages are routine communications.

3.6.8 **Information security**

3.6.8.1 These information exchanges, concerned with the control of aircraft in flight, are to be afforded the maximum security for authentication, access control and data integrity.

3.6.9 **Remarks**

3.6.9.1 Transition

This material is provided as guidance to assist in the transition from character-based, inter-facility data interchange to bit-oriented AIDC message exchange, and to indicate how AIDC messages could be encoded.

3.6.9.1.1 The relationship between the AIDC message set and existing messages currently in use within different ATS regions is expressed in the following table.

AIDC Message	Related Existing ATS Messages
FlightPlanRequest	RQP (ICAO & Pacific ATS)
FlightPlanFiled	FPL (ICAO & Pacific ATS)
FlightPlanModify	CHG (ICAO & Pacific ATS)
FlightPlanDelay	DLA (ICAO & Pacific ATS)
FlightPlanDepart	DEP (ICAO & Pacific ATS)
FlightPlanCancel	CNL (ICAO & Pacific ATS)
Notify	ABI (Europe & NAT)
CoordinateInitial	CPL (ICAO & NAT) EST (ICAO & Pacific ATS) PAC, ACT & RAP (Europe)
CoordinateNegotiate	CDN (ICAO, NAT & Europe) REV & RRV (Europe)
CoordinateAccept	ACP (ICAO, NAT & Europe) LAM (Europe)
CoordinateReject	REJ (NAT) RJC (Europe)
CoordinateCancel	MAC (Europe & NAT)
CoordinateReady	RDY (NAT)
CoordinateCommit	CMT (NAT)
CoordinateRollback	ROL (NAT)
CoordinateUpdate	CUR (NAT)
CoordinateStandby	SBY (NAT)
TransferInitiate	TIM (Europe)
TransferProposal	TOC (NAT) HOP (Europe)
TransferAccept	ROF (Europe)
TransferControl	COF (Europe)
TransferAssume	AOC (NAT) MAS (Europe)
TransferReject	ROC (ADS Panel)

Table 3.6-15. Relationship between AIDC messages and existing ATS messages

AIDC Message	Related Existing ATS Messages
TransferData	SDM (Europe)
SurvADS	ADS (ADS Panel)
SurvReport	TRU (ADS Panel)
DynamicTrack	TDM (Pacific ATS)
TrackSystem	NAT (NAT)
RestrictedAirspace	ASR (Pacific ATS)
EmergencyFreeText	EMG (NAT)
GeneralFreeText	MIS (NAT)
AppStatus	ASM (NAT)
AppAccept	LAM (ICAO, NAT & Europe)
AppError	LRM (NAT)

Table 3.6.15. Relationship between AIDC messages and existing ATS messages (Continued)

3.6.9.1.2 Encoding rules

3.6.9.1.2.1 Encoding rules describe how ATS information is packaged for transmission between, for example, ATS units. This representation is in terms of bits or characters. The actual ATS information itself is described in an abstract fashion using ASN.1 (Appendix A to this chapter).

3.6.9.1.2.2 Until specified by ICAO's Aeronautical Telecommunication Network Panel, it is recommended that ISO 8825-2, "Packed Encoding Rules (PER) – Basic Unaligned", or a functionally equivalent means be utilized to encode/decode the ASN.1 message descriptions given in Appendix A to this chapter. It is also recommended that encoded messages be padded with bits set to the zero value at the end of the message to achieve an integral number of octets. This recommendation applies to all messages except the surveillance messages. These messages should be encoded using a combination of the ADS encodings for the ADSData and TrackData data structures, and PER for all other data structures appearing in the ASN.1 message descriptions.

3.6.9.1.2.3 Various encoding rules are in use today. The most common is the ICAO encoding of ATS information as ICAO ATS fields and messages.

3.6.9.1.3 Inter-operability

3.6.9.1.3.1 To achieve inter-operability between ATS units, ATS regions or even on a global basis, several requirements must be satisfied. Firstly, a common ATS message set must be agreed upon. The AIDC message set can be used for this purpose. Secondly, agreement on how the ATS messages will be used must be reached. The AIDC service descriptions (Appendix B to this chapter) describe how the AIDC messages are intended to be used. Lastly, there must be agreement on the encoding rules. Paragraph 3.6.9.1.2.2 above recommends an international standard, ISO's PER.

3.6.9.1.4 Regional adaptation

3.6.9.1.4.1 ATS regions may select to use a subset of the AIDC message set relevant to the provision of air traffic services within the region.

3.6.9.1.4.2 Most AIDC messages contain optional data elements. For a given AIDC message, a region may mandate the usage or non-usage of these optional data elements.

