



The European Organisation for Civil Aviation Equipment
L'Organisation Européenne pour l'Équipement de l'Aviation Civile

SAFETY AND PERFORMANCE STANDARD FOR AIR TRAFFIC DATA LINK SERVICES IN OCEANIC AND REMOTE AIRSPACE (OCEANIC SPR STANDARD)

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FOREWORD

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EUROCAE

102 rue Etienne Dolet

92240 MALAKOFF

France

Tel: 33 1 40 92 79 30

Fax: 33 1 46 55 62 65

Email: eurocae@eurocae.net

Web Site: www.eurocae.net

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CHAPTER 1

INTRODUCTION

This standard provides the operational, safety, and performance requirements (SPR) for the implementation of air traffic data link services in oceanic and remote airspace. It is intended to be used by air traffic service providers (ATSPs), communication service providers, aircraft manufacturers/modifiers, operators, military, and civil aviation authorities for the implementation of communication, navigation, and surveillance/air traffic management (CNS/ATM) systems in worldwide application.

This document was developed in accordance with the criteria for SPR standards set forth in EUROCAE ED-78A/ RTCA DO-264, "Guidelines for Approval of the Provision and Use of Air Traffic Services (ATS) Supported by Data Communications." It provides the minimum operational, safety, and performance requirements and allocations based on the results of a coordinated requirements determination process, which includes an operational services and environment information capture, operational safety assessment (OSA), and an operational performance assessment (OPA). These requirements are necessary to provide adequate assurance that the elements of the CNS/ATM system, when operating together, will perform their intended function in an acceptably safe manner.

Figure 1-1 provides an overview of the CNS/ATM system and its elements. These elements comprise the aircraft system, the ATSP provisions, and the operator's provisions to use the data link services. The aeronautical operational control (AOC) services are provided through shared ground-ground and air-ground communications to the aircraft end-system. These services are described to the extent that they are used to support the intended ATS functions. The ATSP and the operator's provisions may include third party or contracted communication services, which are considered in this standard. While the figure is conceptual and shows only one of each kind of component, the actual CNS/ATM system in any airspace typically includes multiple ATSP facilities, operators, and aircraft, all of which provide the intended operational capability to multiple operators in a mixed fleet environment.

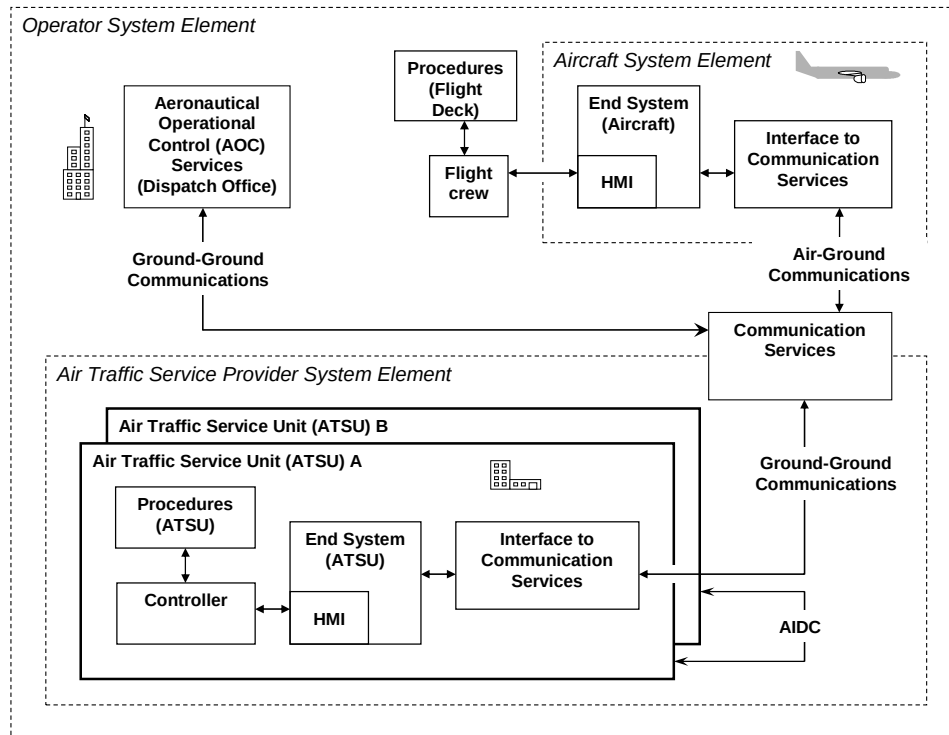


FIGURE 1-1: OVERVIEW OF THE CNS/ATM SYSTEM

1.1

PURPOSE

This document defines and allocates the set of minimum requirements for the operational, safety, and performance aspects for implementations of air traffic data link services in oceanic and remote airspace. Allocation is done by this SPR standard to the necessary elements of the CNS/ATM system.

This SPR standard is intended for use with interoperability requirements (INTEROP) standards, and the guidelines described in ED-78A/DO-264.

NOTE: Based on ED-78A/DO-264, INTEROP and SPR standards provide recommendations intended for government organizations, conference of governments, or agencies having statutory jurisdiction over the use and provision of data link services. These recommendations are for use by such government organizations to enunciate official policy related to such matters in aeronautical information publications (AIPs), notices to airmen (NOTAMs), airplane flight manuals (AFMs), and operator specifications.

1.2

SCOPE

This document provides the operational, safety, and performance requirements for data link services that support specific ATS functions in oceanic and remote airspace. Figure 1-2 provides an overview of the scope of the ATS functions and data link services as it relates to the air traffic services and communication, surveillance, and navigation components.

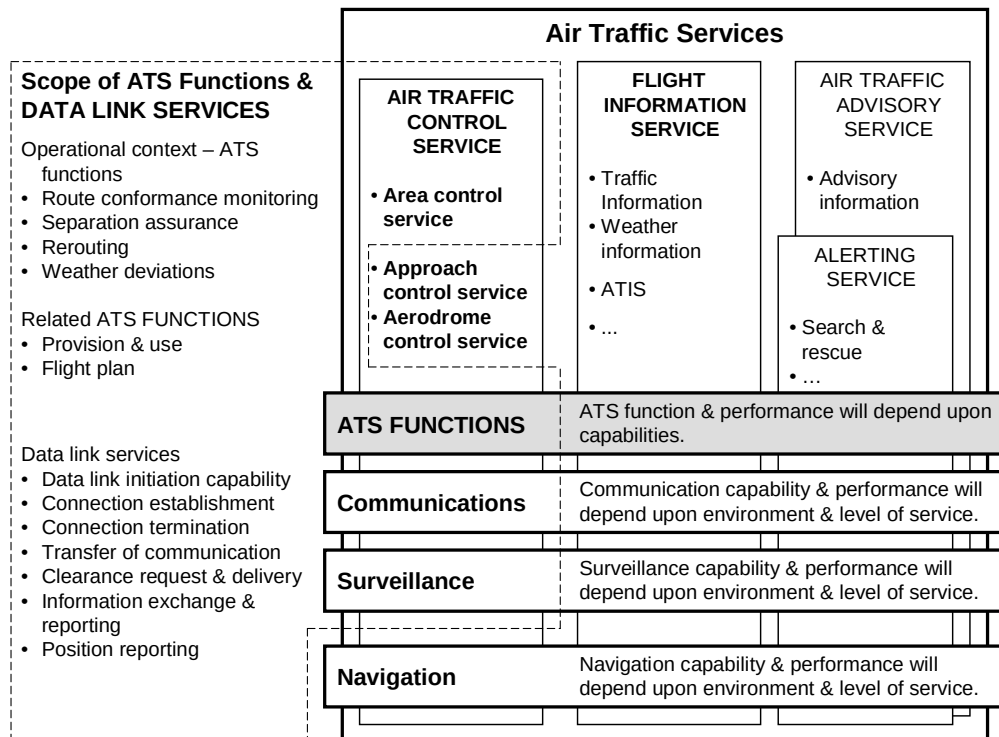


FIGURE 1-2: NOTIONAL RELATIONSHIP OF ATS, ATS FUNCTIONS, COMMUNICATIONS, NAVIGATION AND SURVEILLANCE CAPABILITIES, AND DATA LINK SERVICES

1.2.1 ATS functions supported by data link services

The ATS functions supported by data link services are:

- Route conformance monitoring (RCM);
- Separation assurance (SA);
 - 30 NM lateral, 30 NM longitudinal, and 50 NM longitudinal separation minima (require data link services);
 - Lateral separation equal to or greater than 50 NM and time-based longitudinal separation minima (can use data link services);
- Reroute (RR); and
- Weather deviations (WD).

NOTE 1: The data link services support these ATS functions through communication and surveillance capabilities. For example, the CRD and IER data link services use the CPDLC application to provide a DCPC. The PR data link service uses the ADS-C application to provide automatic position reporting.

NOTE 2: This standard only considers the application of a 30 NM lateral separation minimum in combination with a distance-based longitudinal separation minimum that requires automatic periodic position reporting using ADS-C.

NOTE 3: This standard only considers the application of a 50 NM longitudinal separation minimum that requires the use of data link services. The procedural (non-ADS-C) 50NM longitudinal separation minimum, provided in ICAO Doc 4444, paragraph 5.4.2.6.3.1, and related communication and performance requirements are not considered in this standard.

1.2.2 Data link services

The data link services supporting the ATS functions are:

- a) Data link initiation capability (DLIC);
- b) Connection establishment (CE);
- c) Connection termination (CT);
- d) Transfer of communication (TC);
- e) Clearance request and delivery (CRD);
- f) Information exchange and reporting (IER); and
- g) Position reporting (PR).

NOTE 1: *The scope is limited to the requirements for operational data link services and related ATS functions when operations, safety, and performance are relevant to the air traffic services. Assumptions for the environment and other ATS functions are stated when necessary to establish the operational, safety and performance requirements for the data link services that are within the scope of the document.*

NOTE 2: *This SPR standard is intended to provide the basis for demonstrating that an implemented system, considering its inherent design and technologies, can meet the relevant operational, safety, and performance requirements for the data link services described in this document. It is not intended to limit the use of an implementation only to the data link services and operational context defined herein. However, in cases where it is intended to support additional or define new data link services, the operational, safety and performance requirements for such operational contexts and/or new data link services will need to be established as a basis for approval qualification of the implemented systems.*

NOTE 3: *Requirements related to security are beyond the scope of this document.*

NOTE 4: *Requirements related to the recording of data communications for accident/incident investigation purposes are beyond the scope of this document.*

1.3 RELATIONSHIPS TO OTHER DOCUMENTS

1.3.1 ICAO material

This SPR standard considers the operational aspects of International Civil Aviation Organization (ICAO) material. Terminology used in this standard is consistent with ICAO use.

NOTE: *As this SPR standard is intended to be operationally oriented and not based on any particular technology, when ICAO material refers to a specific technology, this standard only considers the operational intent.*

This SPR standard provides the results of operational assessments on data link services that supplement the communication equipment required by ICAO Annex 6. These data link services support, in part, the provision and use of ATS governed by ICAO Annexes 2, 10 and 11. The extent to which these data link services can support ATS is described in [section 2](#) of this document.

1.3.2 Approval material

This SPR standard is intended to support approval of a CNS/ATM system element. It is used with INTEROP standards and, when appropriate, other SPR standards, as evidence of a coordinated requirements determination process, which is defined in ED-78A/DO-264. These standards provide the basis for qualifying the operational, safety, and performance aspects of an element of the CNS/ATM system. When qualifying, INTEROP standards are shown to be compatible with the SPR standards.

