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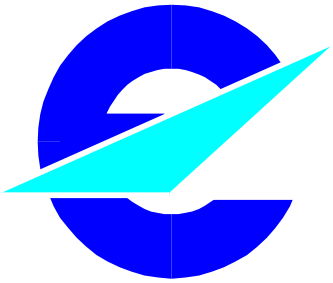

OPERATIONAL REQUIREMENTS FOR AIR TRAFFIC MANAGEMENT (ATM) AIR/GROUND DATA COMMUNICATIONS SERVICES

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ABSTRACT

- This document contains Operational Requirements for Air Traffic Management (ATM) Air-Ground Data Communications Services. The requirements are structured in accordance with a specific template developed by the ODIAC-TF and also applied at the ICAO Automatic Dependent Surveillance Panel.
- The operational requirements contained in this document represent consolidated European requirements and result from work in the Operational Development of Initial Air/ground data Communications Task Force (ODIAC-TF) and provide input to the ICAO Automatic Dependent Surveillance Panel.

KEYWORDS :

Data Link
Air/Ground Data Communications
Operational Requirements
CPDLC
ADAP
D-FIS

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DOCUMENT APPROVAL

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This document was approved by the EATCHIP Liaison Officers on the 1st of November 1997.

DOCUMENT CHANGE RECORD

EDITION	DATE	REASONS FOR CHANGE	SECTIONS/PAGES AFFECTED
0.9	Oct, 1995	In accordance with the ODT/5 conclusions, the phase 1 services from this document have been transferred to a new document : "Transition Guidelines for Initial Air/Ground Communication Services".	All
0.a	Feb, 1996	Redefinition of all the data link services in accordance with the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications", Version 0.1, 05/02/96. New services proposed: 1. Controller Access Parameters (CAP), based on a paper presented by France to the ADSP. 2. Digital METAR, based on the current ADSP material.	All
0.b	May, 1996	The results of ODIAC/10 and the modifications of the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications", Version 0.3, 29/03/96, have been introduced in the document.	Sections 4, 5, 7, 8 and 9. New sections 14 and 15. Appendix B.
0.c	July, 1996	Updated according to ODIAC/11 conclusions.	Sections 1, 4, 5, 6, 7 and 8. New sections 9, 10, 11 and 12.
0.d	Sep, 1996	Updated according to ODIAC/12 conclusions.	Sections 5, 11, 12 and 13. New sections 14, 15, 16 and 17.
0.e	Nov, 1996	Updated according to ODIAC/13 conclusions.	All
0.f	Mar, 1997	Updated according to ODIAC/14 and ODIAC/15 conclusions.	All
0.g	May, 1997	Editorial corrections.	Page 1 and sections 2 and 5.
1.0	Jan 1998	Page footers updated.	All

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Note : A detailed table of contents is provided in each section.

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The operational requirements contained in this document result from the work of the EUROCONTROL Operational Development of Initial Air/ground data Communications Task Force (ODIAC-TF).

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EXECUTIVE SUMMARY

This document presents consolidated **European Operational Requirements** for the introduction of Air/Ground Data Communications for Air Traffic Management (ATM) in the ECAC area as can be anticipated in the near term (2000-2005 time period) and assuming that the Aeronautical Telecommunications Network will be progressively made available. These Operational Requirements constitute **Recommended Practices** for aviation authorities, airspace users and service providers in establishing ATM Data Communications services in their airspace.

The Operational Requirements are composed of:

1. **General Requirements**, providing overall system and procedures requirements and

2. **Service Descriptions** which describe sets of Air Traffic Management related transactions, both system supported and manual, which have a clearly defined operational goal.

The Services defined in this document are grouped into three main categories:

1. **Controller Pilot Data Link Communications (CPDLC)** : a means of communication between Controller and Aircrew, using data link for Air Traffic Control communications.

2. **Automated Downlink of Airborne Parameters (ADAP)** : a means of providing aircraft status and Aircrew preferences information to Controllers and ground systems using air/ground data communications.

3. **Data Link Flight Information Services (D-FIS)** : a means of providing flight information (e.g. ATIS and meteorological information) to Aircrew using air/ground data communications.

The Service descriptions are structured according to a standard template describing inter alia: Scope and Objectives, Expected Benefits, Anticipated Constraints and Human Factors, Service Operational Context, a comparison of current Operating Methods without data link and the proposed operating method with Data Link, detailed step by step description of the data link operating method including procedures and abnormal modes, Quality of Service, detailed definition of the information exchanges and supporting diagrams.

The Services are compliant with the guidance material contained in the **"ICAO Manual of Air Traffic Services (ATS) Data Link Applications**", where applicable, deviations from the ICAO Manual are specifically stated.

The service definitions contained in this document express requirements for procedures, quality of service, performance, timers and information exchanges which have been partly validated through initial trials and safety analysis but require further validation through a full end to end safety assessment, trials and actual operations prior to fully operational implementation.

As Air/ground data communications for ATM is a recent development and a very complex system involving interaction from end to end of humans and systems, many operational and technical questions need to be answered before contemplating full operations. Implementation on the basis of this document has to be considered as a step towards gaining experience in progressing to an operational system, validating and/or updating the requirements as a result. The results of validation exercises, trials and practical experience will be taken into account to review the present material.

Section 1 : Introduction

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1. Document Purpose

The purpose of this document is to provide the detailed EATCHIP Phase III air/ground data communications operational requirements. The contents of the document will therefore define:

- the baseline operational requirements for EATCHIP Phase III technical work (e.g. development of the communications system infrastructure);
- the consolidated EUROCONTROL Member States and Aviation Organisations operational requirements input to International Civil Aviation Conference (ICAO) groups in particular the Automatic Dependent Surveillance Panel (ADSP).

This document is a deliverable of the Specialist Task 05 (ST05) of the EATCHIP Air Traffic Management (ATM) Operational Requirements (OPR) Domain, Executive Task (ET) 1. The primary objective of ST05 is production of operational requirements for air/ground data link services, as a first step in developing and progressing EATCHIP Phase III A/G data communications.

2. Document Scope

This document presents consolidated European Operational Requirements for the introduction of Air/Ground Data Communications for Air Traffic Management (ATM) in the ECAC area as can be anticipated in the near term (2000-2005 time period) and assuming that the Aeronautical Telecommunications Network will be progressively made available.