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APPENDIX A

TO PART II, CHAPTER 3

AIDC MESSAGE STRUCTURE – ASN.1 MESSAGE DEFINITIONS

This appendix provides descriptions of all AIDC messages.

```
AIDCMessageSet DEFINITIONS IMPLICIT TAGS ::=

BEGIN

versionNumber VersionNumber :: 1

--  A.1  IMPORTED CONTROLLER/PILOT DATA LINK COMMUNICATIONS TYPES

--  Many types used to define the CPDLC message elements are
--  used to define the Ground/Ground messages.  Refer to Part
--  II, Chapter 2, Appendix A for further information on the
--  CPDLC types. CPDLC types used include:

Aircraftflightidentification ::= EXTERNAL
Aircrafttype ::= EXTERNAL
Airport ::= EXTERNAL
Airwayidentifier ::= EXTERNAL
ATWlevel ::= EXTERNAL

Beaconcode ::= EXTERNAL
COMNAVequipmentstatus ::= EXTERNAL
Datetimegroup ::= EXTERNAL
Freetext ::= EXTERNAL
Frequency ::= EXTERNAL
ICAOfacilitydesignation ::= EXTERNAL
Level ::= EXTERNAL
Pointdetailsequence ::= EXTERNAL
RTAtime ::= EXTERNAL
RTAtolerance ::= EXTERNAL
Speed ::= EXTERNAL
SSRequipmentavailable ::= EXTERNAL
Time ::= EXTERNAL
Trackdetailmsg ::= EXTERNAL
Verticalchange ::= EXTERNAL

--  The above CPDLC types may be composed of more primitive
--  types, which are not listed here.
```

```
--   A.2   IMPORTED ADS DATA TYPES

--   The types used to define the ADS message elements are
--   used to define parts of the SurvADS and SurvReport mes-
--   sages. Refer to Part II, Chapter 1, Appendix A for further
--   information on the ADS types. ADS types used include:

Basic-ADS ::= EXTERNAL
FlightID ::= EXTERNAL
Projected-Profile ::= EXTERNAL
Ground-Vector ::= EXTERNAL
Air-Vector ::= EXTERNAL
Weather ::= EXTERNAL
AirframeID ::= EXTERNAL
Intermediate-Intent ::= EXTERNAL
Short-Term-Intent ::= EXTERNAL
Extended-Projected-Profile ::= EXTERNAL

--   The ADS types are composed of more primitive
--   types, which are not listed here.


--   A.3   AIDC APPLICATION PROTOCOL DATA UNIT DEFINITION


AIDC-APDU ::= SEQUENCE
{
 AIDCHeader,
 AIDCMessage
}

AIDCHeader ::= SEQUENCE
{
 invokeID      InvokeNumber,
 priority      AIDCPriority,
 timeStamp     YMDHMS,
 refData    ReferenceData     OPTIONAL
}

InvokeNumber ::= INTEGER(0..999999)

AIDCPriority ::= ENUMERATED
{
 flightRegularity              (0),
 flightSafety                  (1),
 urgent           (2),
 emergency                     (3)
}
```

```
YMDHMS ::= SEQUENCE
{
  DateTimeGroup,
  Seconds
}

Seconds ::= INTEGER(0..59)

ReferenceData ::= SEQUENCE
{
  refICAOUnit  ICAOfacilitydesignation,
  refID   InvokeID
}


--  A.4  AIDC MESSAGE SET


AIDCMessage ::= CHOICE
{

--  Flight Plan Request Message
             [0] FlightPlanRequest,

--  Filed Flight Plan Message
             [1] FlightPlanFiled,

--  Flight Plan Modification Message
             [2] FlightPlanModify,

--  Delay Message
             [3] FlightPlanDelay,

--  Departure Message
             [4] FlightPlanDepart,

--  Flight Plan Cancellation Message
                 [5] FlightPlanCancel,

--  Notification Message
                 [6] Notify,

--  Initial Co-ordination Message
                 [7] CoordinateInitial,

--  Co-ordination Negotiation Message
                 [8] CoordinateNegotiate,

--  Co-ordination Acceptance Message
                 [9] CoordinateAccept,

--  Co-ordination Rejection Message
                 [10] CoordinateReject,
```

```
--  Co-ordination Cancellation Message
            [11] CoordinateCancel,

--  Co-ordinate Ready to Commit
--  (Supports Two-Phase Commit Co-ordination Protocol)
            [29] CoordinateReady,

--  Co-ordinate Commit (Finalize) Coordination
--  (Supports Two-Phase Commit Co-ordination Protocol)
            [30] CoordinateCommit,

--  Co-ordinate Rollback to Previously Agreed Coordination
--  Conditions(Supports Two-Phase Commit Coordination Protocol)
            [31] CoordinateRollback,

--  Co-ordinate Update Request
--  Conditions(Supports Two-Phase Commit Coordination Protocol)
            [32] CoordinateUpdate,

--  Co-ordinate Standby
--  Conditions(Supports Two-Phase Commit Coordination Protocol)
            [33] CoordinateStandby,

--  Transfer Initiation Message
                [12] TransferInitiate,

--  (Transfer) Handoff Proposal Message
                [13] TransferProposal,

--  (Transfer) Handoff Acceptance Message
                [14] TransferAccept,

--  (Transfer) Relinquish Control Message
                [15] TransferControl,

--  (Transfer) Assumption of Control Message
                [16] TransferAssume,

--  (Transfer) Rejection of Control Message
                [17] TransferReject,

--  Transfer Executive Data
               [34] TransferData,

--  Free Text Emergency Message
                [18] FreetextEmergency,

--  Free Text General Message
                [19] FreetextGeneral,

--  ADS Report Message
                [20] SurvADS,
```

```
--  Surveillance Report Message
                [21] SurvReport,

--  Dynamic Track Definition Message
            [22] DynamicTrack,

--  Track System Definition Message
            [23] TrackSystem,

--  Airspace Restriction Message
            [24] RestrictedAirspace,

--  Application Status Monitoring Message
                [25] AppStatus,

--  Application Acceptance  Message
                [26] AppAccept,

--  Application Error  Message
                [27] AppError,

--  AIDC Version Number
            [28] VersionNumber,

         [255] NULL
}


--  A.5  AIDC MESSAGE DEFINITIONS


FlightPlanRequest ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination
}

FlightPlanFiled ::= SEQUENCE
{
     FlightID,
     FlightRules,
     Aircraft,
     Equipment,
     Departure,
     Route,
     Destination,
     otherInfo    OtherInformation        OPTIONAL
}
```

```
FlightPlanModify ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination,
     aircraft      [0] Aircraft                      OPTIONAL,
     equipment     [1] Equipment                     OPTIONAL,
     route         [2] Route                         OPTIONAL,
     otherInfo     [3] OtherInformation              OPTIONAL
}

FlightPlanDelay ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination
}

FlightPlanDepart ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination
}

FlightPlanCancel ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination
}

Notify ::= SEQUENCE
{
     FlightID,
     Aircraft,
     Departure,
     Estimate,
     Destination,
     flightRules   [0] FlightRules                   OPTIONAL,
     equipment     [1] Equipment                     OPTIONAL,
     route         [2] Route                         OPTIONAL,
     otherInfo     [3] OtherInformation              OPTIONAL
}
```

```
CoordinateInitial ::= SEQUENCE
{
     FlightID,
     Aircraft,
     Departure,
     Estimate,
     Destination,
     flightRules  [0] FlightRules               OPTIONAL,
     equipment    [1] Equipment                 OPTIONAL,
     route        [2] Route                     OPTIONAL,
     otherInfo    [3] OtherInformation          OPTIONAL
}
CoordinateNegotiate ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination,
     Estimate,
     route    Route                             OPTIONAL
}

CoordinateAccept ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination
}

CoordinateReject ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination
}

CoordinateCancel ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination,
  estimate    [0] Estimate                      OPTIONAL,
  otherInfo   [1] OtherInformation              OPTIONAL
}

CoordinateReady ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination
}
```

```
CoordinateCommit ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination
}

CoordinateRollback ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination,
  otherInfo  [1] OtherInformation  OPTIONAL
}

CoordinateUpdate ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination,
  Estimate,
  route   Route              OPTIONAL
}

CoordinateStandby ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination
}

TransferInitiate ::= SEQUENCE
{
     FlightID,
     departure    [0] Departure              OPTIONAL,
     destination  [1] Destination     OPTIONAL,
  execData      [2] ExecData          OPTIONAL,
  trackData     [3] TrackData         OPTIONAL
}

TransferAccept ::= SEQUENCE
{
     FlightID,
     departure    [0] Departure              OPTIONAL,
     destination  [1] Destination     OPTIONAL,
  frequency     [2] Frequency         OPTIONAL
}
```

```
TransferControl ::= SEQUENCE
{
    FlightID,
    departure          [0] Departure         OPTIONAL,
    destination        [1] Destination       OPTIONAL,
    execData           [2] ExecData          OPTIONAL,
    releaseIndicator   [3] ReleaseIndicator  OPTIONAL
}

TransferProposal ::= SEQUENCE
{
    FlightID,
    departure          [0] Departure         OPTIONAL,
    destination        [1] Destination       OPTIONAL,
    execData           [2] ExecData          OPTIONAL
}

TransferAssume ::= SEQUENCE
{
    FlightID,
    departure     [0] Departure              OPTIONAL,
    destination   [1] Destination            OPTIONAL
}

TransferReject ::= SEQUENCE
{
    FlightID,
    Departure,
    Destination
}

TransferData ::= SEQUENCE
{
    FlightID,
    Departure     [0] Departure              OPTIONAL,
    Destination   [1] Destination            OPTIONAL,
    ExecData      [2] ExecData               OPTIONAL,
    Frequency     [3] Frequency              OPTIONAL
}

SurvADS ::= SEQUENCE
{
    FlightID,
    Departure,
    Destination,
    ADSData
}
```

```
SurvReport ::= SEQUENCE
{
     FlightID,
     Departure,
     Destination,
     TrackData
}

DynamicTrack ::= Trackdetailmsg

TrackSystem ::= SEQUENCE
{
  trackSystemName                          IA5String(SIZE(1..32)),
  rTrackSequence         SEQUENCE SIZE(1..64) OF RTrack,
  trackSystemGenerationTime    [0] Datetimegroup    OPTIONAL,
  trackSystemStartTime [1] Datetimegroup            OPTIONAL,
  trackSystemEndTime   [2] Datetimegroup            OPTIONAL,
  otherInfo            [3] OtherInformation  OPTIONAL
}

RestrictedAirspace ::= SEQUENCE
{
  airspaceName IA5String(SIZE(1..32)),
  startTime    Datetimegroup,
  stopTime     Datetimegroup,
  floorLevel   Level,
  ceilingLevel Level,
  perimeter    Perimeter,
  otherInfo    OtherInformation       OPTIONAL
}

FreetextEmergency ::= SEQUENCE
{
     FunctionalAddress,
     OtherInformation
}

FreetextGeneral ::= SEQUENCE
{
     FunctionalAddress,
     OtherInformation
}

AppStatus ::= NULL

AppAccept ::= NULL
```

```
AppError ::= SEQUENCE