NOTE: Recognition of SPR and INTEROP standards and any unique characteristics or adaptation affecting operations, safety, performance, and interoperability for a specific ATS provision, aircraft type design, or operator's operation can be found in the respective AIPs, NOTAMs, AFMs, and operator's specifications.

1.3.2.1 Provisions for requirements and guidance material supporting approvals

This document uses the word "shall" to indicate a mandated criterion; i.e., compliance is mandatory and no alternative may be applied.

NOTE: In an approval context, the "shalls" are considered a mandated criterion if the:

- Applicant defines this standard, in conjunction with relevant INTEROP standards, and any adaptation (Refer to EUROCAE ED-78A/RTCA DO-264, paragraph 1.3.3), as the approval basis, and
- Approval authority accepts this approval basis, which then defines the criteria for compliance.

1.3.2.2 Additional guidance material supporting approvals

Information on adapting an SPR standard to a specific implementation can be found in paragraph 1.3.3 of ED-78A/DO-264. Guidelines for qualifying a CNS/ATM system element to an SPR standard can be found in section 5 and section 6 of ED-78A/DO-264 and ICAO Doc 9869 (for qualifying to an RCP type).

Table 1-1 provides additional guidance to ED-78A/DO-264, paragraph 4.1.2.1.g) and paragraph 4.1.2.2.g). It includes definition of:

- a) Acceptable risk for Class 3 and Class 4 operational hazards. Quantitative values are provided to support quantitative analysis, when required for approval, and to facilitate operational and engineering judgment during qualitative analyses. It is not envisaged that quantitative analysis would be required to substantiate risk mitigation for Class 4 operational hazards.
- b) Relationships of a software development assurance level to a safety objective. "Development assurance level" determines the level of rigor to be applied throughout system development and qualification. For "development assurance level" of software:
 1. Refer to ED-12B/DO-178B for "failure condition categorization" and its association with aircraft "software level" and guidance for qualifying aircraft software to a "software level."
 2. Refer to ED-109/DO-278 for ATSP "software assurance level" and its association with aircraft "software level" and guidance for qualifying ATSP system software to a "software assurance level."
 3. ED-109/DO-278 is consistent with ED-12B/DO-178B.

NOTE 1: Table 1-1 does not consider Class 1 and Class 2 operational hazards, which have not been identified for any of the data link services defined in this standard.

NOTE 2: If the conditions provided in Table 1-1 are not appropriate for the intended environment, then the associated acceptable risk values are not valid. States may need to adapt acceptable risk values to local conditions based on the acceptable risk value per flight hour provided in the table.

TABLE 1-1: ADDITIONAL GUIDANCE ON ACCEPTABLE RISK AND SOFTWARE CONSIDERATIONS

Hazard Class (See ED-78A/ DO-264, paragraph 4.1.2.1)	Class 3	Class 4
Safety Objective (See ED-78A/ DO-264, paragraph 4.1.2.1)	Remote	Probable
Acceptable Risk (average probability) (See paragraph 1.3.2.a)	$<1 \times 10^{-5}$ per flight hour Given that: 1. An ATSU accumulates an average of 1×10^6 or more flight hours (includes flight hours only of aircraft that are filing to use the data link services) per year (8766 hours of continuous operation) and 2. The identified hazard affects only one aircraft, then the acceptable risk can be defined as: $<1 \times 10^{-3}$ per ATSU hour Given that an average of 10 or less “Class 3” data link service transactions are processed per flight hour, then the acceptable risk can be defined as: $<1 \times 10^{-6}$ per “Class 3” data link service transaction	$<1 \times 10^{-3}$ per flight hour Average probabilities per ATSU hour and per transaction are not defined.
Relationship of a software development assurance level to a safety objective (See paragraph 1.3.2.b)	A failure condition categorization of “major” for the aircraft is associated with a safety objective of “Class 3” hazards occurring no more frequently than “remote.”	A failure condition categorization of “minor” for the aircraft is associated with a safety objective of “Class 4” hazards occurring no more frequently than “probable.”

1.4 DOCUMENT ORGANIZATION

This document is organized as follows:

- [Section 1](#) provides an introduction to this SPR standard.
- [Section 2](#) provides characteristics of oceanic and remote airspace and identifies environmental conditions and requirements related to the provision and use of data link services.
- [Section 3](#) provides a description of the ATS functions that are supported by data link services.

- Section 4 provides a description of the data link services, including operating methods, time sequences of communication transactions, and messages.
- Section 5 includes the results of OSA and OPA, which provide the safety and performance requirements for the data link services.
- Annex A provides operational considerations for data link applications referred by the descriptions of the data link services. These operational considerations are not intended to infer any form of technology.
- Annex B provides a summary of requirements for the data link services described in this document and indicates their applicability and allocation to the operator, aircraft system, and ATSP.
- Appendix A provides a description of the conventions used in this standard. These conventions are used to provide traceability and to enable the user to adapt this standard to meet the specific need for any particular implementation.
- Appendix B provides a list of participants who contributed to the development of this SPR standard.
- Appendix C provides a history and how this document satisfies the terms of reference for WG-53/SC-189.
- Appendix D provides an improvement suggestion form.

1.5

ACRONYMS AND GLOSSARY OF TERMS

The terminology used in this document is consistent with the terminology of ICAO and ED-78A/DO-264. This document also contains additional terms. The following acronyms and terms are used in this document.

ACRONYMS

ACAS	Airborne collision avoidance system
ACARS	Aircraft communications addressing and reporting system
ACK	Acknowledgement
ADS-B	Automatic dependent surveillance – broadcast
ADS-C	Automatic dependent surveillance – contract (data link application)
AFM	Aircraft flight manual
AIDC	ATS Inter-facility data communication
AIP	Aeronautical information publication
AOC	Aeronautical operational control
ATC	Air traffic control
ATIS	Automatic terminal information service
ATM	Air traffic management
ATN	Aeronautical telecommunication network
ATS	Air traffic service
ATSP	Air traffic service provider
ATSU	Air traffic services unit
C-ENV	Environmental condition
CDA	Current data authority
CE	Connection establishment (data link service)

ACRONYMS

CNS/ATM	Communication, navigation, and surveillance/air traffic management
CPDLC	Controller-pilot data link communications (data link application)
CPL	Current flight plan
CRD	Clearance request and delivery (data link service)
CSP	Communication service provider
CT	Connection termination (data link service)
DARPS	Dynamic aircraft route planning system
D-ATIS	Data Link – automatic terminal information service
DCPC	Direct controller/pilot communications
DLIC	Data link initiation capability (data link service)
DM	Downlink Message
EOBT	Estimated off-block time
ET	Communication transaction time
ETA	Estimated time of arrival
ETP	Estimated time of passing
EUROCAE	European Organisation for Civil Aviation Equipment
FANS	Future air navigation system
FIR	Flight information region
FL	Flight level
FMS	Flight management system
FOM	Figure of merit
FPL	Filed flight plan
GNE	Gross navigation error
H-CRD	Hazard for clearance request and delivery
H-IER	Hazard for information exchange and reporting
H-PR	Hazard for position reporting
HMI	Human machine interaction
ICAO	International Civil Aviation Organization
IER	Information exchange and reporting (data link service)
IFR	Instrument flight rules
INS	Inertial navigation system
INTEROP	Interoperability Standard
ISPCG	Information South Pacific Air Traffic Services Coordinating Group
LOCP	Loss of data link capability
LOS	Loss of data link service
NAK	Negative acknowledgement
NCN	Non-compliance notification
NDA	Next data authority
NOTAM	(See <u>NOTAM</u> in glossary of terms).

ACRONYMS

OPA	Operational performance assessment
OR	Operational requirement
OSA	Operational safety assessment
PANS-ATM	Procedures for air navigation services – air traffic management
PR	Position reporting (data link service)
QSPL	Quantitative Safety Performance Level
RCM	Route conformance monitoring (ATS function)
RCP	Required Communication Performance
RNP	Required Navigation Performance
RCTP	Required Communications Technical Performance
RNAV	Area navigation
RNP	Required navigation performance
RPL	Repetitive flight plan
RR	Reroute (ATS function)
RTCA	RTCA, Inc.
RVSM	Reduced vertical separation minimum
SA	Separation assurance (ATS function)
SARPs	Standards and recommended practices
SIR	Safety and interoperability requirements
SO	Safety objective
SPR	Safety and performance standard
SR	Safety requirement
SR&O	System requirements and objectives
SSR	Secondary surveillance radar
TC	Transfer of communications (data link service)
TRN	Monitored Performance (denotes part of operational communication transaction used to define start and end points for monitoring purposes)
UCT	Undetected corruption of the transaction
UIT	Unexpected interruption of the transaction
UM	Uplink message
UTC	Co-ordinated universal time
VMC	Visual meteorological conditions
Voice-ATIS	Voice – automatic terminal information service
WD	Weather deviation (ATS function)
WILCO	Will comply
WPR	Waypoint reporting
Wx	Weather

GLOSSARY OF TERMS	
Term	Definition
Acceptable risk	A quantitative value that represents the acceptable average probability threshold associated with a safety objective and provides the basis for quantitative analyses to determine that the safety objective is met.
Aeronautical operational control (AOC)	Communication required for the exercise of authority over the initiation, continuation, diversion or termination of flight for safety, regularity and efficiency reasons.
Airborne collision avoidance system (ACAS).	An aircraft system based on secondary surveillance radar (SSR) transponder signals which operates independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders.
Aircraft active flight plan	(See <u>flight plan</u>).
Aircraft address	A unique combination of 24 bits available for assignment to an aircraft for the purpose of air-ground communications, navigation and surveillance. (ICAO Doc 4444)
Aircraft identification	A group of letters, figures or a combination thereof which is either identical to, or the coded equivalent of, the aircraft call sign to be used in air-ground communications, and which is used to identify the aircraft in ground-ground ATS communication. (ICAO Doc 4444) <i>Note: Synonymous to flight identification.</i>
Aircraft system	The aircraft system includes all sub-systems between ENTER key of flight crew's HMI and aircraft antenna.
Air traffic advisory service	A service provided within advisory airspace to ensure separation, in so far as practical, between aircraft which are operating on IFR flight plans. (ICAO)
Air traffic control clearance	Authorization for an aircraft to proceed under conditions specified by an air traffic control unit. <i>Note 1: For convenience, the term "air traffic control clearance" is frequently abbreviated to "clearance".</i> <i>Note 2: The abbreviated term "clearance" may be prefixed by the words "taxi", "take-off", "departure", "en-route", "approach" or "landing" to indicate the particular portion of flight to which the air traffic control clearance relates. (ICAO)</i>
Air traffic control instruction	Directives issued by air traffic control for the purpose of requiring a pilot to take a specific action. (ICAO)
Air traffic control service	A service provided for the purpose of: preventing collisions: between aircraft, and on the maneuvering area between aircraft and obstructions; and expediting and maintaining an orderly flow of air traffic (ICAO)

GLOSSARY OF TERMS	
Term	Definition
Air traffic management	The aggregation of the airborne functions and ground-based functions (air traffic services, airspace management and air traffic flow management) required to ensure the safe and efficient movement of aircraft during all phases of operations. (ICAO)
Air traffic service (ATS)	A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service). (ICAO)
Air traffic service unit	A generic term meaning variously, air traffic control unit, flight information centre or air traffic services reporting office. (ICAO)
Alerting service	A service provided to notify appropriate organizations regarding aircraft in need of search and rescue aid, and assist such organizations as required. (ICAO)
Application	The ultimate use of an information system, as distinguished from the system itself. (ICAO) <i>Note: In this document, the term "application" does not imply technology, but is used to express the operational intent of a set of automated algorithms automation or procedures.</i>
ATS function	An application of air traffic services or portions thereof that satisfies an operational need.
ATS interfacility data communication (AIDC).	Automated data exchange between air traffic services units, particularly in regard to co-ordination and transfer of flights. (ICAO)
ATS procedures	Procedures as defined in ICAO Doc 4444.
ATS provider	An appropriate ATS authority in a given airspace.
ATSP system	The total ATS provider system including the technical system and operational procedures.
Automatic terminal information service	The automatic provision of current, routine information to arriving and departing aircraft throughout 24 hours or a specified portion thereof: Data link-automatic terminal information service (D-ATIS). The provision of ATIS via data link. Voice-automatic terminal information service (Voice-ATIS). The provision of ATIS by means of continuous and repetitive voice broadcasts. (ICAO)
Availability	The probability that an operational communication transaction can be initiated when needed. (ICAO Doc 9869)
Clearance	(See <u>air traffic control clearance</u>).