The Requirements contained in this document are compliant with the guidance material contained in the “ICAO Manual of Air Traffic Services (ATS) Data Link Applications”, where applicable, deviations from the ICAO Manual are specifically stated.

The current and transitional operational and functional environment for the services specified in this document are described in the Operational Concept Document for EATCHIP Phase III.

3. Document Applicability

This document contains **Recommended Practices** for ECAC Member states intending to provide ATM air/ground data communications services.

Therefore, within this document:

- The word “shall” denotes a mandatory requirement when implementing these recommended practices.
- The word “should” denotes a preferred requirement.
- The word “may” denotes an option.
- The word “will” denotes a statement of intent.

4. Definition of Terms

Brief definitions for the key terms used in the document, as well as expansion for all acronyms, are held at **Appendix A**. However, one term requires definition for full understanding of the scope of the document.

The term “**Service**” in the context of this document refers to:

> “a set of Air Traffic Management related transactions, both system supported and manual, which have a clearly defined operational goal and begin and end on an operational event.”

5. Dependencies with other EATCHIP activities

EUROCONTROL's Air/Ground Data link activities are an essential part of the EATCHIP Work Programme (EWP). The activities fall into two categories:

- those concerned with EATCHIP Phase III;
- those concerned with Future Concepts (FCO) and the European Air Traffic Management System (EATMS).

The first of these categories, EATCHIP Phase III, is the focus of the A/G data link material in this document. EATCHIP Phase III covers the development of various ATM functionality which begun in 1995, and will continue until FCO/EATMS implementation is underway in approximately 2005.

Division DED/2 oversees development of the EATCHIP Phase III concept and ATM operational requirements and design, to include A/G data communications, through the Operational Requirements and Data Processing Team (ODT).

Division DED/6 oversees development of the EATCHIP Phase III technical communications infrastructure, to include A/G data link, through the Communications Team (COMT).

Division DED/3 oversees development of the EATCHIP Phase III technical surveillance infrastructure, through the Surveillance Team (SURT).

FCO covers the development of various ATM functionality, to include A/G data link, that will be undergoing implementation in a significant number of EATCHIP participating States by the year 2005. EUROCONTROL Division DED/1 oversees development of the EATMS concept, requirements, and technical infrastructure, through the FCO Team (FCOT).

6. Relationship with Specifications and Standards

The operational requirements defined in this document could be progressed through the EATCHIP programme into EUROCONTROL functional specifications and standards, if appropriate. This will be done in close co-ordination with ICAO (International Civil Aviation Conference), and only those matters which are not covered in the ICAO material may be published as EUROCONTROL Standards. In some cases, EUROCONTROL Standards may be published as an interim measure while standardisation material is progressed within the ICAO groups.

Where applicable, this document complies with the “ICAO Manual of Air Traffic Services Data Link Applications” produced by the ICAO Automated Dependent Surveillance (ADS) Panel (ADSP) and with the ICAO Standards and Recommended Practices (SARPs) prepared by the ICAO ATN Panel (ATNP). As a result some of the requirements specified in this document may therefore not be applicable to non-ICAO ATN SARPS compliant environments. Significant parts of this document were used as input to the “ICAO Manual of Air Traffic Services Data Link Applications” in order that consolidated European requirements are covered in the global standards. Discussions at the ADSP also permitted to mature the present document through feedback from world wide experience.

Explanatory material has been included to identify the cases where this document proposes modifications to the functionality described in the ICAO Manual of Air Traffic Services Data Link Applications.

Standardisation activities conducted within other groups such as the European Organisation for Civil Aviation Equipment (EUROCAE), the Airlines Electronic Engineering Committee (AEEC), Aeronautical Radio Incorporated (ARINC), Radio Technical Commission for Aeronautics (RTCA) and relevant ICAO bodies are monitored.

7. Requirements Validation

The service definitions contained in this document express requirements for procedures, quality of service, performance, timers and information exchanges which have been partly validated through initial trials and safety analysis but require further validation through a full end to end safety assessment, trials and actual operations.

Air/ground data communications for ATM is a recent occurrence and a very complex system involving interaction from end to end of humans and systems, therefore many operational and technical questions need to be answered before contemplating full operations.

Implementation on the basis of this document has to be considered towards gaining experience in progressing to an operational system, validating and/or updating the requirements as a result.

The results of validation exercises, trials and practical experience will be taken into account to review the present material.

Regulatory authorities will apply the appropriate regulatory approval process to which this document will provide input.

8. Overview of the Document

8.1. Document Contents

Section	Section Title	Section Contents
1	Introduction	Purpose and Scope of the document. Relationship with other activities. Overview of the document.
2	Context for the Operations of Air/Ground Data Communications Services in Europe	Operational context. Expected benefits. Operational principles.
3	General Requirements	General requirements. Legal considerations.
4, 5, 6, 7, 8, 9	Controller-Pilot Data Link Communications (CPDLC)	Controller Pilot Data Link Communications (CPDLC) is a means of communication between Controller and Aircrew, using data link for Air Traffic Control communications. The electronic messages that can be exchanged between Aircrew and Controllers have been grouped in specific operational Services. These services are described in subsection 8.2 below.
10, 11	Automated Downlink of Airborne Parameters (ADAP)	Automated Downlink of Airborne Parameters (ADAP) is a means of providing aircraft status and Aircrew preferences information to Controllers and ground systems using air/ground data communications. One ADAP service is fully described in this edition of the document in section 11: the Controller Access Parameters (CAP).

Section	Section Title	Section Contents
12, 13	Data Link Flight Information Services (D-FIS)	Data Link Flight Information Services (D-FIS) is a means of providing flight information (e.g. ATIS and meteorological information) to Aircrew using air/ground data communications. Two D-FIS services are described in this edition of the document in sections 12 and 13.

Appendix	Appendix Title	Appendix Contents
A	Glossary and Abbreviations	Contains a definition of the main terms used throughout the document as well as the explanation of all acronyms used.
B	Service Description Template	The description of all data link services in this document follows a standard template that is fully described in this annex.
C	Bibliography	List of the main reference documents and information material used in the preparation of this document.
D	Message Sequence Matrices	This appendix contains diagrams that depict the possible message sequences for the air/ground data communications services defined in this document.