{
  MessageType,
  ComponentType,
  ErrorCode,
  errorData  ErrorData          OPTIONAL

}

--   A.6  AIDC MESSAGE COMPONENT DEFINITIONS


ADSData ::= SEQUENCE
{
  basicADS              Basic-ADS,
  flightID             [12] FlightID                     OPTIONAL,
  projectedProfile     [13] Projected-Profile            OPTIONAL,
  groundVector         [14] Ground-Vector                OPTIONAL,
  airVector            [15] Air-Vector                   OPTIONAL,
  weather              [16] Weather                      OPTIONAL,
  airframeID           [17] AirframeID                   OPTIONAL,
  intermediateIntent         SEQUENCE SIZE(1..64) OF
                       [22] Intermediate-Intent          OPTIONAL,
  shortTermIntent      [23] Short-Term-Intent            OPTIONAL,
  extendedProjectedProfile
                       [31] Extended-Projected-Profile   OPTIONAL
}

Aircraft ::= Aircrafttype
-- Note:  Aircrafttype includes 1 character for wake class

Departure ::= AirportTime

Destination ::= AirportTime

Equipment ::= SEQUENCE
{
     SEQUENCE SIZE (1..26) OF COMNAVequipmentstatus,
     SSRequipmentavailable,
     adsAvailable BOOLEAN,
     acasAvailable BOOLEAN,
     SEQUENCE SIZE (1..4) OF DataLink                    OPTIONAL
}

Estimate ::= SEQUENCE
{

  Position,
  Time,
  Level,
     atwLevel        ATWlevel                            OPTIONAL
}
```

```
ExecData ::= SEQUENCE
{
  speed              [0] Speed                 OPTIONAL,
  level              [1] Level                 OPTIONAL,
  heading            [2] Degreesmagnetic       OPTIONAL,
  vertRate           [3] Verticalchange        OPTIONAL,
  directRouting      [4] DirectRouting         OPTIONAL
}

FlightID ::= SEQUENCE
{
     Aircraftflightidentification,
     beaconCode       [0] Beaconcode           OPTIONAL,
     selcal           [1] Selcal               OPTIONAL,
     registration     [2] Registration         OPTIONAL,
     airframeID       [17]AirframeID           OPTIONAL -- ADS Type
}

FlightRules ::= SEQUENCE
{
     FlightRule,
     flightType       FlightType               OPTIONAL
}

OtherInformation ::=  Freetext

Perimeter ::= SEQUENCE SIZE(1..128) OF Side


Route ::=  SEQUENCE
{
  Speed,
  Level,
  routeSeq    SEQUENCE         SIZE (1..128) OF RouteElement,
  sid         [0] TerminalRoute                OPTIONAL,
  star        [1] TerminalRoute                OPTIONAL,
  truncationIndicator [2] BOOLEAN              OPTIONAL
}

RTrack ::= SEQUENCE
{
  --  Track should be defined from entry fix to exit fix
  --  for one-way tracks.
  rTrack      Pointdetailsequence,

  --  Connecting routes at beginning of track, typically
  --  feed traffic into the track.
  feederRoutes      [0]     SEQUENCE    SIZE(1..16)    OF
                  Airwayidentifier    OPTIONAL,
```

```
  --  Connecting routes at end of track, typically
  --  distribute traffic from track.
  distributionRoutes            [1] SEQUENCE SIZE(1..16) OF
Airwayidentifier OPTIONAL

}

TrackData ::= SEQUENCE
{
     basicADS            Basic-ADS,
     groundVector    [14] Ground-Vector     OPTIONAL
}

--   A.7  AIDC PRIMITIVE TYPE DEFINITIONS


--   The types listed in this section do not currently appear in
--   the CPDLC or ADS message definitions.
--   These types are unique (at this time) to the AIDC messages.

AirportTime ::= SEQUENCE
{
     Airport,
     Time               OPTIONAL
}

ConstrainedSpeed ::= SEQUENCE
{
  Speed,
  SpeedTolerance  OPTIONAL
}

ConstrainedTime ::= SEQUENCE
{
  RTAtime,
  RTAtolerance OPTIONAL
}

CruiseClimb ::= SEQUENCE
{
     Position,
     Speed,
     Level,
     ATWlevel
}

DataLink ::= ENUMERATED
{
     hf       (0),
     modeS    (1),
     satcom   (2),
     vhf      (3)
}
```

```
DirectRouting ::= SEQUENCE
{
  fix2     [1] Position,
  fix1     [0] Position          OPTIONAL
}

DistanceESNM ::= INTEGER(0..65535) --In 0.1 Nautical miles
--  Distance measured along the Earth's surface.


FlightRule ::= ENUMERATED
{
     ifr       (0),
     vfr       (1),
     ifrfirst  (2),
     vfrfirst  (3)
}

FlightType ::= ENUMERATED
{
     scheduledAirTransport           (0),
     nonScheduledAirTransport        (1),
     generalAviation                 (2),
     military                        (3),
     otherFlights                    (4)
}

FunctionalAddress ::= IA5String(SIZE(2..7))

GreatCircleArc ::= NULL

Registration ::= IA5String(SIZE(4..7))

ReleaseIndicator ::= IA5String(SIZE(1))



RouteElement ::= CHOICE
{
     significantPoint     [0] SignificantPoint,
     airwayIdentifier     [1] Airwayidentifier,
     flightRule           [2] FlightRule,
     cruiseClimb          [3] CruiseClimb
}

Selcal ::= IA5String(SIZE(4))

Side ::= SEQUENCE
{
  Position,
  SideType
}
```

```
SideType ::= CHOICE
{
  [0] GreatCircleArc,
  [1] SmallCircleArc
}

SignificantPoint ::= SEQUENCE
{
  Position,
  rtaTime              [0] ConstrainedTime         OPTIONAL,
  priorSpeedLevel      [1] SpeedLevelConstraint    OPTIONAL,
  postSpeedLevel       [2] SpeedLevelConstraint    OPTIONAL
}

SmallCircleArc ::= SEQUENCE
{
  center     Position,
  radius     DistanceESNM
}

SpeedLevelConstraint ::= SEQUENCE
{
  constrainedSpeed     [0] ConstrainedSpeed        OPTIONAL,
  atwLevel             [1] ATWLevel                OPTIONAL
}

SpeedTolerance ::= ENUMERATED
{
  at                (0),
  atOrLessThan      (1),
  atOrGreaterThan     (2)
}

TerminalRoute ::= IA5String(SIZE(4..8))     -- See ICAO Annex 11
-- 2, 3 or 5 letter fix name, 1 or 2 digits, 1 letter

VersionNumber ::= INTEGER(1..256)
```

```
--  A.8  AIDC ERROR-RELATED TYPES

ComponentType ::= ENUMERATED
{
  ctUnknown                                        (0),
  ctNotApplicable                                  (1),
  ctFlightID                                       (7),
  ctFlightRules                                    (8),
  ctAircraft                                       (9),
  ctEquipment                                      (10),
  ctDeparture                                      (13),
  ctEstimate                                       (14),
  ctRoute                                          (15),
  ctDestination                                    (16),
  ctExecData                                       (26),
  ctADSData                                        (27),
  ctTrackData                                      (28),
  ctRTrack                                         (29),
  ctPerimeter                                      (30),
  ctFunctionalAddress                              (31)
  ctFrequency                                      (32),
  ctUnrecognized                                   (255)
}

ErrorCode ::= ENUMERATED
{
  invalidAircraftType                              (0),
  invalidWakeCategory                              (1),

  invalidDepartureAerodrome                        (2),
  invalidDepartureTime                             (3),
  invalidDestinationAerodrome                      (4),
  invalidDestinationTime                           (5),

  invalidSSREquipment                              (6),
  invalidCOMNAVEquipment                           (7),
  invalidDataLink                                  (8),

  invalidPosition                                  (9),
  invalidTime                                      (10),
  invalidLevel                                     (11),
  invalidSpeed                                     (12),

  invalidConstrainedTime                           (13),
  invalidConstrainedSpeed                          (14),
  invalidATWlevel                                  (15),

  invalidHeading                                   (16),
  invalidVerticalChange                            (17),
  invalidDirectRouting                             (18),

  invalidAircraftFlightID                          (19),
  invalidBeaconCode                                (20),
  invalidSelcal                                    (21),
  invalidRegistration                              (22),
  invalidAirframeID                                (23),
```

```
    invalidFlightRule                                    (24),
    invalidFlightType                                    (25),

    invalidSID                                           (26),
    invalidSTAR                                          (27),

    invalidRouteElement                                  (28),
    invalidSignificantPoint                              (29),
    invalidAirwayID                                      (30),
    invalidCruiseClimb                                   (31),

    invalidTrackName                                     (32),
    invalidTrackSystemName                               (33),
    invalidPointDetail                                   (34),
    invalidStartTime                                     (35),
    invalidStopTime                                      (36),
    invalidGenerationTime                                (37),
    invalidDateTimeGroup                                 (38),

    invalidFeederRoute                                   (39),
    invalidDistributeRoute                               (40),
    invalidFloorLevel                                    (41),
    invalidCeilingLevel                                  (42),

    invalidBasicADS                                      (43),
    invalidProjectedProfile                              (44),
    invalidGroundVector                                  (45),
    invalidAirVector                                     (46),
    invalidWeather                                       (47),
    invalidIntermediateIntent                            (48),
    invalidShortTermIntent                               (49),
    invalidExtendedProfile                               (50),

    invalidSide                                          (51),
    invalidFunctionalAddress                             (52),

    invalidInvokeID                                      (240),
    invalidRefID                                         (241),
    invalidRefICAOUnit                                   (242),
    invalidTimeStamp                                     (243),

    corruptedMessage                                     (252),
    messageTooShort                                      (253),
    messageTooLong                                       (254),
    unknown                                              (255)
}

ErrorData ::= BIT STRING(SIZE(1..256))

MessageType ::= INTEGER(0..255)
--  Corresponds to the CHOICE identifier found in the
--  AIDCMessage type (p. A-3).
```