GLOSSARY OF TERMS	
Term	Definition
Communication and controller intervention buffer	A buffer time that is used to model the collision risk related to distance-based longitudinal separation. It allows for the possibility that, when the next distance check is obtained, it may become apparent to the controller that separation will be lost, requiring the controller to establish some alternative form of separation. (Derived from ICAO Doc 9689)
Communication services	The delivery of data messages and/or voice between end systems.
Communication transaction time (ET)	The maximum time for the completion of the operational communication transaction after which the initiator reverts to an alternative procedure. (ICAO Doc 9869)
Continuity	The probability that an operational communication transaction can be completed within the communication transaction time. (ICAO Doc 9869)
Current data authority (CDA)	The designated ground system through which a CPDLC dialogue between a pilot and a controller currently responsible for the flight is permitted to take place. (ICAO Doc 4444)
Current flight plan (CPL)	(See flight plan).
Data link application	A data link application is the implementation of data link technology to achieve specific air traffic management (ATM) operational functionalities. For example, in this context the current functionalities are DLIC, ADS-C, and CPDLC.
Data link service	A set of ATM-related transactions, both system supported and manual, within a data link application, which have a clearly defined operational goal. Each data link service is a description of its recommended use from an operational point of view.
Development assurance	Planned and systematic actions performed to minimize generic errors during development and implementation, and provide confidence that the system is suitable for its intended use. (ED-78A/DO-264)
Direct controller pilot communication	A form of ATC communication between the flight crew and controller in which no other human is involved in completing the operational communication process. <i>Note 1: For example, use of direct speech circuits, direct voice controller pilot communication, and CPDLC application are considered to be characteristic of direct controller pilot communications.</i> <i>Note 2: Definition derived from ICAO Doc 4444 and Annex 11 material.</i>
End System	A system that contains the human-machine interface, application processing, and is distinct from system components interfacing the communication services. <i>Note: This definition is modified from ED-78A/DO-264 to remove technological dependencies.</i>

GLOSSARY OF TERMS	
Term	Definition
Estimated off-block time (EOBT)	The estimated time at which the aircraft will commence movement associated with departure. (ICAO)
EUROCAE	Eurocae is an international, non-profit making organization. Membership is open to users and manufacturers in Europe of equipment for aeronautics, trade associations, national civil aviation administrations and, under certain conditions, non-European members. Its work programme is principally directed to the preparation of performance specifications and guidance documents for civil aviation equipment, for adoption and use at European and world wide levels
Filed flight plan (FPL)	(See flight plan).
Flight identification	(See aircraft identification).
Flight information service	A service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights. (ICAO)
Flight plan	Specified information provided to air traffic services units, relative to an intended flight or portion of a flight of an aircraft. (ICAO) A flight plan can take several forms, such as: Current flight plan (CPL). The flight plan, including changes, if any, brought about by subsequent clearances. <i>Note 1: When the word "message" is used as a suffix to this term, it denotes the content and format of the current flight plan data sent from one unit to another.</i> Filed flight plan (FPL). The flight plan as filed with an ATS unit by the pilot or a designated representative, without any subsequent changes. <i>Note 2: When the word "message" is used as a suffix to this term, it denotes the content and format of the filed flight plan data as transmitted.</i> Repetitive flight plan (RPL). A flight plan related to a series of frequently recurring, regularly operated individual flights with identical basic features, submitted by an operator for retention and repetitive use by ATS units. Aircraft active flight plan. The flight plan used by the flight crew. The sequence of legs and associated constraints that define the expected 3D or 4D trajectory of the aircraft from takeoff to landing.
Ground-ground communications	Two-way communication among stations or locations on the surface of the earth.
Instruction	(See air traffic control instruction).
Integrity	The probability of one or more undetected errors in a completed communication transaction. (Modified for clarity from ICAO Doc 9869)

GLOSSARY OF TERMS	
Term	Definition
Monitored performance (TRN)	The portion of the operational communication transaction that does not include message composition or recognition of the operational response. <i>Note: TRN is not defined by ED78A/DO264 and has been introduced in this standard to provide practical start and end points for operational monitoring</i>
Next data authority (NDA)	The ground system so designated by the current data authority through which an onward transfer of communications and control can take place. (ICAO Doc 4444) <i>Note: The term is used when CPDLC is used to transfer the communications.</i>
NOTAM	A notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations. (ICAO Doc 4444)
Operational communication transaction	The process a human uses to initiate the transmission of an instruction, clearance, flight information, and/or request, and is completed when that human is confident that the transaction is complete. (ICAO Doc 9869)
Operator	A person, organization or enterprise engaged in or offering to engage in an aircraft operation.
Primary ATC communications	ATC communication capability that is required for operational approval. <i>Note: The term "primary" is used in this standard with different forms of communication, e.g., primary direct controller pilot communication, to indicate that the form is required for operational approval.</i>
Quantitative safety performance level (QSPL)	A quantitative value based on the OSA results. QSPLs are used to establish values for the RCP parameters.
Repetitive flight plan (RPL)	(See flight plan).
Required communication performance (RCP)	A statement of the performance requirements for operational communication in support of specific ATS functions. (ICAO Annex 11)
RCP type	A label (e.g., RCP 240) that represents the values assigned to RCP parameters for communication transaction time, continuity, availability, and integrity. (ICAO Annex 11)
RCP type allocations	RCP type allocation is the process of apportioning the various RCP type values to the various parts of the system. (ICAO Doc 9869)

GLOSSARY OF TERMS	
Term	Definition
Required communication technical performance (RCTP)	RCTP is determined for a specific RCP, where the human performance probabilities have been assessed in order to establish the RCTP, i.e., performance requirements bearing on the underlying infrastructure. (DO-264) RCTP is a statement of the performance requirements for operational communication limited to the technical communication portions of the communication process. (ICAO) RCTP=TRN-Responder RCTP is the sum of aircraft system, ATSP system, the operator's CSP and internetworking as appropriate. The first portion of RCTP starts when the message is released by the controller, the flight crew, or by an automated system on behalf of the controller or flight crew, for onward transmission. It ends when the responder receives an indication of the message. The second portion of RCTP starts when the operational reply is released by the responder or by an automated system on behalf of the pilot or controller, for onward transmission. It ends when the initiator receives an indication of the operational response.
Route clearance	An air traffic control clearance that contains instructions to proceed via a specified route.
Supplemental ATC communication	ATC communication capability that is not required for the intended operation, but if available can be used as an alternative to the primary means in accordance with operational approval. <i>Note: The term "supplemental" is used in this standard with different forms of communication, e.g., supplemental data communications, to indicate that the form is not required for operational approval.</i>

1.6

REFERENCES

The references cited in this document are listed below:

- a) EUROCAE ED-78A/ RTCA DO-264, Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by Data Communications.
- b) EUROCAE ED-100A/RTCA DO-258A, Interoperability Requirements for ATS Applications Using ARINC 622 Data Communications (FANS 1/A INTEROP Standard).
- c) EUROCAE ED-109/RTCA DO-278, Guidelines for Communication, Navigation, Surveillance, and Air Traffic Management (CNS/ATM) Systems Software Integrity Assurance.
- d) EUROCAE ED-12B/RTCA DO-178B, Software Considerations for Airborne Systems and Equipment Certification.
- e) ICAO Annex 2 — Rules of the Air.

- f) ICAO Annex 6 — Operation of Aircraft, Part I – International Commercial Air Transport – Aeroplanes.
- g) ICAO Annex 10 — Aeronautical Telecommunications – Volume II (Communications Procedures including those with PANS status).
- h) ICAO Annex 10 — Aeronautical Telecommunications – Volume III (Communication Systems).
- i) ICAO Annex 11 — Air Traffic Services.
- j) ICAO Annex 15 — Aeronautical Information Services.
- k) ICAO Doc. 4444 — Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM).
- l) ICAO Doc 7030 — Regional Supplementary Procedures.
- m) ICAO Doc 8400 — Procedures for Air Navigation Services – ICAO Abbreviations and Codes (PANS-ABC).
- n) ICAO Doc. 9689 — Manual on Airspace Planning Methodology for the Determination of Separation Minima.
- o) ICAO Doc 9869 — Manual on Required Communication Performance (RCP).

CHAPTER 2

ENVIRONMENTAL CONSIDERATIONS

This section defines the environmental considerations for oceanic and remote airspace applicable to the provision and use of data link services supporting the ATS functions described in this document. These considerations include environmental characteristics, operational requirements, and conditions to the extent necessary to:

- establish operational requirements for the data link services;
- establish mitigation strategies and related conditions for hazards identified for the data link services; and
- establish capability and performance requirements for the data link services.

2.1 ENVIRONMENTAL CHARACTERISTICS

An ATS function can only be provided in an airspace if a set of capabilities and performances defining the complete CNS/ATM system is present in the airspace where it is intended to be used.

This set of capabilities and performances comprises different components: communication, navigation, surveillance, and ATM that are dependent on each other. For instance, the communication and surveillance capability and performance requirements for a given ATS function will depend on the navigation and air traffic management capability and performance requirements.

Since the navigation, surveillance, air traffic management and some communication capabilities are dictated by other standards, the characteristics are provided as environmental conditions. These conditions are based on a review of ICAO material referenced in [paragraph 1.6](#).

[Table 2-1](#) presents an overview of the environmental characteristics for oceanic and remote airspace that are considered in this SPR standard.

TABLE 2-1: OCEANIC AND REMOTE OPERATIONAL ENVIRONMENT CHARACTERISTICS

Environmental characteristic	Environments using data link services	Environments requiring data link services		
Airspace characteristics				
Horizontal separation <i>Note: RVSM assumed for vertical separation.</i>	Lateral separation equal to or greater than 50 NM and time-based longitudinal separation	50 nm longitudinal separation	30 nm lateral	30 nm longitudinal separation
Operational assumptions for navigation and ATSU interface				
Navigation	INS (2 nm/hr drift)	RNP 10 or RNP 4	RNP 4	
ATSU interface	Voice – HF (or equivalent approved long range voice communication capability) Data, – FANS 1/A (ED100A/DO258A, Transport & above) – ATN (Annex 10, Vol. II and III, Transport & above) – Interface specification for an equivalent approved long range data communication capability.	Voice – HF (or equivalent approved long range voice communication capability) Data, – FANS 1/A (ED100A/DO258A, Transport & above) – ATN (Annex 10, Vol. II and III, Transport & above) – Interface specification for an equivalent approved long range data communication capability.		
<i>Note 1: See interoperability standards for technical provisions that define the ATSU interface.</i>				
<i>Note 2: Refer to ICAO Annexes and ICAO Doc 4444 for requirements applicable to voice communication.</i>				
<i>Note 3: See paragraph 2.2 for operational requirements related to communications and surveillance.</i>				
<i>Note 4: See section 3 for descriptions of the ATS functions in the environments described</i>				
<i>Note 5: See section 4 for the data link services providing communication and surveillance capability supporting the ATS functions.</i>				
<i>Note 6: See section 5 for safety and performance requirements applicable to data link services when used or required in the environments described.</i>				

2.2 OPERATIONAL REQUIREMENTS RELATED TO COMMUNICATIONS AND SURVEILLANCE

Table 2-2 provides the operational requirements that relate to the communication and surveillance capabilities supporting the ATS functions described in [section 3](#). The table also shows for each operational requirement, the data link services described in [section 4](#), and the data link applications, described in [Annex A](#) that are applicable in the context of the relevant ATS functions. The operational requirements are used as the basis for determining the safety and performance requirements ([section 5](#)) for the data link services.