Annex	Annex Title	Annex Contents
1	Future ODIAC Work	This Annex contains information material on services that are not part of ODIAC's current mandate but have already been discussed due to their potential for early development. These will be part of ODIAC's future work.
2	ATN Implementation Issues	This Annex contains additional explanations for the implementation of the services if applied under the CNS/ATM-1 infrastructure.

8.2. Data Link Services Overview

In order to provide an operationally oriented description of the use of data communications for Air Traffic Services, the definitions and treatment of the electronic messages that can be exchanged between aircraft/Aircrew and Air Traffic Service Units/Controllers have been grouped in operational Services.

These services describe a set of actions and a set of data link messages which have a clearly defined operational goal and which begin and end on an operational event.

The data link services developed in this document are:

Service Name	Service Overview
CPDLC Services	
ATC Communications Management Service (ACM)	When a flight is about to be transferred from one sector/Air Traffic Services Unit (ATSU) to another sector/ATSU, the Aircrew is instructed to change to the voice channel of the next sector/ATSU to take control of the flight. The ACM Service provides automated assistance to the Aircrew and current and next Controllers for conducting this transfer of ATC communications. The ACM Service encompasses the transfer of **all** Controller/Aircrew communications, both the voice channel and the new data communications channel used to accomplish the ACM Service.
Clearances and Information Communications Service (CIC)	This service describes aircraft/Controlling ATSU (C-ATSU) air-ground data communication message exchange and procedures for operations within the European region for the following: • Aircrew's reports and clearance requests; • Controller's delivery of clearances, instructions and notifications to aircraft; • Support and system messages. The service description states the exchanges that could be conducted via data communications, the rules for the combination of voice and data link communications and abnormal mode requirements and procedures.
Departure Clearance Service (DCL)	A flight due to depart from an airfield must first obtain departure information and clearance from the Controlling Air Traffic Services Unit (C-ATSU). The Departure Clearance (DCL) Service provides automated assistance for requesting and delivering departure information and clearance, with the objective of reducing Aircrew and Controller workload and diminishing clearance delivery delays.
Downstream Clearances Service (DSC)	Aircrew, in specific instances, need to obtain clearances or information from ATSUs which may be responsible for control of the aircraft in the future, but are not yet in control of it. Such 'downstream' clearances and information are often provided through ground/ground co-ordination, but are also obtained via direct contact with the 'Downstream' ATSU (D-ATSU) in certain circumstances (e.g., when ground/ground communications are unavailable or inefficient, due to the size of the airspace, due to the complexity of the route structure, or due to meteorological conditions). The Downstream Clearance (DSC) Service provides assistance for requesting and obtaining D-ATSU clearances or information, using air/ground data link.
ADAP Service	
Controller Access Parameters Service (CAP)	This data link service aims at enhancing the ATC surveillance and the availability of aircraft parameters to the Controller by extracting and downlinking data from the airborne system. The service is foreseen to be primarily used in continental airspace, both in en-route and terminal areas.

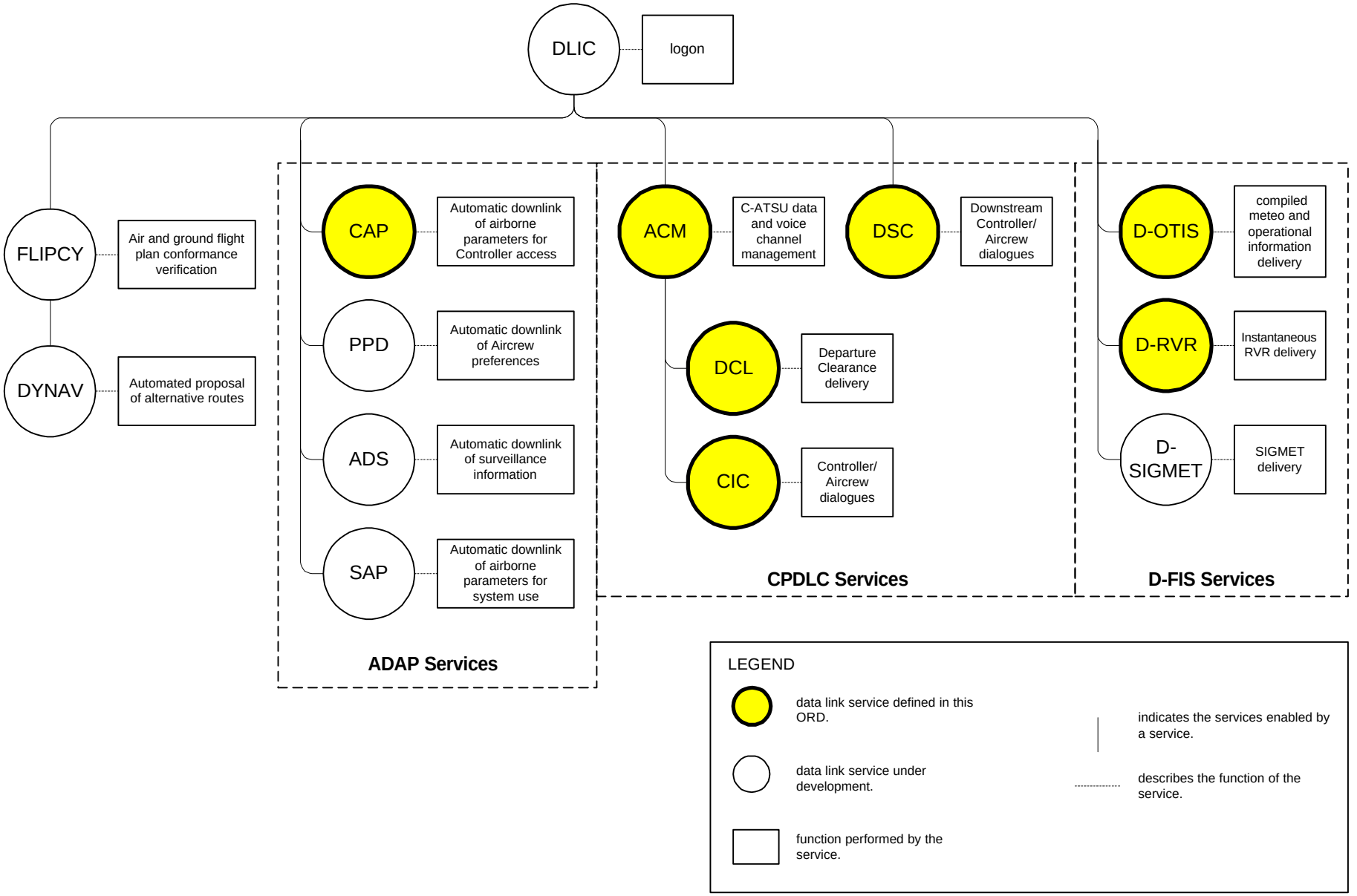
Service Name	Service Overview
D-FIS Services	
Data Link Operational Terminal Information Service (D-OTIS)	The D- OTIS service provides automated assistance in requesting and delivering compiled meteorological and operational flight information derived from ATIS, METAR and NOTAMs / SNOWTAMs, specifically relevant to the departure, approach and landing flight phases.
Data Link Runway Visual Range (D-RVR)	The D-RVR service provides automated assistance in requesting and delivering the Instantaneous Runway Visual Range (RVR) to the Aircrew.