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APPENDIX B

TO PART II, CHAPTER 3

AIDC SERVICE DESCRIPTIONS

The AIDC service descriptions which follow are in terms of the AIDC messages. These services also encompass all messages in current use (i.e. NAT SPG, European OLDI and Pacific ATS). Tables 2.3.8 – 3.3.14 relate the AIDC messages to existing messages. Substitute the existing message for the AIDC message in the corresponding service description to produce a service description using the existing message.

For example, the initial co-ordination service is described in terms of the AIDC message CoordinateInitial. For a NAT SPG-specific service, substitute the existing CPL message for the CoordinateInitial message. For a European OLDI-specific service, substitute the existing PAC or ACT message for the CoordinateInitial message. For a Pacific ATS-specific service, substitute the existing EST for the CoordinateInitial service. As is apparent from this example, the use of AIDC messages within the service descriptions reduces the number of services required.

In all service descriptions, the AIDC messages AppAccept and AppError translate directly to LAM and LRM messages, respectively.

3B.1 FLIGHT PLANNING SERVICES

3B.1.1 Flight plan request service

3B.1.1.1 *Service definition.* This service permits ATSU1 to request flight plan information from ATSU2.

3B.1.1.2 *Service procedure.* When the service is initiated by ATSU1, ATSU1 transmits a FlightPlanRequest message to ATSU2. ATSU2 validates the received message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.1.1.3 *Conditions of transfer.* This service is initiated when ATSU1 determines that it requires flight information for the specified flight.

3B.1.1.4 *Sequence of services.* This service may be invoked at any time. This service is followed by a flight plan transfer service invocation, if ATSU2 possesses the requested flight plan information.

3B.1.2 Flight plan transfer service

3B.1.2.1 *Service definition.* This service allows ATSU1 to transfer flight plan information to a peer ATSU2. This service is typically invoked once per flight.

3B.1.2.2 *Service procedure.* When the service is initiated by ATSU1, ATSU1 transmits a FlightPlanFiled message to ATSU2. ATSU2 validates the received message and, if found to be valid, transfers an AppAccept to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.1.2.3 *Conditions of transfer.* When ATSU1 receives new flight plan data.

3B.1.2.4 *Sequence of services.* This service must be invoked prior to any flight plan cancellation, flight plan modification, flight plan departure notification, or flight plan delay notification service invocations for the specified flight.

3B.1.3 Flight plan cancellation service

3B.1.3.1 *Service definition.* This service allows ATSU1 to notify ATSU2 that a previously issued (by ATSU1) flight plan is no longer valid.

3B.1.3.2 *Service procedure.* When the service is initiated by ATSU1, ATSU1 transmits a FlightPlanCancel message to ATSU2. ATSU2 validates the received message and, if found to be valid, transfers an AppAccept to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.1.3.3 *Conditions of transfer.* This service is initiated when ATSU1 determines that a previously issued flight plan is no longer valid.

3B.1.3.4 *Sequence of services.* This service may be invoked subsequent to a flight plan transfer service invocation for the specified flight.

3B.1.4 Flight plan modification service

3B.1.4.1 *Service definition.* This service allows ATSU1 to change the flight information contained in a previously issued FlightPlanFiled or FlightPlanModify message.