NOTE 1: *The operational capability and performance requirements were taken from ICAO Annex 2 and ICAO Doc 4444. Guidance material from ICAO Annex 11, Attachment B, and ICAO Doc 7030, Supplemental procedures for the Asia-Pacific Region were used to establish the requirement for a lateral deviation event report when applying a 30 NM lateral separation minimum. Other guidance material related to separation minima can be found at ICAO Doc 9613, ICAO Doc 9869, and ICAO Doc 9689.*

NOTE 2: *“RNP [x]” is sometimes referred to as “RNAV [x]” for implementations that do not provide monitoring and alerting in non-compliant situations. In this document, the term “RNP [x]” is used consistently with the navigation requirements provided in the ICAO Doc 4444 at the time this SPR was published.*

TABLE 2-2: OPERATIONAL REQUIREMENTS FOR COMMUNICATIONS AND SURVEILLANCE

Ref:	Airspace Requirement	Relationship to data link service/application
OR-1	ANNEX 2, paragraph 3.6.5.1. An aircraft operated as a controlled flight shall maintain continuous air-ground voice communication watch on the appropriate communication channel of, and establish two-way communication as necessary with, the appropriate air traffic control unit, except as may be prescribed by the appropriate ATS authority in respect of aircraft forming part of aerodrome traffic at a controlled aerodrome. <i>Note: The requirement for an aircraft to maintain air-ground voice communication watch remains in effect after CPDLC has been established.</i>	Normal means of communication for lateral separation greater than or equal to 50 NM and time-based longitudinal separation CRD, IER CPDLC application

**TABLE 2-2: OPERATIONAL REQUIREMENTS FOR COMMUNICATIONS AND SURVEILLANCE
(CONTINUED)**

Ref:	Airspace Requirement	Relationship to data link service/application
OR-2	ICAO Doc 4444, <u>paragraph 4.11.1.1</u>. On routes defined by designated significant points, position reports shall be made by the aircraft when over, or as soon as possible after passing, each designated compulsory reporting point, except as provided in 4.11.1.3. Additional reports over other points may be requested by the appropriate ATS unit. ICAO Doc 4444, <u>paragraph 4.11.1.2</u>. On routes not defined by designated significant points, position reports shall be made by the aircraft as soon as possible after the first half hour of flight and at hourly intervals thereafter, except as provided in 4.11.1.3. Additional reports at shorter intervals of time may be requested by the appropriate ATS unit. ICAO Doc 4444, <u>paragraph 5.4.2.1.6</u>. Time-based separation applied in accordance with 5.4.2.2 and 5.4.2.4 may be based on position information and estimates derived from voice reports, CPDLC or ADS-C.	Normal means of surveillance for lateral separation greater than or equal to 50 NM or time-based longitudinal separation PR, IER ADS-C application CPDLC application
OR-3	ICAO Doc 4444, <u>paragraph 5.2.2</u>. Degraded aircraft performance. Whenever, as a result of failure or degradation of navigation, communications, altimetry, flight control or other systems, aircraft performance is degraded below the level required for the airspace in which it is operating, the flight crew shall advise the ATC unit concerned without delay. Where the failure or degradation affects the separation minimum currently being employed, the controller shall take action to establish another appropriate type of separation or separation minimum.	Monitoring, indication, and reporting requirements for failures of communication systems CRD, IER, PR ADS-C application CPDLC application
OR-4	Annex 11, Attachment B, <u>paragraph 3.4.1.e</u>). For a 30 NM lateral separation, direct controller-pilot voice communications or controller-pilot data link communications (CPDLC) shall be maintained.	Normal means of communication for 30 NM lateral separation minima – DCPC capability CRD, IER CPDLC application

**TABLE 2-2: OPERATIONAL REQUIREMENTS FOR COMMUNICATIONS AND SURVEILLANCE
(CONTINUED)**

Ref:	Airspace Requirement	Relationship to data link service/application												
OR-5	Annex 11, Attachment B, <u>paragraph 3.4.1.e</u>). For a 30 NM lateral separation, an ADS-C system in which an event contract must be set that includes a lateral deviation event report whenever a deviation from track centre line greater than 9.3 km (5 NM) occurs. <i>Note: The safety assessment in this standard considers the potential loss of the lateral deviation event report as an insignificant contributor to any hazard. Further safety assessment and appropriate risk mitigation strategies would need to be put in place for implementations that rely on the lateral deviation event report for separation assurance.</i>	Normal means of surveillance for 30 NM lateral separation minimum IER ADS-C application – 5 NM lateral deviation event report functionality												
OR-6	ICAO Doc 4444, <u>paragraph 5.4.2.6.2.2</u> . Direct controller-pilot communications shall be maintained while applying a distance-based separation minima. Direct controller-pilot communications shall be voice or CPDLC. The communication criteria necessary for CPDLC to satisfy the requirement for direct controller-pilot communications shall be established by an appropriate safety assessment.	Normal means of communication for 50 NM and 30 NM longitudinal separation minima – DCPC capability CRD, IER CPDLC application												
OR-7	ICAO Doc 4444, 5.4.2.6.4.3. For aircraft cruising, climbing or descending on the same track, the following separation minima may be used: <table> <tr> <th>Separation minima</th><th>RNP type</th><th>Maximum ADS-C periodic reporting interval</th></tr> <tr> <td>93 km (50 NM)</td><td>10</td><td>27 minutes</td></tr> <tr> <td></td><td>4</td><td>32 minutes</td></tr> <tr> <td>55.5 km (30 NM)</td><td>4</td><td>14 minutes</td></tr> </table>	Separation minima	RNP type	Maximum ADS-C periodic reporting interval	93 km (50 NM)	10	27 minutes		4	32 minutes	55.5 km (30 NM)	4	14 minutes	Normal means of surveillance for 50 NM and 30 NM longitudinal separation PR ADS-C application
Separation minima	RNP type	Maximum ADS-C periodic reporting interval												
93 km (50 NM)	10	27 minutes												
	4	32 minutes												
55.5 km (30 NM)	4	14 minutes												
OR-8	ICAO Doc 4444, <u>paragraph 5.4.2.6.4.1</u> (partial). Separation based on the use of ADS-C shall be applied so that the distance between the calculated positions of the aircraft is never less than the prescribed minimum.	Normal means of surveillance for 50 NM and 30 NM longitudinal separation PR ADS-C application												

**TABLE 2-2: OPERATIONAL REQUIREMENTS FOR COMMUNICATIONS AND SURVEILLANCE
(CONTINUED)**

Ref:	Airspace Requirement	Relationship to data link service/application
OR-9	ICAO Doc 4444, 5.4.2.6.2.2.1. Prior to and during the application of a distance-based separation minimum, the controller should determine the adequacy of the available communication link, considering the time element required to receive replies from two or more aircraft, and the overall workload/traffic volume associated with the application of such minima. <i>Note: Whether or not the controller is involved in determining the adequacy is a local matter.</i>	Normal means of communication for 50 NM and 30 NM longitudinal separation CRD, IER CPDLC availability and continuity. Normal means of surveillance PR, IER ADS-C availability and continuity.
OR-10	ICAO Doc 4444, paragraph 5.4.2.6.4.3.2. The communication system provided to enable the application of the separation minima in 5.4.2.6.4.3 shall allow a controller, within 4 minutes, to intervene and resolve a potential conflict by contacting an aircraft using the normal means of communication. An alternative means shall be available to allow the controller to intervene and resolve the conflict within a total time of 10½ minutes, should the normal means of communication fail.	Normal mean of communication (intervention) for 50 NM and 30 NM longitudinal separation – DCPC capability CRD CPDLC transaction time value is a function of 4 min. <i>Note 1: Alternative means of communication is assumed to be third party voice – transaction times are assumed to be a function of 10½ min.</i> <i>Note 2: Values are at 95% probability.</i>

**TABLE 2-2: OPERATIONAL REQUIREMENTS FOR COMMUNICATIONS AND SURVEILLANCE
(CONTINUED)**

Ref:	Airspace Requirement	Relationship to data link service/application
OR-11	ICAO Doc 4444, paragraph 5.4.2.6.4.3.3. When an ADS-C periodic or waypoint change event report is not received within 3 minutes of the time it should have been sent, the report is considered overdue and the controller shall take action to obtain the report as quickly as possible, normally by ADS-C or CPDLC. If a report is not received within 6 minutes of the time the original report should have been sent, and there is a possibility of loss of separation with other aircraft, the controller shall take action to resolve any potential conflict(s) as soon as possible. The communication means provided shall be such that the conflict is resolved within a further 7½ minutes.	Normal means of surveillance for 50 NM and 30 NM longitudinal separation – report delivery time is a function of 3 min. PR ADS-C periodic report, and ADS-C waypoint change event report 1st attempt transaction time is function of 6 minutes, using either IER ADS-C demand contract/report; or CPDLC request/response. <i>Note 1: Alternative means of communication (2nd attempt) is assumed to be third party voice – transaction times are assumed to be a function of 7½ min.</i> <i>Note 2: Values are at 95% probability.</i>
OR-12	Annex 2, paragraph 3.5.3. Wherever time is utilized in the application of data link communications, it shall be accurate to within 1 second of UTC.	For all aircraft systems providing communication and surveillance capabilities using data link services to support the ATS functions described in this document. All data link services All data link applications
OR-13	Annex 11, paragraph 2.24.3. Air traffic services unit clocks and other time recording devices shall be checked as necessary to ensure correct time to within plus or minus 30 seconds of UTC. Wherever data link communications are utilized by an air traffic services unit, clocks and other time-recording devices shall be checked as necessary to ensure correct time to within 1 second of UTC.	For all ground systems providing communication and surveillance capabilities using data link services to support the ATS functions described in this document. All data link services All data link applications

2.3

ENVIRONMENTAL CONDITIONS

Table 2-3 provides specific environmental conditions relevant to the operational safety (OSA) and performance assessment (OPA) results. The actual environment in which data link services are used or required needs to be validated against these conditions.

NOTE: *Failure to meet any of these environmental conditions may not prohibit use of the data link services, but may place constraints on the ATS functions supported by the data link services.*

TABLE 2-3: ENVIRONMENTAL CONDITIONS RELEVANT TO THE OSA AND OPA RESULTS

Reference	Environmental Condition
C-ENV-1	In airspace where ATC data link services are used, an alternative communication mean as required by the operating rule, is available (e.g. third party voice).
C-ENV-2	Surveillance enables the controller to detect aircraft deviation from the route clearance.
C-ENV-3	Upon the issuance of a new clearance, the airspace pertaining to both the existing clearance and new clearance is protected until the controller receives the pilot's response indicating acceptance or rejection.
C-ENV-4	Separation minima are applied in accordance with the ICAO Doc 4444 and ICAO Doc 7030, Part 1 of the Regional Supplementary Procedures.
C-ENV-5	Airborne weather radar minimum range is 40 NM. <i>Note: This condition is to assess the safety and performance requirement associated with the use of the data link for the weather deviation procedure.</i>
C-ENV-6	Reduced separation standard as defined in ICAO 4444 provides sufficient time in the intervention buffer to revert to DCPC or voice communication when a current or future loss of separation is detected in case of data link communication failure.
C-ENV-7	Aircraft are flying the current flight plan according to the navigation performance required for the separation minima.
C-ENV-8	Weather deviation procedure is applied in accordance with ICAO Doc 4444, <u>paragraph 15.2.3</u> . <i>Note: This procedure also details the procedures to be followed when ATC clearance cannot be obtained, and deviation under the authority of the pilot-in-command is necessary in accordance with the provisions of ICAO Annex 2, <u>paragraph 2.3.1</u>.</i>

CHAPTER 3

DESCRIPTION OF ATS FUNCTIONS

This section provides a description of the ATS functions that are supported by the data link services defined in this standard. The ATS functions are:

- a) Route conformance monitoring (RCM);
- b) Separation assurance (SA) for 50 NM longitudinal, 30 NM lateral, 30 NM longitudinal separation--where data link services are required, and for lateral separation greater than or equal to 50 NM and time-based longitudinal separation--where data link services can be used;
- c) Reroute (RR); and
- d) Weather deviations (WD).