The following services are not yet finalised and will be subject to a further edition of this document:

Service Name	Service Overview
Data Link Initiation Capability (DLIC)	Service providing access to all data link services (logon), which will enable the other services. A detailed description of this service can be found in the ICAO Manual of Air Traffic Services Data Link Applications.
Flight Plan Consistency Service (FLIPCY)	This service permits the ground system to check that flight data in the FDPS correspond to actual flight plan data from the aircraft. This service should take place automatically at logon.
Dynamic Route Availability Service (DYNAV)	This service provides automated assistance for the proposal of alternative routes to Aircrew as they become available (e.g. when military areas become free to civil use). This service could take place automatically after FLIPCY.
Pilot Preferences Downlink Service (PPD)	This service permits the downlink of pilot preferences to the ground system for display to Controllers. These preferences relate to flight parameters having operational implications for ATC and not requiring Controller response.
System Access Parameters Service (SAP)	This service aims at downlinking aircraft parameters to be used by several ground functions. SAP is an automatic system-to system service, without Aircrew or Controller involvement.
Automated Dependent Surveillance (ADS)	This service aims at downlinking aircraft data for surveillance and other purposes (e.g. conformance monitoring, trajectory prediction) to be developed for use in European continental airspace.
Data Link SIGMET Service	This service provides automated assistance in requesting and delivering the Significant Meteorological Information (SIGMET) to the Aircrew.

Note: Draft versions for some of the services to be introduced in a future edition of this document are provided in Annex 1.

8.3. Data Link Services and their Relationships



8.4. Template for the Detailed Service Description

The description of all data link services in this document follows a standard template that is fully described at annex B. The table below provides and overview of the main template subsections:

Subsection Name	Subsection Contents
Scope and Objective	Contains a brief description of what the Service provides from an operational perspective.
Expected Benefits, Anticipated Constraints, and Associated Human Factors	Provides a non-exhaustive list of the benefits expected from implementation of the Service, the associated constraints and the human factors aspects considered essential for its safe and coherent operation.
Service Operational Context	Describes the environment and constraints of current non-data link services and some additional constraints applicable to the data link service in the European airspace.
Overview of Operating Methods with and without Data Link	Provides a comparison between the way the controller, Aircrew, or support systems perform the Service in a non-data link environment and the proposed operating method using data link.
Information Exchange Diagram	Provides a graphical representation of the information flows interchanged via the data link in order to implement the service operating method.
Detailed Service Operating Method	Provides a detailed description of the proposed operating method with the data link service.
Time Sequence Diagram	Illustrates the information flows in chronological order for the standard execution of a Dialogue within the Service.
Quality Of Service Requirements	Specifies the Quality of Service (i.e. transfer times, priorities, urgency and security) requirements of the service.
Information Exchanges	Provides the full definition of each information flows and messages required by the service.
Event Sequence Diagram	Depicts an overview of the normal and abnormal sequence of events within a service.

Section 2 : Context for the Operations of Air/Ground Data Communications Services in Europe

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1. Expected Operational Benefits

The overall operational aim of the introduction of ATM air/ground data communications is to enhance ATM in accordance with the ECAC objectives, whilst permitting a transition from existing, voice-only procedures to mixed voice and data link procedures towards an integrated air and ground ATM system.

The specific operational goals of implementing data link services are as listed in the following tables.

Note: The benefits listed in the following table complement and detail the expected benefits identified in the Operational Concept Document (OCD) for EATCHIP Phase III.

TO IMPROVE SAFETY BY:
• reducing the risk of Controller/Aircrew misunderstandings. • providing Controller/Aircrew with more accurate data. • providing an alternative means of communication. • reducing the risk of failures in the transfer of data. • reducing congestion on voice channels. • providing a visual copy of ATC messages.

TO IMPROVE ATM EFFICIENCY BY:
• increasing Controller and Aircrew productivity. • reducing the voice communications workload. • enabling automation. • providing precise and concise exchanges between Aircrew and Controllers. • optimising task distribution in ATC sectors and in the cockpit. • reducing Controller-to-Controller co-ordination. • optimising Controller/Aircrew interactions. • improving cost/efficiency. • providing Aircrew and Controllers with information otherwise unavailable (e.g. Advanced notification of Aircrew preferences to Planning Controllers).

2. Operational Constraints

The successful introduction of Air Traffic Management air/ground data communications will only be achieved by correctly addressing the following constraints:

- The use of data communications to replace, or to supplement, routine voice communications introduces significant differences to the operating practices of both Aircrew and Controllers. The operational benefits from the introduction of these services can only be realised by ensuring a full appreciation of the factors that affect human performance in complex dynamic systems.
- Data link interfaces could be more complex to use than the simple voice communication interfaces (microphone, headphone or loudspeaker) which allow the completion of routine or sequential tasks (either visual or manual) whilst listening to or answering the radio.
- The use of data link equipment will require specific additional training of human operators.
- Controllers and Aircrew will have to adjust to a dual voice/data link communication environment with mixed procedures.
- Data link may not provide the operational flexibility of ATC voice communications which make use of standard phraseology, non-standard phraseology, language and context, as appropriate. Voice is the most natural means of human communication.
- Extensive use of data link communications in ATC will result in more silent environment. Unless alternative technical means of compensation with a high degree of efficiency are implemented, this may cause a loss of situational awareness for both Aircrew and Controller:
    - this may make the use of data link communications unsuitable for tactical situations, busy phases of flight and terminal area operations.
    - this may also have adverse effects on the co-ordination and working methods of human operators.
- Air/Ground data link communications are asynchronous and this will affect Controller and Aircrew operating procedures.
- Data link will change workload distribution and this needs to be evaluated.
- The ATC systems will have to accommodate a mixed (data link-equipped/non-equipped) aircraft population.
- Data link systems and procedures, both in the air and on the ground will have to be harmonised to allow operations without major technical and operational constraints regardless of region, type of aircraft or operator.
- A multiplication and succession of various versions of data link communications systems will increase complexity and cost for the users.
- All components of a data link system will have to be subject to approval and certification processes by the appropriate regulatory bodies.