3B.1.4.2 *Service procedure.* When the service is initiated by ATSU1, ATSU1 transmits a FlightPlanModify message to ATSU2. ATSU2 validates the received message and, if found to be valid, transfers an AppAccept to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.1.4.3 *Conditions of transfer.* This service is initiated when ATSU1 determines that the information in a previously issued flight plan must be updated.

3B.1.4.4 *Sequence of services.* This service may only be invoked subsequent to a flight plan transfer service invocation.

3B.1.5 Delay notification service

3B.1.5.1 *Service definition.* This service allows ATSU1 to notify ATSU2 of a delay in a flight's departure time.

3B.1.5.2 *Service procedure.* When the service is initiated by ATSU1, ATSU1 transmits a FlightPlanDelay message to ATSU2. ATSU2 validates the received message and, if found to be valid, transfers an AppAccept to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.1.5.3 *Conditions of transfer.* This service is initiated when ATSU1 determines that a flight for which it previously issued a flight plan will have a delayed departure.

3B.1.5.4 *Sequence of services.* This service may only be invoked subsequent to the flight plan transfer service invocation and prior to the departure notification service invocation.

3B.1.6 Departure notification service

3B.1.6.1 *Service definition.* This service allows ATSU1 to notify ATSU2 of a flight's actual departure time.

3B.1.6.2 *Service procedure.* When the service is initiated by ATSU1, ATSU1 transmits a FlightPlanDepart message to ATSU2. ATSU2 validates the received message and, if found to be valid, transfers an AppAccept to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.1.6.3 *Conditions of transfer.* This service is initiated when the flight departs.

3B.1.6.4 *Sequence of services.* This service may only be invoked subsequent to the flight plan transfer service.

3B.2 NOTIFICATION SERVICES

3B.2.1 Advance flight notification service

3B.2.1.1 *Service definition.* This service allows the C-ATSU to notify a D-ATSU of a flight's cleared profile some time period before the flight enters the D-ATSU's area of interest. This service may be invoked a multiple number of times for the same flight, depending on the number and type of changes made to the flight's cleared profile.

3B.2.1.2 *Service procedure.* When the service is initiated, the C-ATSU transmits a notification message to a D-ATSU. The D-ATSU validates the received message and, if found to be valid, transfers an AppAccept message to the C-ATSU. Otherwise, an AppError response, indicating the error, is transmitted to the C-ATSU.

The C-ATSU must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.2.1.3 *Conditions of transfer.* This service may be initiated a specified time before boundary crossing, or when a change in a flight's profile (altitude, route, speed, boundary crossing time, etc.) occurs.

3B.2.1.4 *Sequence of services.* This service may only be invoked prior to invocation of the initial co-ordination for the specified flight.

3B.3 CO-ORDINATION SERVICES

3B.3.1 Initial co-ordination service

3B.3.1.1 *Service definition.* This service allows the C-ATSU to begin the initial co-ordination of the conditions of transfer of a flight with a D-ATSU.

3B.3.1.2 *Service procedure.* When this service is initiated by the C-ATSU, the C-ATSU transmits a CoordinateInitial message to a D-ATSU. The D-ATSU validates the received message and, if found to be valid, transfers an AppAccept message to the C-ATSU. Otherwise, an AppError response, indicating the error, is transmitted to the C-ATSU.

The C-ATSU must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.3.1.3 *Conditions of transfer.* This service is initiated when the C-ATSU determines that a flight under its control is in the proximity of a D-ATSU's airspace, and it must be co-ordinated with the adjacent D-ATSU.

3B.3.1.4 *Sequence of services.* This service must be invoked prior to a transfer initiation service invocation for the specified flight. This service is invoked only once per flight between the C-ATSU and a particular D-ATSU. The appropriate response to this service by the D-ATSU is either a co-ordination negotiation service invocation, or a co-ordination acceptance service invocation.

3B.3.2 **Co-ordination negotiation service**

3B.3.2.1 *Service definition.* This service allows ATSU1 to negotiate modifications to a flight's existing co-ordination conditions with ATSU2. This service can be used as part of a co-ordination dialog, or to provide coordination revisions from the C-ATSU to a D-ATSU. If rejected, any currently agreed co-ordination conditions remain in affect.

3B.3.2.2 *Service procedure.* When this service is initiated by ATSU1, ATSU1 transmits a CoordinateNegotiate message to ATSU2. ATSU2 validates the received message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.3.2.3 *Conditions of transfer.* This service is initiated when ATSU1 wishes to propose modifications to a flight's co-ordination conditions.

3B.3.2.4 *Sequence of services.* This service may only be invoked after the initial co-ordination service for the specified flight. The appropriate response by ATSU2 is either another co-ordination negotiation service invocation, a co-ordination acceptance service invocation, or a co-ordination rejection service invocation.

3B.3.3 **Co-ordination acceptance service**

3B.3.3.1 *Service definition.* This service allows ATSU1 to notify ATSU2 that ATSU1 accepts the co-ordination conditions proposed.

3B.3.3.2 *Service procedure.* When the service is initiated, ATSU1 transmits a CoordinateAccept message to ATSU2. ATSU2 validates the received message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.3.3.3 *Conditions of transfer.* This service may be initiated upon receipt of a CoordinateInitial or CoordinateNegotiate message.

3B.3.3.4 *Sequence of services.* This service may only be invoked subsequent to invocation of an initial co-ordination, a co-ordination update, or co-ordination negotiation service invocation for the specified flight.

3B.3.4 **Co-ordination rejection service**

3B.3.4.1 *Service definition.* This service allows ATSU1 to notify ATSU2 that ATSU1 rejects the co-ordination conditions proposed.

3B.3.4.2 *Service procedure.* When the service is initiated, ATSU1 transmits a CoordinateReject message to ATSU2. ATSU2 validates the received message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.3.4.3 *Conditions of transfer.* This service may be initiated upon receipt of a CoordinateNegotiate message.

3B.3.4.4 *Sequence of services.* This service may only be invoked subsequent to invocation of a co-ordination update or co-ordination negotiation service invocation for the specified flight.

3B.3.5 **Co-ordination cancellation service**

3B.3.5.1 *Service definition.* This service allows the C-ATSU to notify a D-ATSU that the co-ordination (or notification) previously effected is no longer relevant for the specified flight.

3B.3.5.2 *Service procedure.* When the service is initiated, the C-ATSU transmits a CoordinateCancel message to a D-ATSU. The D-ATSU validates the received message and, if found to be valid, transfers an AppAccept message to the C-ATSU. Otherwise, an AppError response, indicating the error, is transmitted to the C-ATSU.

The C-ATSU must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.3.5.3 *Conditions of transfer.* This service is initiated when the C-ATSU determines that a flight under its control that was expected to enter the D-ATSU's area of interest will no longer do so.

3B.3.5.4 *Sequence of services.* This service may only be invoked subsequent to a notification, service invocation, and prior to the invocation of the transfer initiation service for the specified flight.

3B.3.6 **Co-ordination ready service**

3B.3.6.1 *Service definition.* This service allows a D-ATSU to notify the C-ATSU that the D-ATSU can accept the proposed co-ordination conditions.