It also provides a description of provision and use and flight planning, which are related ATS functions, but data link services supporting these ATS functions are not considered in this document.

3.1 OPERATIONAL CAPABILITIES PROVIDED BY DATA LINK SERVICES

Data link services are intended to provide for the following communication and surveillance capability and performance that support the ATS functions:

- a) Supplemental communications, i.e., not required by operating rules. Supplemental means are characterized as follows:
 - 1. Used in situations where the delay or loss in operational data communications is not significant to the safety of operations. Delay or loss in operational data communications may be significant to operational usefulness of the system.
 - 2. Procedures are established to revert to ATC voice communications, as required by operating rules, and within acceptable time limits when data link service can no longer be provided.
 - 3. Required ATC communication, e.g., HF voice, has the functionality and performance to satisfy the operational capability provided by the data link services in the event of loss of those data link services.
 - 4. Provides sufficient integrity of operational communications to avoid the need for procedural mitigation of anomalous behavior of the system (e.g., voice read-back of the data message).
- b) Direct controller-pilot communications (DCPC) characterized as follows:
 - 1. Qualified to the operational, safety, and performance requirements required for supporting the ATS function.
 - 2. Procedures are established to revert to degraded operation within acceptable time limits when primary communications are lost and others means of communication are not adequate to perform the intended ATS functions, e.g., procedures to apply an alternative form of separation.
 - 3. Approved for Use.

c) Enhanced surveillance, characterized as follows:

1. Automatic position reporting used to provide surveillance capability as the normal means.
2. Third party voice position report as an alternative means.

Data link services will provide aircraft information to the controller for communication and surveillance capability and performance.

3.1.1 Relationship of ATS functions, data link services, and data link applications to ATS procedures

Table 3-1 shows the relationship among data link services, air traffic services, and related international ATS procedures as defined in ICAO Doc 4444. The table signifies those international ATS procedures for which the data link services described in this document were intended. States that adapt this standard to apply to international ATS procedures not indicated in the table will need to assess the applicability of the data link services to those procedures.

TABLE 3-1: RELATIONSHIP OF ATS FUNCTIONS, DATA LINK SERVICES AND DATA LINK APPLICATIONS TO ICAO DOC 4444 PROCEDURES

ATS Functions, data link service, or data link application	Related ICAO Annex 11 air traffic services	Related ICAO Doc 4444 procedures
ATS Functions		
RCM	ATC area control service	13, Automatic dependent surveillance services
SA	ATC area control service	5, Separation methods and minima
RR	ATC area control service	11.4.2.2.4 Modification (chg) messages
WD	ATC area control service	11.4.2.2.4 Modification (chg) messages

TABLE 3-1: RELATIONSHIP OF ATS FUNCTIONS, DATA LINK SERVICES AND DATA LINK APPLICATIONS TO ICAO DOC 4444 PROCEDURES (CONTINUED)

ATS Functions, data link service, or data link application	Related ICAO Annex 11 air traffic services	Related ICAO Doc 4444 procedures
Data link services		
DLIC	General	4.15, Data link initiation procedures
CE	ATC area control service	4.15, Data link initiation procedures
CT	ATC area control service	10.4, Coordination in respect of the provision of air traffic control service [Includes transfer of communication]
TC	ATC area control service	8.7.5, 10.4.2.4, Transfer of communication
CRD	ATC area control service	4.5, Air traffic control clearances 4.6, Horizontal speed control instructions 4.7, Vertical speed control instructions 4.13, Presentation and updating of flight plan and control data 11, Air traffic service messages
IER	ATC area control service	4.12, Reporting of operational and meteorological information 8.8, Emergencies, hazards and equipment failures 11, Air traffic service messages 15, Procedures related to emergencies, communication failure and contingencies
PR	ATC area control service	4.11, Position reporting
DLIC	ATC area control service	4.15, Data link initiation procedures
CPDLC	ATC area control service	14, Controller pilot data link communications
ADS-C	ATC area control service	13, Automatic dependent surveillance services
Supporting AOC applications (See Note).	AOC	Not applicable
<i>Note: The supporting AOC applications are used in conjunction with the CPDLC application in the reroute procedure to negotiate route information with the AOC dispatch office and to provide meteorological information to the aircraft. The flight management system (FMS) waypoint position reporting (WPR) can also be used in the separation assurance and route conformance monitoring procedures to provide position information as an alternative to the ADS-C application where permitted.</i>		

3.1.2 Data link services supporting ATS functions

Table 3-2 provides the data link services that support each of the ATS functions.

TABLE 3-2: DATA LINK SERVICES SUPPORTING ATS FUNCTIONS

	RCM	SA	RR	WD
DLIC	X	X	X	X
CE	X	X	X	X
CT	X	X	X	X
TC		X		
CRD		X	X	X
IER	X	X		X
PR	X	X		X

Figure 3-1 shows the dependencies among the related ATS functions and data link services. Prior to operational use of data link services in a particular airspace:

- a) Operators, the State, and its ATS provider satisfy the prerequisites for the provision and use of ATS functions. Operators file flight plans indicating intent to use the data link services and ATS providers accept flight plans, per paragraph 3.1.4;
- b) For data link services enabled via the CPDLC application and/or the ADS-C application, the flight crew and ATSU complete DLIC per paragraph 4.1; and

NOTE: *Position reporting can be enabled via supporting AOC applications, which are not dependent on DLIC. However, other means are used to uniquely identify the aircraft and the ATSU and to determine that the aircraft equipage is compatible with the data link service provision.*

- c) The ATSU and flight crew take appropriate actions to provide and use the ATS functions. Environmental conditions, per section 2, are valid. The data link services that provide communication and surveillance supporting the ATS function, as per Table 3-2, are described in section 4. The safety and performance requirements for each of those data link services are established based on its operational context with the ATS function as follows:
 - 1) RCM per paragraph 3.2;
 - 2) SA per paragraph 3.3;
 - 3) RR per paragraph 3.4; and
 - 4) WD per paragraph 3.5.

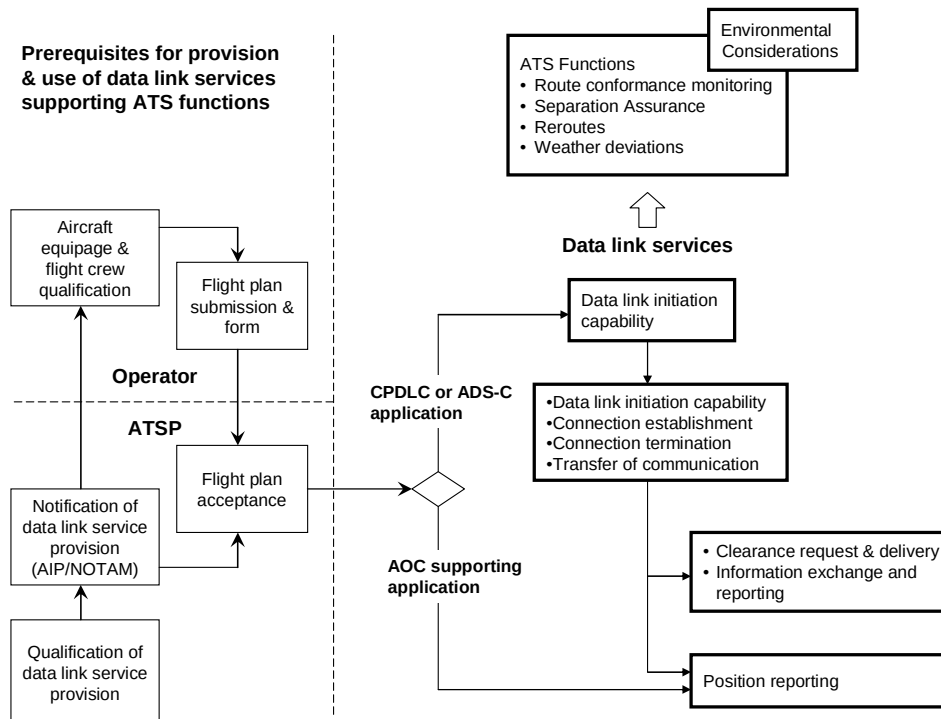


FIGURE 3-1: DEPENDENCY DIAGRAM OF DATA LINK SERVICES

3.1.3

Provision and use

- The ATS provider qualifies and obtains approval of the data link service for operational use.
- The ATS provider notifies operators of data link services using the AIP or NOTAM. Notification indicates:
 - ATS facility designation, e.g., 4 character ICAO code;
 - Technology dependent parameters, as applicable, e.g., DLIC address;
 - Applications, including for each application; application name, version interoperability coverage, scheduled service, shutdowns, and information/alert bulletins;
 - Differences between national regulations and practices, and related ICAO SARPs and procedures;
 - Requirements for use, including procedures for initiation and RCP type(s); where applicable, and
 - Flight plan form and submission requirements.

NOTE: *Data link services are provided in an environment that is consistent with the standards set forth in ICAO material as described in paragraph 1.3.1 of this document. Environments that deviate from this ICAO material will need to be assessed by the State against the criteria set forth in this standard to determine the suitability of the data link services in such environments.*

- The operator obtains information for flight planning and use of data link services from AIPs/NOTAMs and flight manuals to formulate approved operating specifications. The operator determines:
 - aircraft are properly equipped and approved for intended use of the data link services; and
 - flight crews are qualified to use the data link services.

3.1.4

Flight plan

Prior to the initiation of data link services with any aircraft, a flight plan is processed.

- a) Operator prepares and submits flight plan per ICAO format. The flight plan provides relevant data for data link services:

1. Aircraft identification (Flight Id or Callsign), Field 7; and
2. Aircraft data link equipment and capabilities, Field 10 & 18.

NOTE 1: *Use of Aircraft registration (Tail Number), Field 18; Departure aerodrome, Field 13; Estimated off-block time (EOBT), Field 13; and Destination aerodrome, Field 16, may also be relevant depending on technologies used for providing the data link services.*

- b) ATSU is responsible for the origination of the flight and ATSUs along filed route receive, process, and accept the flight plan. ATSUs use information from the filed (accepted) flight plan to:

1. associate flight data obtained from flight crew/aircraft with the current flight plan information; and
2. determine whether or not to provide the data link service based on the requirements for use per the AIP/NOTAM and the current flight plan.

- c) Flight crew operator executes the aircraft active flight plan when a clearance is received from the ATSU in control.