3. Air-Ground Data Link Operational Principles

3.1 Human Factors

The data link services described in is document are based on the principle that Aircrew and Controllers are the primary decision making components of the ATM. Automation should then follow a human-centred approach following the basic principles identified in the ICAO Circular 249-AN/149.

PRINCIPLES OF HUMAN-CENTRED AUTOMATION

The Human bears the ultimate responsibility for the safety of the aviation system. Therefore:

- The human must be in command.
- To command effectively, the human must be involved.
- To be involved, the human must be informed.
- Functions must be automated only if there is a good reason for doing so.
- The human must be able to monitor the automated system.
- Automated systems must, therefore, be predictable.
- Automated systems must be able to monitor the human operator.
- Each element of the system must have the knowledge of the others' intent.
- Automation must be designed to be simple to learn and operate.

3.2 Controller/Aircrew Communications

The basic principles in which the Controller/Aircrew Communications services contained in this document are based are:

- Data communications will not substitute but supplement and support voice communications.
- Data link is expected to play an important role for transmission of routine exchanges, in order to achieve a substantial gain in voice channel availability. Such exchanges, while not directly related to safety or separation-related actions in tactical or strategic traffic situations, do require a substantial percentage of voice channel occupancy and of executive Controller workload.
- It is expected that data communications will not normally be used for transmission of urgent or safety critical messages in tactical traffic situations. At the discretion of both Controllers and Aircrew and subject to defined operational procedures, data link would become a back-up safety channel in the event of failure or blockage of the R/T frequency.
- Data link procedures shall be consistent with voice procedures.
- Operational ATC data link messages should be consistent with voice phraseology standards and in accordance with relevant ICAO documents.
- Data link will permit to downlink from aircraft to ATC actual flight parameters and Aircrew preferences (e.g. top-of-descent, alternate aerodrome, preferred flight level,...), thus providing useful information to Controllers for planning tasks, while preventing the need to continuously intervene in the voice channel in request of such information.

3.3 Improved Automation

Automated functions performed by the system on the basis of air/ground data communications will increase the communication capacity and the efficiency of the system and enable to realise the full benefits that data communications can provide; a typical example is the possibility for the Aircrew to automatically load the FMS with route data provided by ATC without having to input all the waypoints manually. The system should provide automated assistance to the Controller, so as to present automatic default options for Controller approval and transmission to aircraft (e.g. responses to requests, warnings, time outs, priorities, etc.).

The following specific functions are potential candidates for either full or partial automation: frequency change, SSR code transmission, Standard Arrival Routes (STAR) notification, Required time of Arrival notification, Delay notification, Radar identification notification, Flight Plan consistency check (FLIPCY), Dynamic Route availability (DYNAV).

Meteorological information items could be automatically transmitted to concerned aircraft without need for Controller intervention, e.g. reports on significant meteorological phenomena such as turbulence, icing, hail, jetstreams, etc.

3.4 Enhanced and Advanced Surveillance

The surveillance function in European continental airspace meets the EATCHIP requirements in most areas by means of the radar. Automatic Dependant Surveillance (ADS) addressed and/or broadcast can provide added surveillance capabilities to the Controllers and basic surveillance in oceanic areas, as well as in areas where radar coverage is not available or adequate.

Within radar-covered continental airspace, the surveillance function can be further enhanced through downlinking from the aircraft to the ground system of flight parameters such as start-of-turn, end-of-turn, vertical speed, horizontal speed (IAS/Mach Number), indicated heading, intent data, etc., which will provide Controllers with data otherwise unavailable.

Airborne devices will permit to provide Aircrew with enhanced situational awareness and allow a more co-operative ATM between Controllers and Aircrew.

3.5 Delivery of Flight Information Services via data link

Aircrew will have access on request to aeronautical information of interest to flights, such as weather reports and forecasts, notice to airmen (NOTAM), Automatic Terminal Information Service (ATIS) and Instantaneous Runway Visual Range readouts. Additionally Controllers are discharged of delivering such information to Aircrew via voice, thus contributing at the same time to off-loading the R/T channel.

Data link technology will also permit contract requests, whereby Aircrew will be able to receive onboard all possible updates to requested aeronautical information during a given period of time, as specified in the contract request. Moreover, these benefits will become available without the geographical constraints of current voice VHF transmissions (e.g. ATIS, VOLMET), which are only accessible within a certain range from the broadcasting antenna.

Data link will permit the downlinking from aircraft of flight reported meteorological conditions, such as wind direction and speed, air temperature and pressure, significant met., etc., which will contribute to improve aeronautical meteorological reports and forecast and improve Controllers and Aircrew environmental awareness.

4. Guidelines for the Development of ATM Air/Ground Data Communications

Direct contact between engineers and operational staff is essential. In order to maximise effectiveness, practising air traffic Controllers and Aircrew must be directly involved in the design, set-up, participation, and further evaluation and validation of data link systems development. Involvement must remain in effect throughout the development programme.

This procedure is a productive method of achieving effective results in a relatively short period of time, and offers the following advantages over other alternatives:

User acceptance

- User acceptance of the operational system will be high, ensuring rapid and cost-effective application of the implemented technology.

User defined

- The system is defined by the users, which ensures its suitability to operational needs.

Risk reduction

- The risks for misconceptions are reduced, and system design errors are minimised.

User Motivation

- The users of the new system are motivated because they realise they are being listened to. They can see that they are influencing the design of their system, and they understand why certain design, implementation, and performance decisions have been taken.