3B.3.6.2 *Service procedure.* When the service is initiated, the D-ATSU transmits a CoordinateReady message to the C-ATSU. The C-ATSU validates the received message and, if found to be valid, transfers an AppAccept message to the D-ATSU. Otherwise, an AppError response, indicating the error, is transmitted to the D-ATSU.

The D-ATSU must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.3.6.3 *Conditions of transfer*. This service is initiated in response to an initial co-ordination or co-ordination update service invocation, when a D-ATSU determines that the proposed co-ordination conditions are acceptable.

3B.3.6.4 *Sequence of services*. This service may only be invoked subsequent to an initial co-ordination or co-ordination update service invocation, and prior to the invocation of the transfer initiation service invocation for the specified flight. This service is part of the two-phase commit co-ordination protocol.

3B.3.7 Co-ordination commit service

3B.3.7.1 *Service definition*. This service allows the C-ATSU to notify a D-ATSU that the co-ordination conditions agreed upon should be used to update the D-ATSU's flight data base.

3B.3.7.2 *Service procedure*. When the service is initiated, the C-ATSU transmits a CoordinateCommit message to a D-ATSU. The D-ATSU validates the received message and, if found to be valid, transfers an AppAccept message to the C-ATSU. Otherwise, an AppError response, indicating the error, is transmitted to the C-ATSU.

The C-ATSU must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.3.7.3 *Conditions of transfer*. This service is initiated when the C-ATSU wants to signal D-ATSUs to update their flight data bases with the co-ordinated flight profile.

3B.3.7.4 *Sequence of services*. This service may only be invoked subsequent to a co-ordination ready-to-commit service invocation, and prior to the invocation of the transfer initiation service invocation for the specified flight. This service is part of the two-phase commit co-ordination protocol.

3B.3.8 Co-ordination rollback service

3B.3.8.1 *Service definition*. This service allows the C-ATSU to notify a D-ATSU that the co-ordination conditions recently agreed upon are no longer valid for the specified flight.

3B.3.8.2 *Service procedure*. When the service is initiated, the C-ATSU transmits a CoordinateRollback message to a D-ATSU. The D-ATSU validates the received message and, if found to be valid, transfers an AppAccept message to the C-ATSU. Otherwise, an AppError response, indicating the error, is transmitted to the C-ATSU.

The C-ATSU must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.3.8.3 *Conditions of transfer*. This service is initiated when the C-ATSU determines that the previous co-ordinated flight profile used to update D-ATSU data bases is no longer valid. The D-ATSUs must return (i.e. rollback) to the previously co-ordinated state, if one exists.

3B.3.8.4 *Sequence of services.* This service may only be invoked subsequent to an initial co-ordination, or co-ordination update service invocation, and prior to the invocation of the transfer initiation service invocation for the specified flight. This service is part of the two-phase commit co-ordination protocol.

3B.3.9 **Co-ordination update service**

3B.3.9.1 *Service definition.* This service allows ATSU1 to request an update to a flight's existing coordination conditions with ATSU2. If rejected, any currently agreed co-ordination conditions remain in affect.

3B.3.9.2 *Service procedure.* When this service is initiated by ATSU1, ATSU1 transmits a CoordinateUpdate message to ATSU2. ATSU2 validates the received message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.3.9.3 *Conditions of transfer.* This service is initiated when ATSU1 wishes to request an update to a flight's co-ordination conditions.

3B.3.9.4 *Sequence of services.* This service may only be invoked after the initial coordination service for the specified flight. The appropriate response by ATSU2 is either a co-ordination negotiation service invocation, a co-ordination rejection service invocation, or a co-ordination ready service invocation. This service is part of the two-phase commit co-ordination protocol.

3B.3.10 **Co-ordination standby service**

3B.3.10.1 *Service definition.* This service allows ATSU1 to notify ATSU2 that the co-ordination dialogue between ATSU1 and ATSU2 is being temporarily suspended.

3B.3.10.2 *Service procedure.* When the service is initiated, ATSU1 transmits a CoordinateStandby message to ATSU2. The ATSU2 validates the received message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.3.10.3 *Conditions of transfer.* This service may be initiated when ATSU1 must first complete a co-ordination dialogue with a third (or more) ATSU before it can complete the co-ordination dialogue with ATSU2.

3B.3.10.4 *Sequence of services.* This service may only be invoked subsequent to an initial co-ordination or co-ordination update service invocation, and prior to the transfer initiation service invocation for the specified flight. This service is part of the two-phase commit co-ordination protocol.

3B.4 TRANSFER OF CONTROL SERVICES

3B.4.1 Transfer initiation service

3B.4.1.1 *Service definition.* This service allows the C-ATSU to initiate the transfer of a flight to the R-ATSU.

3B.4.1.2 *Service procedure.* When the service is initiated, the C-ATSU transmits a TransferInitiate message to the R-ATSU. The R-ATSU validates the message and, if found to be valid, transfers an AppAccept message to the C-ATSU. Otherwise, an AppError response, indicating the error, is transmitted to the C-ATSU.

The C-ATSU must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.4.1.3 *Conditions of transfer.* This service is initiated when the C-ATSU wishes to initiate the transfer of control phase. This typically occurs when the C-ATSU determines that a flight is within a specified distance or flying time of the R-ATSU's airspace.

3B.4.1.4 *Sequence of services.* This service may only be invoked after completion of the initial co-ordination service invocation for the specified flight.

3B.4.2 Transfer hand-off proposal service

3B.4.2.1 *Service definition.* This service allows the C-ATSU to offer control authority for a flight to the R-ATSU.

3B.4.2.2 *Service procedure.* When the service is initiated, the C-ATSU transmits a TransferProposal message to the R-ATSU. The R-ATSU validates the message and, if found to be valid, transfers an AppAccept message to the C-ATSU. Otherwise, an AppError response, indicating the error, is transmitted to the C-ATSU.

The C-ATSU must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.4.2.3 *Conditions of transfer.* This service is initiated when the C-ATSU wishes to offer control authority for a flight to the R-ATSU.

3B.4.2.4 *Sequence of services.* This service may only be invoked after completion of the transfer initiation service for the specified flight.

3B.4.3 Transfer acceptance service

3B.4.3.1 *Service definition.* This service allows the R-ATSU to indicate that it is prepared to assume control authority for a flight to the C-ATSU.

3B.4.3.2 *Service procedure.* When the service is initiated, the R-ATSU transmits a TransferAccept message to the C-ATSU. The C-ATSU validates the message and, if found to be valid, transfers an AppAccept message to the R-ATSU. Otherwise, an AppError response, indicating the error, is transmitted to the R-ATSU.

The R-ATSU must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.4.3.3 *Conditions of transfer.* This service is initiated when the R-ATSU wishes to assume control authority for a flight from the C-ATSU.

3B.4.3.4 *Sequence of services.* This service may only be invoked after completion of the transfer initiation service. This service may be invoked either in response to the receipt of a TransferProposal message by the R-ATSU, or as an unsolicited service invocation after the receipt by the R-ATSU of a TransferInitiate message.

3B.4.4 **Relinquish control service**

3B.4.4.1 *Service definition.* This service allows the C-ATSU to indicate that it has relinquished control authority for a flight to the R-ATSU.