NOTE 2: *The aircraft active flight plan data may be different than the current flight plan data (e.g. due to different data format in the aircraft and on the ground). As a result, while it is intended that the data be consistent, anomalies may occur which can result in inadvertent inconsistencies. The severity of the operational effect of the inconsistencies and appropriate mitigation is provided in the OSA results, as appropriate.*

NOTE 3: *ATSUs along the filed route receive the current flight plan via ATS interfacility data communication (AIDC) or other means as established by States and regional agreements.*

3.2

ROUTE CONFORMANCE MONITORING (RCM)

RCM monitors the aircraft's active flight plan and actual route information to ensure that the aircraft conforms to the current flight plan. The next and next +1 position information is monitored for lateral conformance to the cleared profile and the time estimate for the next position is monitored for longitudinal conformance. The position information includes a figure of merit (FOM) indicating position accuracy, which is monitored against the navigation performance requirement for the separation being applied. RCM confirms that the aircraft active flight plan conforms to the ATSU current flight plan. When RCM detects a discrepancy, the controller is informed for corrective action.

3.2.1

Data link services supporting RCM

RCM uses PR to obtain ADS-C periodic and waypoint change event reports and/or CPDLC/FMS WPR position reports to compare the actual flight information received in the reports with the current flight plan for the aircraft. In addition, RCM uses IER to obtain an event report other than the waypoint change event report or to obtain a position report when a periodic or waypoint change event report is overdue.

When using data link services for RCM, it is assumed that both DLIC and data communication connections have occurred.

3.2.2 Procedure for RCM

When carrying out RCM the ATSU initiates the appropriate data link services per Table 3-2.

- a) The ATSU/controller and aircraft/flight crew establish the means to provide position reports using the PR and IER services.
 1. For lateral separation minima greater than or equal to 50 NM and time-based longitudinal separation minima, PR can use ADS-C, CPDLC, and/or FMS WPR, to provide periodic and/or waypoint change event reports per OR-2 and regional air navigation agreement.
 2. For distance-based longitudinal separation minima, PR requires the ADS-C application to provide the basic and predicted ADS-C position reports at a specified reporting interval per OR-7. The position reports include as a minimum, aircraft identifier, latitude, longitude, figure of merit (FOM), flight level, and time for the current position, and the position and predicted time of the next waypoint, and the position of the next + 1 way point.
 3. For 30 NM lateral separation minimum, IER uses the ADS-C application, which is required to establish a lateral deviation event contract per OR-5.

NOTE1: *RCM will only detect situations where the aircraft is deviating from its active flight plan such as by deliberate pilot intervention or an inadvertent autopilot mode change. RCM cannot detect errors in the active flight plan that make it different from the current flight plan and cause gross navigation errors i.e. waypoint position insertion errors and transposed waypoints sequences.*

- b) The ATSU compares the information received from the aircraft with the current flight plan and verifies that the aircraft is in conformance with its clearance and ATSU profile data used for separation. Any variance between the received flight data and the current flight plan is notified to the controller.

NOTE 2: *The actual data that is compared and the tolerances used to provide notification to the controller of a potential conflict situation can vary from one ATSU to another depending on local safety assessment.*

NOTE 3: *See paragraph 3.3.2 for actions taken by the controller when notified of a variance between the received flight data and the current flight plan.*

In the case of overdue position report, either periodic or waypoint change event, the ATSU may use IER to request a position report with an ADS-C demand contract or a CPDLC request.

3.3 SEPARATION ASSURANCE (SA)

SA requires that specified navigation, communication, and surveillance requirements are met in accordance with the separation minima being applied. Prior to applying any separation minima, the ATSU verifies that the aircraft is properly equipped by examining its filed flight plan.

The following reduced separation minima require data link services:

- 50 NM longitudinal separation minimum;
- 30 NM lateral separation minimum; and
- 30 NM longitudinal separation minimum.

NOTE: *For the above reduced separation minima, RCM requires data link services to ensure that the aircraft conforms to the current flight plan, which is protected. DCPC is also required for controller intervention capability to correct a loss of separation possibly because of, for example, a non-equipped intruder or a poorly performing aircraft, to divert aircraft around hazardous areas such as volcanic ash, or to divert around closed military airspace.*

Data link can also be used to support lateral separation minimum equal to or greater than 50 NM and time-based longitudinal separation minimum.

3.3.1 Data link services supporting SA

SA uses the clearance request and delivery (CRD) data link service, the information exchange and reporting (IER) data link service and the position reporting (PR) data link service. DLIC and the required data communication connections are prerequisite.

The application of 30 NM or 50NM longitudinal separation requires the PR service to establish ADS-C periodic contracts at specified intervals depending on RNP type. The application of 30 NM lateral separation requires the IER service to establish an ADS-C 5 NM lateral deviation event contract. The IER service may also be used to establish an ADS-C level range deviation event contract to monitor the aircraft for vertical profile conformance.

The controller uses CRD to intervene, as necessary, to resolve loss of separation within the communication and controller intervention buffer specified for the separation standard being applied. The controller uses IER to confirm when the flight crew has executed the clearance and to obtain other reports, as necessary.

NOTE: *RCM, using PR and IER, ensures that the aircraft conforms to the current flight plan, which is protected. CRD and IER provide DCPC for controller intervention capability.*

3.3.2 Procedure for SA

When using data link to either apply, or support, a specific separation minima, the ATSU initiates the appropriate data link services per [Table 3-2](#).

- a) The ATSU ensures RCM is established per [paragraph 3.2](#).
- b) The ATSU establishes the CPDLC connection with the aircraft per 0, 0 or 0 to provide CRD and IER.

NOTE 1: *For 30 NM lateral separation minima and distance-based longitudinal separation minima, an alternative form of separation would be applied if the criteria of [paragraph 5.2.6](#) for CRD and [paragraph 5.2.3.4](#) for position report delivery time are no longer being met.*

NOTE 2: *For lateral separation greater than or equal to 50 NM and time-based longitudinal separation, communication failure procedures per ICAO Doc 4444, chapter 15, would be applied if the criteria of [paragraph 5.2.6](#) for CRD or [paragraph 5.2.4.2](#) are no longer being met.*

- c) When RCM notifies the controller of a variance between the actual flight data received from the aircraft and the current flight plan, or for other reasons, the controller may need to use CRD to intervene to correct a loss of separation. Additionally, the controller may use IER to request a report confirming when the flight crew has complied with the clearance.
- d) The flight crew sends an acknowledgement to comply with the clearance.
- e) The flight crew sends the report when compliance with the clearance is achieved.

3.4 REROUTE (RR)

RR, as described herein, enables a pilot to request a revised route to destination compared to current flight plan while in flight. This reroute request is initiated by a pilot after the aeronautical operational control (AOC) facility has computed and dispatched a revised routing to the aircraft. The AOC computes the revised route using updated meteorological forecasts received after the aircraft has departed with the aim of achieving more efficient flight routing.

NOTE: *The pilot or controller may also initiate changes to the route of flight during flight. The changes initiated may not involve a new route to destination. These are addressed through general use of CRD.*

3.4.1 Data link services supporting RR

The AOC will use AOC data link to provide the revised route to the aircraft.

Prior to a reroute request, it is assumed that DLIC and CE have occurred. RR uses CRD.

3.4.2 Procedure for RR

The AOC facility determines from updated meteorological forecasts that a reroute will obtain benefits. The reroute changes are determined from a waypoint ahead of the aircraft that is on the current route and proceed to destination. The reroute is then sent to the aircraft using AOC supporting application.

- a) The flight crew automatically loads into the aircraft system and validates the reroute received from the AOC.
- b) The flight crew uses CPDLC DM24 to request a route clearance that automatically includes the validated reroute from the aircraft system.
- c) Upon receipt of the route clearance request, the controller decides based on the location of other traffic in the area, airspace restrictions in effect, and appropriate inter-facility coordination (e.g., subsequent Flight Information Region (FIR) on the route) whether or not a route clearance can be issued. The controller may optionally issue a standby.
- d) If the clearance can be issued, the controller composes the route clearance message using CPDLC UM79, UM80, or UM83 and sends it.

NOTE: *The first waypoint in a route clearance needs to be far enough ahead of the aircraft (normally 30 minutes) to ensure that the waypoint will not be passed before processing is complete.*

- e) The flight crew automatically loads the route clearance, verifies its acceptability, and sends a WILCO in response to the clearance.
- f) The controller receives the response to confirm flight crew acceptance of the reroute.
- g) If the route clearance cannot be issued, the controller denies the request by composing a clearance request denial message (e.g. UNABLE). If appropriate, explanatory information (e.g. DUE TO TRAFFIC) is added.

3.5 WEATHER DEVIATION (WD)

WD enables the flight crew to request a weather deviation clearance, the controller to issue a weather deviation clearance (or deny it), and the pilot to acknowledge the clearance. The WD is ended when the controller confirms that the aircraft is back on the original route.

During the weather deviation procedure, the controller may request other information, such as position reports, for SA, which is addressed in [paragraph 3.2](#).

Weather deviation procedures that use a reroute are addressed in [paragraph 3.4](#).

NOTE: *In areas of known convective weather, frequent use of the weather deviation procedure may warrant special conditions be placed on the operational and technical requirements for route conformance monitoring and separation assurance. A system verification of sufficient duration and integrity must be performed to assess such parameters and conditions. For example, to monitor against erosion of the longitudinal separation minimum owing to deviation clearances, an increase in the position reporting rate for route conformance monitoring and increased performance of DCPC for separation assurance may be necessary.*

3.5.1 Data link services supporting WD

The flight crew and controller use CRD to execute the weather deviation clearance transaction. The controller uses IER to request a report back on route.

Prior to a WD, it is assumed that DLIC and CE have occurred.

3.5.2 WD procedure

Based on sensor data (e.g. weather radar), the pilot initiates the WD procedure to avoid hazardous weather

- a) The flight crew requests a deviation, identifying the lateral distance (e.g. up to 50 miles) and direction of deviation (e.g. left, right, or either side of route)
- b) The controller (upon receipt of the weather deviation request) decides (based on the location of other air traffic in the area and the separation standard in effect), whether or not the requested weather deviation clearance or a modified one can be issued. The controller may optionally issue a standby.
- c) If the weather deviation clearance can be issued, the controller composes the weather deviation clearance message specifying the lateral extent and direction of the deviation, appends a request for a report back on route, and sends the message. At this time, the controller protects the airspace by allowing a tolerance for the aircraft from the area beginning at the original route to a virtual path at the maximum deviation granted. The aircraft may vary its route anywhere within this region while avoiding the weather.
- d) The flight crew sends a WILCO response to the clearance.
- e) The controller receives the response to confirm flight crew acceptance of the weather deviation.
- f) If the weather deviation clearance cannot be issued, the controller denies the request by composing a clearance request denial message (e.g. Unable). If appropriate, explanatory information (e.g. Due Traffic) is added.
- g) When the aircraft is back on route, the flight crew responds to the Report request to inform the controller.
- h) The controller receives the response to confirm that the WD has ended.

NOTE: *An ATSU may deny a weather deviation request if it results in a loss of separation. If the aircraft deviates on captain's authority, the ATSU will provide all concerned aircraft with essential traffic information. This could be performed using IER. This is not described in the above procedure.*

CHAPTER 4

DESCRIPTION OF DATA LINK SERVICES

The data link services shall be provided and used in accordance with the operating methods described in this section. Data link services include.

- a) Data link initiation capability (DLIC);
- b) Connection establishment (CE);
- c) Connection termination (CT);
- d) Transfer of communication (TC);
- e) Clearance request and delivery (CRD);
- f) Information exchange and reporting (IER); and
- g) Position reporting (PR).

The data link services are enabled through the use of data link applications. The operational considerations for these applications are provided in Annex A.