User Input

- The operational experience and professional creativity of the users are captured at an early stage, greatly enhancing the functions being developed. Current users understand prevailing operational problems, and how best to overcome those.

Safety

- The user vision on safety aspects, based on professional experience, is taken into account as an inherent part of the overall application of the functions.

Pragmatic approach

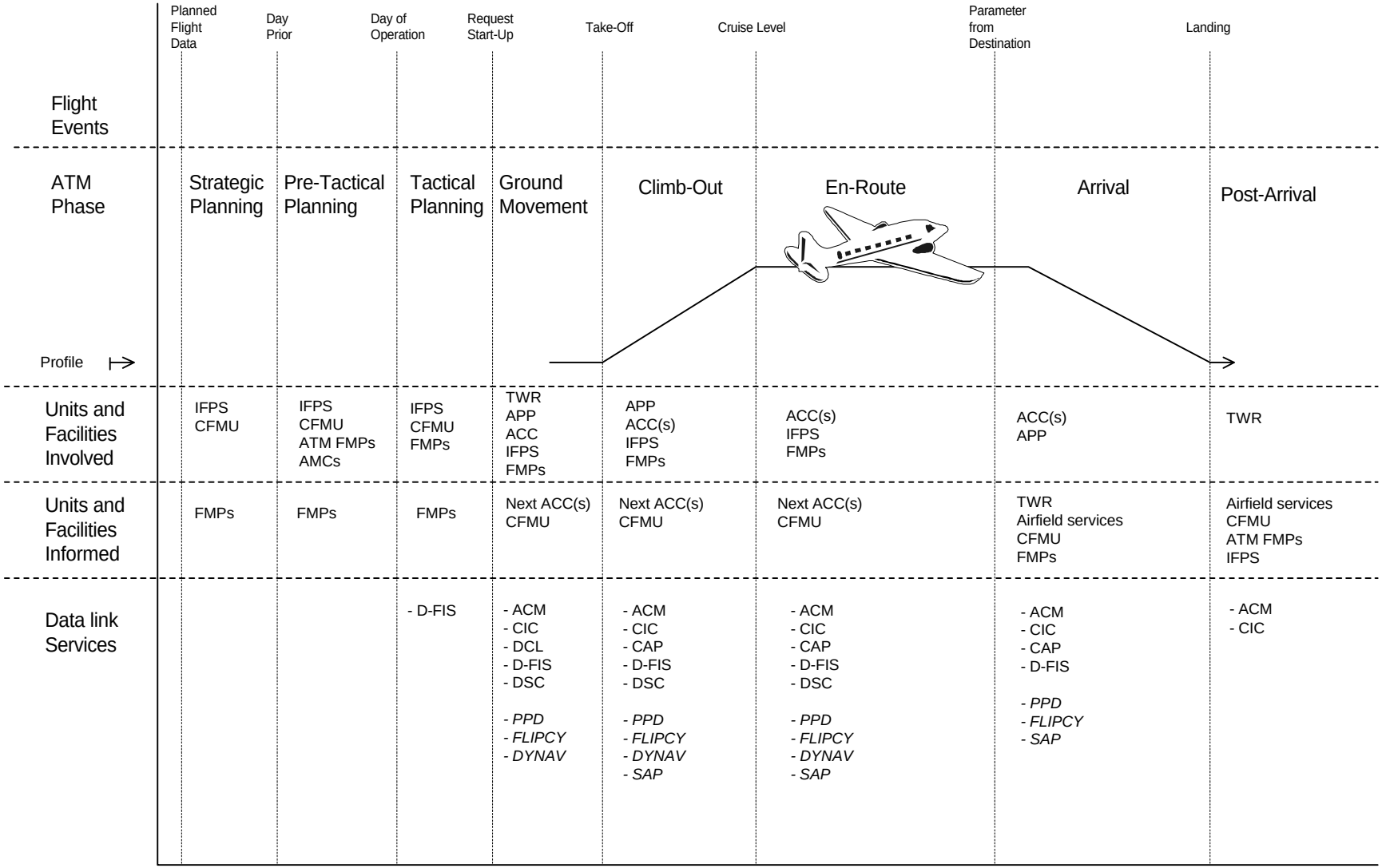
- The users are careful about technological over-engineering. They are capable of deciding how to use the tools put at their disposal in an optimum way.

Human factors

- The users have the knowledge and experience to determine how to merge the human factor aspects and the technology in a safe and efficient manner, in particular for using and mastering automation.

5. Use of Data Link Services per Flight Phase

The diagram below is intended to illustrate the normal sequence of use of data link services in relation to flight phases, ATM phases and units involved.



Note: Services under development are shown in italics

Section 3 : General Requirements

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1. Functional Requirements

This section contains general functional requirements to be supported by the data link system (i.e. the system that provides the air/ground data communications Services to Aircrew and Controllers). The data link system is considered to be composed of three subsystems: the ground end system, the aircraft end system and the communications system.

[FR 1]

The data link system shall support the exchange of ATM messages to all suitably equipped aircraft receiving air traffic services.

[FR 2]

The data link system shall support the exchange of data between ground and aircraft systems in all airspace types.

[FR 3]

The data link system shall support the technical and operational procedures described for the European ICAO region, as contained in this Operational Requirements Document.

[FR 4]

Aircrew shall be provided with information on the surrounding traffic using the appropriate technology (e.g. CDTI).

[FR 5]

Ground end systems supporting the delivery of flight information services shall not deny access from aircraft end systems.

[FR 6]

The data link system shall support distress and emergency functions. This includes a covert capability to deal with acts of unlawful interference.

[FR 7]

Operational compatibility shall be maintained for all new data link services.

[FR 8]

The data link system should be capable to accommodate the data exchanges for the predicted 2015 air traffic.

[FR 9]

The data link system shall provide the capability to unambiguously identify and validate the source and destination end systems for each message transmitted through it.

[FR 10]

The data link end-systems shall have the capability to notify the originator when a transmitted message has not successfully reached its addressee, or has not been responded by the latter within a defined time frame.

[FR 11]

The data link system shall ensure correct addressing of messages.

[FR 12]

A common time reference source shall be used for the synchronisation of the data link end systems.

[FR 13]

The data link system shall support syntax and credibility checks.

[FR 14]

The data link system shall reject invalid or corrupted data and allow notification of data to users and data recording.