3B.4.4.2 *Service procedure.* When the service is initiated, the C-ATSU transmits a TransferControl message to the R-ATSU. The R-ATSU validates the message and, if found to be valid, transfers an AppAccept message to the C-ATSU. Otherwise, an AppError response, indicating the error, is transmitted to the C-ATSU.

The C-ATSU must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.4.4.3 *Conditions of transfer.* This service is initiated when the C-ATSU wishes to indicate to the R-ATSU that it has relinquished control authority for a flight to the R-ATSU.

3B.4.4.4 *Sequence of services.* This service may only be invoked after completion of the transfer initiation service.

3B.4.5 **Assumption of control service**

3B.4.5.1 *Service definition.* This service allows the R-ATSU to indicate to the C-ATSU that it has assumed control authority for a flight.

3B.4.5.2 *Service procedure.* When the service is initiated, the R-ATSU transmits a TransferAssume message to the C-ATSU. The C-ATSU validates the message and, if found to be valid, transfers an AppAccept message to the R-ATSU. Otherwise, an AppError response, indicating the error, is transmitted to the R-ATSU.

The R-ATSU must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.4.5.3 *Conditions of transfer.* This service is initiated when the R-ATSU wishes to indicate to the C-ATSU that it has assumed control authority for a flight from the C-ATSU.

3B.4.5.4 *Sequence of services.* This service may only be invoked after completion of the transfer initiation service. This message terminates the transfer phase.

3B.4.6 **Rejection of control service**

3B.4.6.1 *Service definition.* This service allows the R-ATSU to indicate that it is not prepared to assume control authority for a flight to the C-ATSU.

3B.4.6.2 *Service procedure.* When the service is initiated, the R-ATSU transmits a TransferReject message to the C-ATSU. The C-ATSU validates the message and, if found to be valid, transfers an AppAccept message to the R-ATSU. Otherwise, an AppError response, indicating the error, is transmitted to the R-ATSU.

The R-ATSU must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.4.6.3 *Conditions of transfer.* This service is initiated when the R-ATSU wishes to indicate that it does not wish to assume control authority for a flight from the C-ATSU.

3B.4.6.4 *Sequence of services.* This service may only be invoked after completion of the transfer initiation service. This service may be invoked either in response to the receipt of a TransferProposal message by the R-ATSU, or as an unsolicited service invocation after the receipt by the R-ATSU of a TransferInitiate message.

3B.4.7 **Transfer of executive data service**

3B.4.7.1 *Service definition.* This service permits an ATSU to transfer executive control data to an adjacent ATSU.

3B.4.7.2 *Service procedure.* When this service is initiated, ATSU1 transmits a TransferData message to a ATSU2. ATSU2 validates the received message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must taken an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.4.7.3 *Conditions of transfer.* This service is initiated when the executive control data for a flight is changed.

3B.4.7.4 *Sequence of services.* This service may only be invoked after completion of the initial co-ordination service invocation for the specified flight.

3B.5 SURVEILLANCE DATA TRANSFER SERVICE

3B.5.1 ADS report transfer service

3B.5.1.1 *Service definition*. This service allows ATSU1 to transfer ADS data to ATSU2.

3B.5.1.2 *Service procedure*. When the service is initiated, ATSU1 transmits a SurvADS message to ATSU2. ATSU2 validates the message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.5.1.3 *Conditions of transfer*. This service is invoked when the conditions specified in the bilateral agreement between the ATS units are satisfied.

3B.5.1.4 *Sequence of services*. This service may be invoked at any time which is in accordance with the bilateral agreement.

3B.5.2 General surveillance report transfer service

3B.5.2.1 *Service definition*. This service allows ATSU1 to transfer surveillance data to ATSU2.

3B.5.2.2 *Service procedure*. When the service is initiated, ATSU1 transmits a SurvReport message to ATSU2. ATSU2 validates the message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.5.2.3 *Conditions of transfer*. This service is invoked when the conditions specified in the bilateral agreement between the ATS units are satisfied.

3B.5.2.4 *Sequence of services*. This service may be invoked at any time which is in accordance with the bilateral agreement.

3B.6 AIRSPACE MANAGEMENT SERVICES

3B.6.1 Dynamic track transfer service

3B.6.1.1 *Service definition*. This service allows ATSU1 to transfer dynamic track information to ATSU2.

3B.6.1.2 *Service procedure*. When the service is initiated, ATSU1 transmits a DynamicTrack message to ATSU2. ATSU2 validates the message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.6.1.3 *Conditions of transfer*. This service is invoked when a new dynamic track must be co-ordinated with other ATSUs.

3B.6.1.4 *Sequence of services*. This service may be invoked at any time.

3B.6.2 **Track system transfer service**

3B.6.2.1 *Service definition*. This service allows ATSU1 to transfer track system information to ATSU2.

3B.6.2.2 *Service procedure*. When the service is initiated, ATSU1 transmits a TrackSystem message to ATSU2. ATSU2 validates the message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.6.2.3 *Conditions of transfer*. This service is invoked when a new track system must be disseminated to other ATSUs.

3B.6.2.4 *Sequence of services*. This service may be invoked at any time.

3B.6.3 **Restricted airspace transfer service**

3B.6.3.1 *Service definition*. This service allows ATSU1 to transfer the description of a restricted airspace to ATSU2.

3B.6.3.2 *Service procedure*. When the service is initiated, ATSU1 transmits a RestrictedAirspace message to ATSU2. ATSU2 validates the message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.6.3.3 *Conditions of transfer*. This service is invoked when a new reserved airspace is received or generated by ATSU1.

3B.6.3.4 *Sequence of services*. This service may be invoked at any time.

3B.7 MISCELLANEOUS SERVICES

3B.7.1 Emergency free text messaging service

3B.7.1.1 *Service definition.* This service permits ATSU1 to exchange free text (i.e. unstructured) messages with ATSU2. This service is invoked to convey free text messages during emergency situations.

3B.7.1.2 *Service procedure.* When the service is initiated, ATSU1 transmits a FreeTextEmergency message to ATSU2. ATSU2 validates the message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.7.1.3 *Conditions of transfer.* This service is initiated at the request of ATS personnel.

3B.7.1.4 *Sequence of services.* This service may be invoked at any time in accordance with local ATS procedures.

3B.7.2 General free text messaging service

3B.7.2.1 *Service definition.* This service permits ATSU1 to exchange free text (i.e. unstructured) messages with ATSU2. This service is invoked to convey free text messages during normal situations.

3B.7.2.2 *Service procedure.* When the service is initiated, ATSU1 transmits a FreeTextGeneral message to ATSU2. ATSU2 validates the message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.7.2.3 *Conditions of transfer.* This service is initiated at the request of ATS personnel.

3B.7.2.4 *Sequence of services.* This service may be invoked at any time in accordance with local ATS procedures.

3B.7.3 Application status monitoring service

3B.7.3.1 *Service definition.* This service allows ATSU1 to verify the viability of the ATC application residing in ATSU2 of an adjacent FIR.

3B.7.3.2 *Service procedure.* When the service is initiated, the ATSU1 transmits an AppStatus message to ATSU2. ATSU2 validates the message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAccept or AppError response is received within a specified time period.

3B.7.3.3 *Conditions of transfer.* This service is initiated when no message of any type has been received from ATSU2 within a specified time period.

3B.7.3.4 *Sequence of services.* This service may be invoked at any time.