4.1 DATA LINK INITIATION CAPABILITY (DLIC) – SERVICE DESCRIPTION

DLIC provides the capability for the aircraft to indicate to the ground that it is available for data communication, and provide information to allow the ground ATS systems to compare the aircraft against filed flight plans to validate that communication is being established with the correct information. It also indicates what data communication capabilities are available on the aircraft and provides a mechanism whereby the aircraft can be requested to declare its readiness for data communication service with the next ATSU. This data link service provides the capability to:

- Determine compatibility of aircraft and ATSP systems;
- Correlate information between aircraft active flight plan and current flight plan; and
- Notify the data link initiation with the next ATSU.

DLIC uses two basic modes of operation:

- a) Manual initiation, when, in response to pilot actions, the aircraft exchanges messages with ATSUs to declare the data link initiation with the aircraft.
- b) Address forwarding, whereby the current data authority requests the aircraft to exchange messages with the next ATSU to announce the aircraft's readiness for data communications.

DLIC is a necessary precursor for any data link service that uses the CPDLC application.

4.1.1 Operating method for DLIC

4.1.1.1 Operating method for data link initiation

Table 4-1 provides the operating method for data link initiation, which consists of a single transaction initiated by the aircraft.

TABLE 4-1: OPERATING METHOD FOR DATA LINK INITIATION

Step	Operating Method
1	The aircraft sends a logon/contact message to the ATSU including: • information on each requested application for data link service, • information from the aircraft active flight plan to allow unambiguous association of the aircraft with the current flight plan information used by an ATSU.
2	The communication service provider uses the 4-character ICAO code to determine the 7-character address to be used for delivery of the message, and delivers it to that address.
3	The ATSU correlates data received in the data link initiation message with the current flight plan.
4A	When the aircraft information received correlates with the current flight plan, and local conditions are satisfied, the ATSU sends a response to the aircraft indicating successful completion of the data link initiation message.
4B	When the aircraft information does not correlate, the ATSU sends a response to the aircraft indicating that the data link initiation was not successfully completed.
5	The ATSU may indicate to the controller that the data link initiation was completed or not.
6	When the aircraft system receives the ATSU response, it may indicate to the flight crew that the data link initiation was completed or not.
7	When the aircraft does not receive a response from the ATSU within a predetermined period of time, the aircraft system indicates to the flight crew that the data link initiation was not completed.

4.1.1.2 Operating method for address forwarding

Table 4-2 provides the operating method for address forwarding, which consists of two nested transactions, the first transaction is initiated by the ATSU.

TABLE 4-2: OPERATING METHOD FOR ADDRESS FORWARDING

Step	Operating Method
1	The originating ATSU sends a contact advisory request to the aircraft with the specified address for the next ATSU
2	Optionally, the aircraft may send a response to the originating ATSU indicating receipt of contact advisory request.
3	The aircraft initiates data link with the next ATSU per the operating method for data link initiation.
4	The aircraft sends a contact advisory completion message to the originating ATSU indicating success/failure of initiation with next ATSU.

4.1.2 Time sequence diagram for DLIC

4.1.2.1 Time sequence diagram for data link initiation

Figure 4-1 provides a time sequence diagram of the data link initiation transaction between the flight crew/aircraft and ATSU/controller. Numbers shown in the diagram correspond to steps shown in the operating method for data link initiation described in Table 4-1.

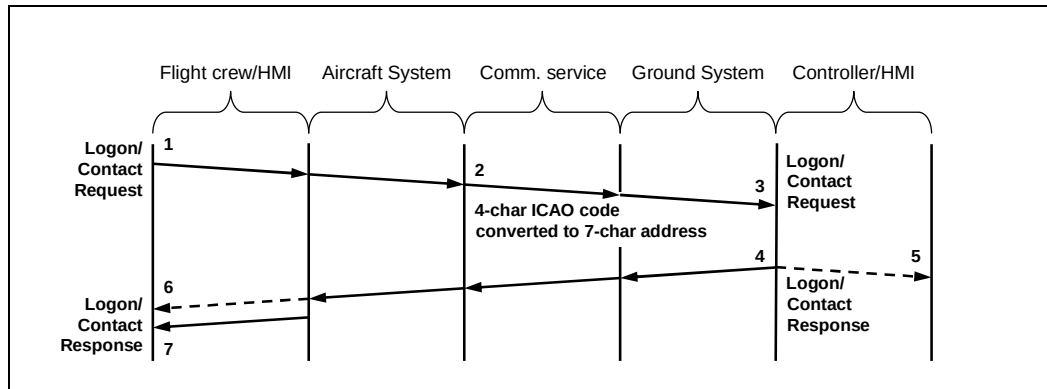


FIGURE 4-1: DLIC – DATA LINK INITIATION TRANSACTION

4.1.2.2 Time sequence diagram for address forwarding

Figure 4-2 provides a time sequence diagram for the address forwarding transactions among the originating ATSU/controller, the flight crew/aircraft, and the next ATSU/controller. Numbers shown in the diagram map to steps shown in the operating method for address forwarding described in Table 4-2.

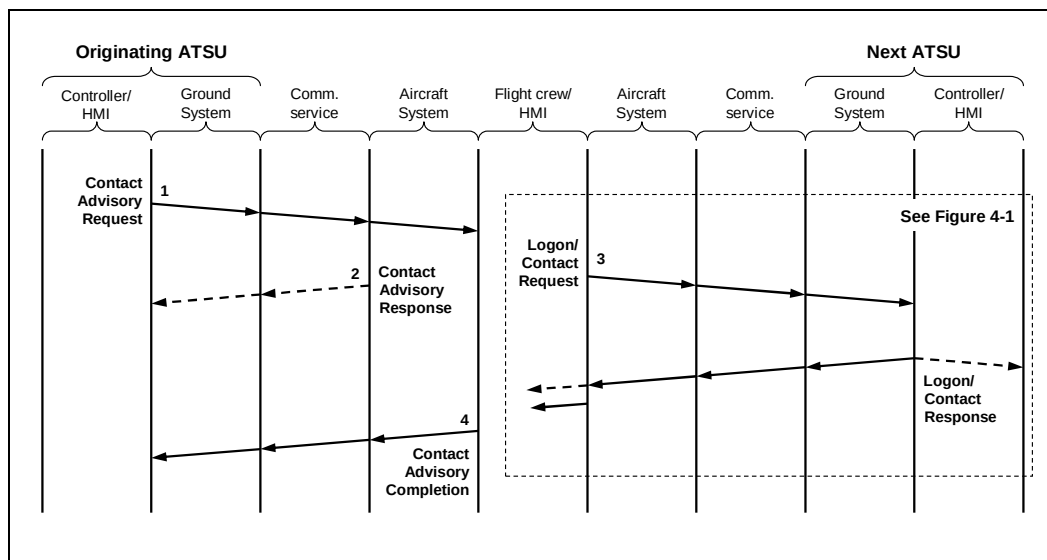


FIGURE 4-2: DLIC – ADDRESS FORWARDING TRANSACTIONS

4.1.3 Messages for DLIC

Table 4-3 provides the messages for the DLIC.

NOTE 1: The facility identification is used by the aircraft to unambiguously identify the ATSU. It takes the form of facility designation (4-8 characters).

NOTE 2: The aircraft identifier is used by the ATSU to unambiguously identify the aircraft. It can take the form of flight (or aircraft) identification, aircraft registration (tail number), the aircraft address (24-bit), and/or other information such as departure and destination airports and estimated time of departure.

NOTE 3: At a minimum, the time stamp includes hours, minutes, and seconds.

TABLE 4-3: MESSAGES FOR DLIC

Message	Information
Logon/contact	Facility identification (Note 1) Aircraft identifier (Note 2) Time stamp (Note 3) Application names Application versions
Logon/contact acknowledgement	Facility identification (Note 1) Aircraft identifier (Note 2) Time stamp (Note 3) Application names Application reason codes
Contact advisory request	Originating facility identification (Note 1) Aircraft identifier (Note 2) Time stamp (Note 3) Next facility identification (Note 1)
Contact advisory response	Originating facility identification (Note 1) Aircraft identifier (Note 2) Time stamp (Note 3) Reason code
Contact advisory completion	Originating facility identification (Note 1) Aircraft identifier (Note 2) Time stamp (Note 3) Next facility identification (Note 1) Reason code

4.2 CONNECTION ESTABLISHMENT (CE) – SERVICE DESCRIPTION

CE provides the capability for an ATSU to establish a CPDLC connection and/or an ADS connection with a suitably equipped airplane as an active center called the Current Data Authority (CDA). CE also provides for a third-party entity to establish an ADS connection for monitoring purposes. CE comprises two different operating methods, one for the CPDLC application and one for the ADS-C application. An ATSU may be executing either or both operating methods.

4.2.1 Operating method for CE

Table 4-4 provides the operating method for the CE for data link services that use the CPDLC application. The operating method for CPDLC connection establishment consists of a single transaction initiated by an ATSU. ADS-C applications do not use a separate connection establishment service, as such. Contract requests are used to set up ADS-C reporting, and if no ADS-C connection already exists one is automatically set up to support the requested ADS-C contract. Table 4-5 provides the operating method for the CE for data link services that use the ADS-C application.

TABLE 4-4: OPERATING METHOD FOR CE (CPDLC CONNECTION)

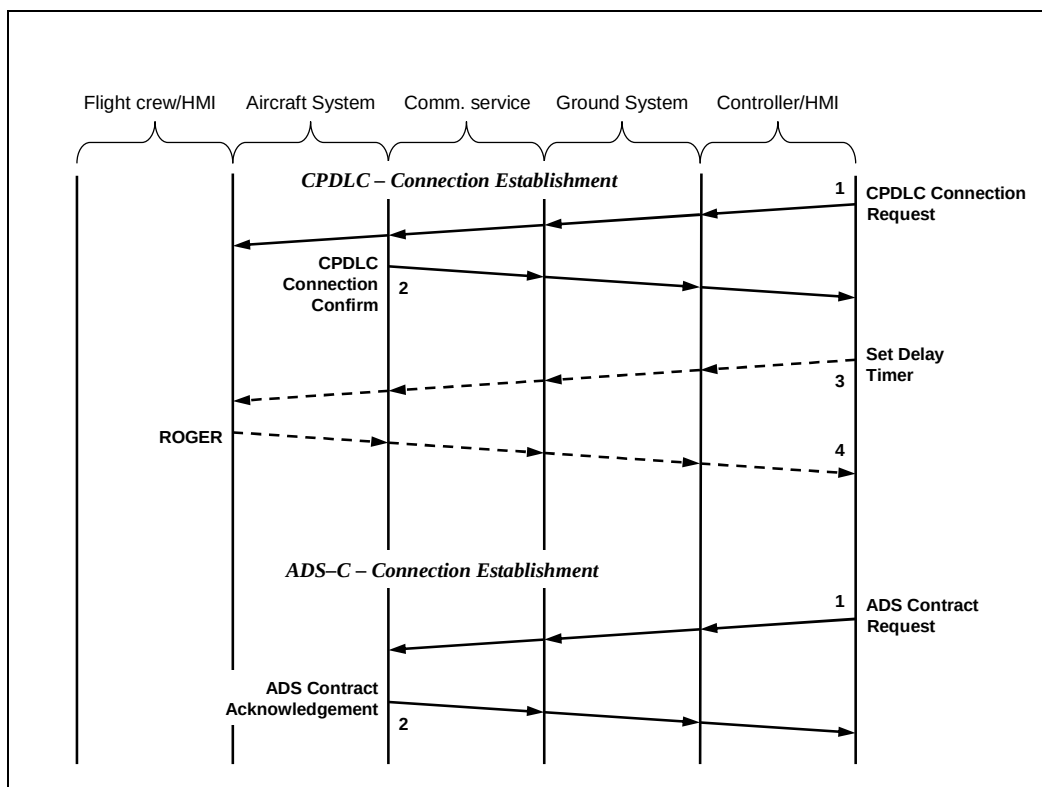
Step	Operating Method
1	The ATSU sends a CPDLC connect request message to the aircraft.
2A	If the aircraft does not have a CDA, then the ATSU sending the request will become the CDA. The aircraft sends a CPDLC connect confirm to the ATSU. The aircraft provides an indication to the flight crew of the CDA together with the identity of the CDA. <i>Note: If the aircraft has an active connection designated as the CDA, see paragraph 0, for a transfer of communication.</i>
2B	If the aircraft already has a CDA, the aircraft system checks to see if the received ICAO code matches the previously received NDA address from CDA. If it matches, the ATSU sending the request will become the NDA and the aircraft system sends a CPDLC connect confirm message to the NDA. If it does not match, the aircraft system sends a disconnect request message.
2C	If the aircraft cannot accept the CPDLC connection because it already has an active connection, and the ATSU sending the CPDLC connection request has not been designated as the NDA, then it sends a disconnect request message.
3	Optionally, the ATSU may send a free text uplink message SET MAX UPLINK DELAY TO [nnn] SEC, where [nnn] is the maximum delay allowed for CPDLC uplink messages.
4	On receipt of the message, the flight crew will send a ROGER response, and set the uplink delay timer in the airplane. If the aircraft cannot comply with this request, the flight crew should inform the ATSU for appropriate action.