[FR 15]

The data link system should provide the users with the capability to manually select available data communications medium when required by operational circumstances (or Quality of Service).

[FR 16]

In the event of link abortion or system shutdown, the ground and the airborne systems should support retention of messages.

[FR 17]

ATM data link services will depend on the end-to-end performance and quality of the entire chain of components contributing to a data link system, from the ground to the aircraft via the communication networks. An end-to-end approach must therefore apply at every level of design, manufacture, test, installation, certification, operation and maintenance of a data link system.

[FR 18]

The data link system shall adjust to changes in communication media (notably, VHF, Mode-S and Satellite) depending on technical availability.

[FR 19]

The data link system shall provide automatic error checking of user-composed, system-generated, and received messages, as well as informative error messages.

[FR 20]

Downlinked selected aircraft parameters (e.g. auto flight system panel settings and FMS target values) should not be used in integrated co-operative ATM applications and in safety critical systems without establishing their absolute validity and their relevance to the intended flight profile of the aircraft prior to their transmissions.

[FR 21]

The implementation of ATM applications and of safety critical systems using downlinked selected aircraft parameters should not result in the requirement to fly aircraft coupled to the autoflight system or specific modes at all time. Therefore the use of selected aircraft parameters should only be considered as a means to provide non essential enhancements to the normal operation of the above applications and systems.

2. Operational and Procedural Requirements

2.1. Data Link Procedures

2.1.1. General principles

[OPR 1]

Direct Aircrew/Controller voice communications shall always be available when air/ground data communications are used for Air Traffic Management (ATM).

[OPR 2]

Controllers and Aircrew shall use Data Link in conjunction with voice communications in accordance with the service descriptions contained in this document.

[OPR 3]

The procedures for use of air/ground data link communications shall be uniform and standardised in the European ICAO region in compliance with the applicable ICAO procedures.

[OPR 4]

The data link services available in every region or at ATSU shall be published in the relevant Aeronautical Information Publication.

[OPR 5]

Data link communications shall be based on the world-wide standard message sets, codes and abbreviations as contained in the relevant ICAO documents.

[OPR 6]

The display of messages by end systems shall be unambiguous and shall be in accordance with their message intent as described in the relevant ICAO documents.

[OPR 7]

In order to enable optimum use of automation, minimise error and avoid confusion, Aircrew and Controllers are expected to use free text only when no suitable standard message is available, and to limit it to the essential minimum.

2.1.2. Data Link Notification

[OPR 8]

On initiation and in the event of any subsequent change Aircrew and Controllers shall be able to identify the data link services available to them and any relevant restriction on their use (e.g. longer than usual message transfer delays).

[OPR 9]

The Aircrew shall be able to access the data authority status for each CPDLC connected ATSUs. The data authority status of an ATSU can be: Current Data Authority, Next Data Authority or Downstream Data Authority.

[OPR 10]

The Aircrew shall be able to access the identity of all connected ATSUs and the services they are performing.

2.1.3. Normal Operating Modes and Procedures

[OPR 11]

Regardless of the number of ATSUs with which an aircraft maintains data link contact, only the Current Data Authority and the Downstream Data Authority shall be able to issue clearances.

[OPR 12]

Downstream Data Authority clearances shall be in accordance with Downstream Clearance procedures published in AIPs.

[OPR 13]

The establishment of data link for ATS purposes shall only be aircraft initiated. Once the link has been established, the initiation of a specific service or message may be either ground or air initiated.

[OPR 14]

An explicit Aircrew action shall be required to acknowledge a clearance or instruction and to transmit a clearance request.

[OPR 15]

Execution of a clearance received via data link may begin as soon as the clearance is received by the Aircrew.

[OPR 16]

For each received, valid CPDLC data link message, the ground and the airborne systems shall transmit a Logical Acknowledgement (LACK) to indicate that the message has been successfully received and is operationally acceptable for further processing and eventual display.

[OPR 17]

Aircrew shall have the ability to discontinue one or more Air Traffic Services provided via data link during any phase of flight. Relevant ATSUs shall be informed of all Aircrew initiated service termination.

[OPR 18]

ATSUs shall have the ability to discontinue one or more Air Traffic Services provided via data link at any time. Involved Aircrew shall be informed of all ATSU initiated service termination.

2.1.4. Abnormal Modes and Procedures

[OPR 19]

When a required operational response is not successfully received, the message initiator shall be responsible for querying the state of the response via an appropriate medium.

[OPR 20]

When indication is provided to end-users that a data link message has not been received, the originator shall revert to voice communications when required by service descriptions.

[OPR 21]

Aircrew and Controllers shall be informed of any degradation of the Quality of Service for the data link services they are using. Quality of Service parameters and their required levels are specified in service descriptions.

[OPR 22]

Scheduled Data Link Communications Services unavailability shall be advised by NOTAM

[OPR 23]

In the event of an aircraft end system failure, Aircrew shall inform ATS using voice communications.

[OPR 24]

Clear and Unambiguous procedures for reversion to voice in abnormal situations shall be published in relevant documentation.

[OPR 25]

Appropriate phraseology shall be used to attract the attention of the end users when shifting unexpectedly from data link to voice contact. This phraseology should ensure the authentication of the originator of the voice message.

2.1.5. Mixed Data/Voice Environment Procedures

[OPR 26]

In the dual media communications environment, data link procedures shall be compatible and consistent with voice procedures.

[OPR 27]

Voice shall be the primary controller/pilot communication channel for non-routine or flight/time critical messages.

[OPR 28]

When a controller or pilot communicates via voice, the response should be via voice.

[OPR 29]

Controllers shall not be required to transmit a message via voice to an Aircrew if they are aware that the Aircrew has already received the message via data link.

[OPR 30]

Existing procedures for maintaining a continuous listening watch on the active voice frequency shall be maintained when using air/ground data link.

[OPR 31]

Instructions and acknowledgements given via voice shall have precedence over instructions and acknowledgements given via data link, except in the case of suspected unauthorised intrusion on the voice channel.

[OPR 32]

In the case of suspected unauthorised intrusion on the voice channel, the appropriate authentication procedures via data link shall be executed if possible.

3. Human Factors Requirements

3.1. Situational Awareness

[HFR 1]

Technical means of maintaining or improving situational awareness for Controllers and Aircrew shall be implemented to compensate for any potential loss of the party line effect.