3B.7.4 **Version identification service**

3B.7.4.1 *Service definition.* This service allows ATSU1 to notify ATSU2 of the AIDC message set version it is using.

3B.7.4.2 *Service procedure.* When the service is initiated, the ATSU1 transmits a VersionNumber message to ATSU2. ATSU2 validates the message and, if found to be valid, transfers an AppAccept message to ATSU1. Otherwise, an AppError response, indicating the error, is transmitted to ATSU1.

ATSU1 must take an appropriate action if no AppAcccept or AppError response is received within a specified time period.

3B.7.4.3 *Conditions of transfer.* This service may be initiated when ATSU1 wishes to notify ATSU2 of the AIDC message set version number it is using.

3B.7.4.4 *Sequence of services.* This service may be invoked at any time. In particular, it may occur immediately after the establishment of a communications link between ATSU1 and ATSU2.

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APPENDIX C

TO PART II, CHAPTER 3

AIDC MESSAGE ELEMENTS AND RESOLUTIONS

Almost all AIDC messages are composed using CPDLC message elements. Some AIDC messages utilize ADS message elements. Refer to the CPDLC and ADS material for further information on these message elements.

The following message elements are unique to the AIDC data link application.

Data Item	Resolution	Description
Data link capability	2 bits	0 – HF DL-equipped 1 – Mode S DL-equipped 2 – Satcom DL-equipped 3 – VHF DL-equipped
Distance measured along the earth's surface (DistanceESNM)	16 bits, 0.1 NM	0 to 6 553 NM in 0.1 NM increments. Used in definition of small arcs (e.g. parallels of latitude).
Error codes	8 bits	Specifies the error code 0 to 255
Field number	5 bits	An integer value between 3 and 22 inclusive. The values 4, 5, 6, 11, 12, 19, 20, and 21 are currently invalid.
Flight rules	2 bits	One of: 0 – IFR 1 – VFR 2 – IFR first 3 – VFR first
Flight type	3 bits	One of: 0 – Scheduled air transport 1 – Non-scheduled air transport 2 – General aviation 3 – Military 4 – Other flights
Speed tolerance	2 bits	One of: 0 – at 1 – at or less than 2 – at or greater than

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GLOSSARY OF ACRONYMS

ACC	area control centre
ACK	acknowledge
ADS	automatic dependent surveillance
ADS-ATC	ADS-based air traffic control system
ADSF	automatic dependent surveillance function
ADSP	ADS processor
ADSU	automatic dependent surveillance unit
AGCS	air-ground communication system
AIDC	ATS interfacility data communications
ALRT	alert
AMSS	aeronautical mobile-satellite service
ARM	ADS report message
ASM	airspace management
ASN.1	abstract syntax notation one
ATFM	air traffic flow management
ATIS	automatic terminal information service
ATM	air traffic management
ATN	aeronautical telecommunication network
ATS	air traffic services
ATSU	air traffic services unit
C-ATSU	controlling ATS unit
CCR	cancel contract request
CER	cancel emergency mode request
CLI	cancel emergency mode indication
CMU	communications management unit
CNS	communications, navigation, and surveillance
CNS/ATM	communications, navigation, and surveillance/air traffic management
CPDLC	controller-pilot data link communications
CPL	current flight plan
CTC	cancel all contracts and terminate connection request
D-ATSU	downstream ATS unit
DGL	VHF digital data link
ECR	event contract request
EMG	emergency
FANS	Special Committee on Future Air Navigation Systems
FANS Phase II	Special Committee for the Monitoring and Co-ordination of Development and Transition Planning for the Future Air Navigation System
FASID	Facilities and Services Implementation Document
FDPS	flight data processing system
FIR	flight information region
FOM	figure of merit

FPL	filed flight plan
GGCS	ground-ground communications subsystem
GNSS	global navigation satellite system
HF	high frequency
ILS	instrument landing system
INS	inertial navigation system
MET	meteorology
Mode S	selective interrogation mode of SSR
NAK	negative acknowledgment
NAT	North Atlantic
NAT SPG	North Atlantic Systems Planning Group
NCN	non-compliance notification
O.R.	operational requirement
OLDI	on-line data interchange
OSI	open systems interconnection
PANS-RAC	*Procedures for Air Navigation Services – Rules of the Air and Air Traffic Services* (Doc 4444)
PCR	periodic contract request
PER	packed encoding rules
QOS	quality of service
R-ATSU	receiving ATS unit
REC	recall
RESP	response
RGCSP	Review of the General Concept of Separation Panel
RTF	radiotelephony
SARPs	Standards and Recommended Practices
SATCOM	satellite communication
SC 170	RTCA Special Committee 170
SF	scaling factor
TCAS	traffic alert and collision avoidance system
URG	urgency
UTC	Co-ordinated Universal Time
VHF	very high frequency
VOR	VHF omnidirectional radio range

– END –

ICAO TECHNICAL PUBLICATIONS

The following summary gives the status, and also describes in general terms the contents of the various series of technical publications issued by the International Civil Aviation Organization. It does not include specialized publications that do not fall specifically within one of the series, such as the Aeronautical Chart Catalogue *or the* Meteorological Tables for International Air Navigation.

International Standards and Recommended Practices are adopted by the Council in accordance with Articles 54, 37 and 90 of the Convention on International Civil Aviation and are designated, for convenience, as Annexes to the Convention. The uniform application by Contracting States of the specifications contained in the International Standards is recognized as necessary for the safety or regularity of international air navigation while the uniform application of the specifications in the Recommended Practices is regarded as desirable in the interest of safety, regularity or efficiency of international air navigation. Knowledge of any differences between the national regulations or practices of a State and those established by an International Standard is essential to the safety or regularity of international air navigation. In the event of non-compliance with an International Standard, a State has, in fact, an obligation, under Article 38 of the Convention, to notify the Council of any differences. Knowledge of differences from Recommended Practices may also be important for the safety of air navigation and, although the Convention does not impose any obligation with regard thereto, the Council has invited Contracting States to notify such differences in addition to those relating to International Standards.

Procedures for Air Navigation Services (PANS) are approved by the Council for world-wide application. They contain, for the most part, operating procedures regarded as not yet having attained a sufficient degree of maturity for adoption as International Standards and Recommended Practices, as well as material of a more permanent character which is considered too detailed for incorporation in an Annex, or is susceptible to frequent amendment, for which the processes of the Convention would be too cumbersome.

Regional Supplementary Procedures (SUPPS) have a status similar to that of PANS in that they are approved by the Council, but only for application in the respective regions. They are prepared in consolidated form, since certain of the procedures apply to overlapping regions or are common to two or more regions.

The following publications are prepared by authority of the Secretary General in accordance with the principles and policies approved by the Council.

Technical Manuals provide guidance and information in amplification of the International Standards, Recommended Practices and PANS, the implementation of which they are designed to facilitate.

Air Navigation Plans detail requirements for facilities and services for international air navigation in the respective ICAO Air Navigation Regions. They are prepared on the authority of the Secretary General on the basis of recommendations of regional air navigation meetings and of the Council action thereon. The plans are amended periodically to reflect changes in requirements and in the status of implementation of the recommended facilities and services.

ICAO Circulars make available specialized information of interest to Contracting States. This includes studies on technical subjects.

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