TABLE 4-5: OPERATING METHOD FOR CE (ADS-C CONNECTION)

Step	Operating Method
1	The ATSU sends an ADS contract request message to the aircraft.
2A	If the aircraft can accept the ADS contract request, and has no existing ADS-C connection with that ATSU, then the aircraft sets up an ADS-C connection with the ATSU, and sends a positive ADS-C acknowledgement message to the ATSU.
2B	If the aircraft can accept the ADS contract request, and has an existing ADS-C connection with that ATSU, then the aircraft uses that existing ADS-C connection with the ATSU to send a positive ADS-C acknowledgement message to the ATSU.
2C	If the aircraft cannot accept the ADS-C request, then it sends a negative ADS-C acknowledgement, containing a reason code indicating the reason for the rejection.

4.2.2 Time sequence diagram for CE

Figure 4-3 provides a time sequence diagram for the CPDLC and ADS-C connection establishment transactions between the flight crew/aircraft and ATSU/controller. Numbers shown in the diagram map to steps shown in the operating method for CE described in Table 4-4 (for CPDLC) and Table 4-5 (for ADS-C).

**FIGURE 4-3: CE – TRANSACTIONS FOR CPDLC AND ADS-C**

4.2.3 Messages for CE

CE uses the CPDLC application messages denoted as “CE” or “All” in [Annex A, Table A-1](#) (uplink) and [Table A-2](#) (downlink).

CE uses the ADS application messages described in [Annex A](#). For contract request messages, see [paragraph A.3.1.2](#) (demand), [paragraph A.3.2.2](#) (event), [paragraph A.3.3.2](#) (periodic), and [paragraph A.3.5.2](#) (emergency). For ADS-C acknowledgement messages, see [Table A-8](#).

4.3 CONNECTION TERMINATION (CT) – SERVICE DESCRIPTION

CT provides the capability for the ATSU, flight crew, or aircraft system to terminate a CPDLC or ADS-C connection. ATSU initiated CPDLC connection termination normally occurs when transitioning between ATSUs as part of the transfer of communication service if the next ATSU has data link capability. If the next ATSU does not have data link capability the ATSU initiates a simple connection termination. Aircraft system initiated CPDLC or ADS-C connection termination occurs at the end of a flight. The flight crew or the ATSU can terminate connections at anytime. The flight crew has the capability to terminate connections anytime.

4.3.1 Operating method for CT

[Table 4-6](#) provides the operating method for CT for data link services that use the CPDLC application. The operating method for CPDLC connection termination consists of a single message initiated by the flight crew/aircraft system. [Table 4-7](#) provides the operating method for connection termination for data link services that use the ADS-C application.

TABLE 4-6: OPERATING METHOD FOR CT (CPDLC APPLICATION)

Step	Operating Method
	Transition between ATSUs.
1	The current ATSU sends a CPDLC connection termination message to the aircraft. <i>Note: The next ATSU cannot terminate a CPDLC Connection by sending a CPDLC connection termination message.</i>
2	If there is no inactive (NEXT CENTER) connection, then the aircraft system terminates the connection and sends a connection termination confirm message to the ATSU.
	Flight crew terminates CPDLC application
3	Flight crew terminates the CPDLC application.
4	The aircraft system terminates the connection and sends a connection termination confirm message to the ATSU.
	Aircraft system terminates CPDLC application
5	The aircraft system terminates the CPDLC connection and sends a connection termination confirm message to the ATSU when: • end of flight is detected; or • an exceptional event occurs, such as the trigger of an inactivity timer or a change of aircraft identification.

TABLE 4-7: OPERATING METHOD FOR CT (ADS-C APPLICATION)

Step	Operating Method
ATSU initiated connection termination	
1	The ATSU sends an ADS connection termination message to the aircraft.
2	The aircraft system terminates the connection with that ATSU and sends an ADS-C termination confirm message to the ATSU.
Flight crew terminates ADS-C application	
3	Flight crew selects all ADS-C connections to be terminated or selects a specific connection to be terminated.
4	The aircraft system terminates the connection with all ATSUs and sends a connection termination confirm message to each ATSU, or terminates the connection to the selected ATSU, and sends connection termination confirm message to that ATSU.
Aircraft system terminates ADS-C application	
5	The aircraft system terminates the ADS-C connection and sends a connection termination confirm message to the ATSU when: • end of flight is detected; or • an exceptional event occurs, such as the trigger of an inactivity timer or following the generation of a series of consecutive negative acknowledgments on the same connection.

4.3.2 Time sequence diagram for CT

Figure 4-4 provides a time sequence diagram for the CPDLC connection termination transactions between the flight crew/aircraft and ATSU/controller. Numbers shown in the diagram map to steps shown in the operating method for CPDLC connection termination described in Table 4-6.

Figure 4-5 provides a time sequence diagram for the ADS-C connection termination transactions between the flight crew/aircraft and ATSU/controller. Numbers shown in the diagram map to steps shown in the operating method for ADS-C connection termination described in Table 4-7.

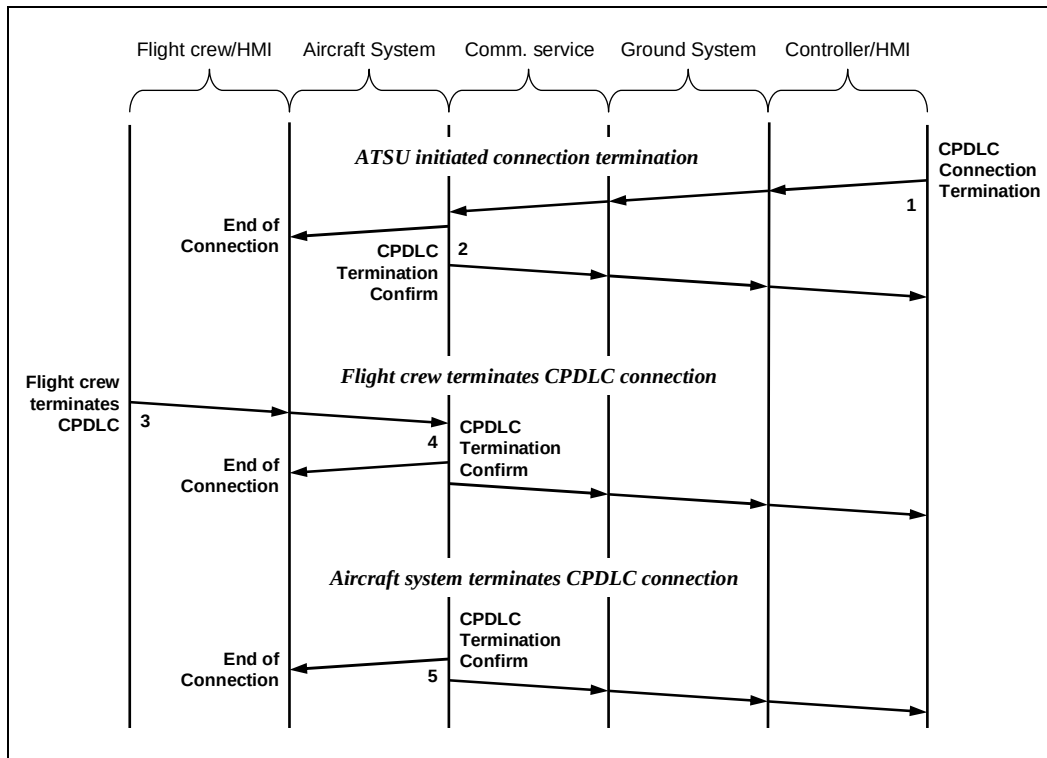


FIGURE 4-4: CT – TRANSACTIONS FOR CPDLC APPLICATION

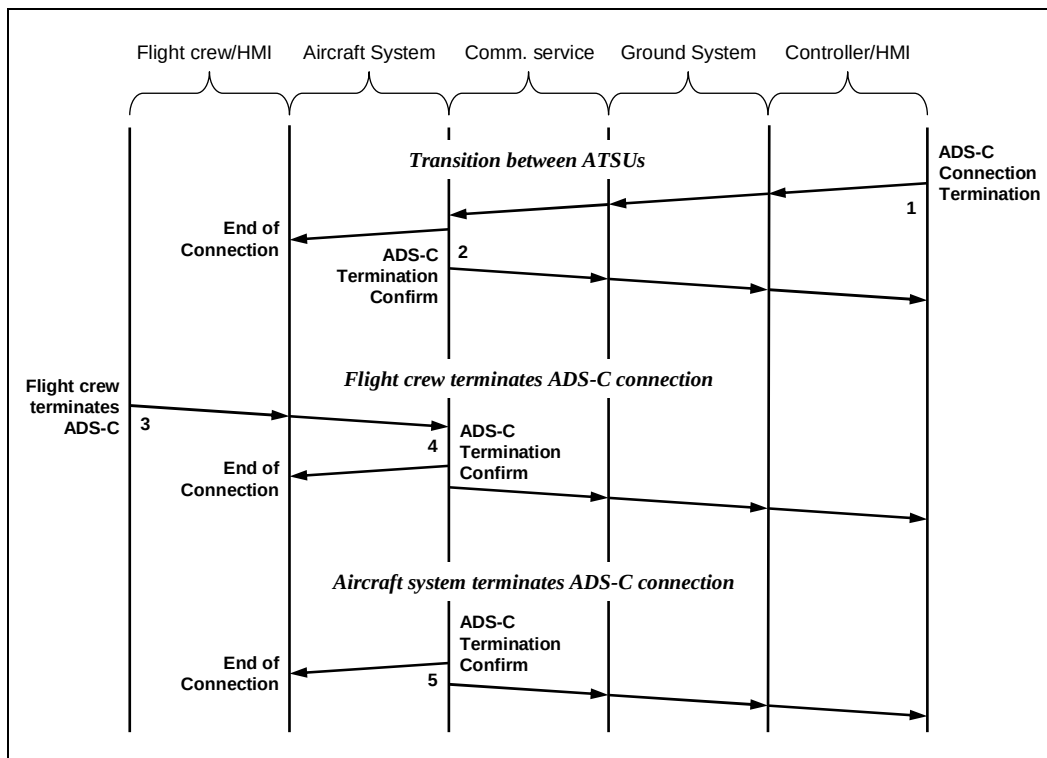


FIGURE 4-5: CT – TRANSACTIONS FOR ADS-C APPLICATION