3.2. Impact on Aircrew/Controller Workload

[HFR 2]

The use of data link communications will have an effect on the working procedures of both Aircrew and Controllers. Therefore, the effect of data link on operations shall be carefully studied before deciding to what extent voice will be replaced by data link, in order to prevent adverse consequences.

[HFR 3]

The use of data link equipment should not increase significantly the amount of head-down time and key-stroking, in particular within the cockpit. Any possible increase in head-down time in the cockpit or at the sector suite shall not provoke any disruption, breakdown in operating procedures or incompatibility with working methods essential to other functions and duties of Controllers and Aircrew.

[HFR 4]

The introduction of A/G data communications shall ensure that the total workload is not increased.

[HFR 5]

The use of different data link media shall not add additional workload to the Controller or Aircrew.

[HFR 6]

The impact on workload introduced by operational environments supporting the use of mixed voice and data link communications shall be minimised.

[HFR 7]

The potential sources of confusion leading to human error introduced by operational environments supporting the use of mixed voice and data link communications shall be eliminated.

3.3. HMI Requirements

3.3.1. General

[HFR 8]

The data link system human-machine interface shall be designed in accordance with human factors design principles and guidelines, such as minimal user action requirement for initialisation of the system, minimisation of user re-entry of data link information to update airborne and ground-based systems, provision of aids for message acknowledgement and preparation that minimise user actions, minimisation of the opportunity for user data entry errors, no alert on routine messages, message display in a non-disruptive manner.

[HFR 9]

To support multiple operators working as a team, data link system interface for message preparation and display shall be located within reach and within the forward field of view of all Aircrew and Controller team members, and it shall operate in a manner that is consistent with surrounding flight deck or ATC working position functions.

[HFR 10]

The data link system shall provide the adequate filters, in order to display to end-system users only the required information according to operational needs.

[HFR 11]

The data link system shall have the capability to inform its user on its current operational status and configuration (including the status of all automatic functions).

[HFR 12]

Mechanisms to support controllers and Aircrew in formatting and inputting messages to the data link systems should be designed to be error resistant to minimise the consequences of incorrect inputs.

[HFR 13]

Unless specifically stated otherwise, in cases where Services are invoked by manual input of operational data (e.g. ATC Clearances), ground and airborne systems shall have facilities for controllers and Aircrew to knowingly validate the specific data before triggering the Service.

[HFR 14]

Where different data link media are available, the ground working positions and the avionics functionality shall not require the Controller and the Aircrew to use different input and output devices to exchange data link messages.

[HFR 15]

The HMI shall automatically display the appropriate prompts and relevant default values in support to the composition of responses to previously received messages.

[HFR 16]

The data link system shall provide capability for the user to preview messages as they are composed and before they are transmitted.

[HFR 17]

Means shall be provided to permit Aircrew and Controllers to immediately identify and respond to urgent messages.

[HFR 18]

The data link system shall provide a capability for the user to temporarily set aside an ongoing data link message or process and resume processing at the point at which it was set aside.

[HFR 19]

The data link system shall have the capability to receive, maintain, and manage a queue of incoming messages, to notify the user of its presence and to distribute them to flight deck and ground system displays and output devices.

[HFR 20]

The data link system shall provide the capability for the operator to access and respond to messages in any order.

[HFR 21]

The data link system shall provide user access to data link message history.

[HFR 22]

Automatic visual or aural warnings shall be provided in the event of malfunction of any element of the data link system.

[HFR 23]

The data link system shall provide the capability for the user to shut down a data link equipment where applicable.

[HFR 24]

The system shall provide the capability for the user to inhibit automatic transmission of messages.'

[HFR 25]

The data link system shall provide the capability to display the reception of Logical Acknowledgment (LACK) messages.

[HFR 26]

When a CPDLC message requires a response, the receiving Aircrew or Controllers shall be informed by suitable means.

3.3.2. Aircrew Interface

[HFR 27]

Aircrew should have the means to monitor and control ATM data link communications to and from the aircraft.

[HFR 28]

The HMI should reduce the number and the duration of each access to head-down devices during critical flight phases to a minimum. The pilot flying -i.e. the one handling the aircraft trajectory - should not have to use any of these devices during such phases, except for the purpose of cross-checking the actions of other crew members.

Critical flight phases are take-off, final approach and landing and emergency situations.

[HFR 29]

Data link equipment should allow for simple and effective means for the retrieval and display of information permitting easy cross-checks between crew members, i.e. all crew members should be able to monitor both up-linked and down-linked messages without any breakdown in crew co-ordination and operating procedures.

[HFR 30]

Data link control and display units should be integrated in the cockpit within easy reach and forward field of view of Aircrew members.

[HFR 31]

Message characters shall remain readable under all cockpit conditions, including turbulence.

[HFR 32]

Provisions should be made for automatic storage, and retrieving of data link messages. The crew should be able to edit old messages and send them as new messages. A facility to produce hard-copies should be provided in the cockpit.

[HFR 33]

Uplink messages shall be announced by appropriate visual and/or aural alerting.

[HFR 34]

Aircrew alerting shall not overload the visual sensor.

[HFR 35]

Aural alerting shall not be disturbing, specially during critical flight phases.

[HFR 36]

The use of synthetic voice to facilitate the co-ordination of communications management tasks with other cockpit operating procedures should be explored.

[HFR 37]

Immediate and simple access to specific distress or emergency data link functions shall be available to the Aircrew. This includes the ability to select and to terminate an ADS emergency mode, and to covertly indicate that an unlawful interference has occurred.

[HFR 38]

The airborne system will clearly indicate to the Aircrew when a clearance execution must be deferred, as specified in the contents of the message.

[HFR 39]

ICAO sector/unit names received in ACM and data link authority messages shall be displayed to the Aircrew using the ATSU voice identifier, to prevent misunderstanding in mixed data-voice operations.

3.3.3. Controller Interface

[HFR 40]

Data-link-related HMI shall make all data link-equipped aircraft clearly distinctive to the controller.

[HFR 41]

The data link applications supported by the aircraft shall be clearly indicated to the Controller.

[HFR 42]

The capability shall be provided to the Controller to select distribution lists defining multiple recipients for the same message (e.g. "turbulence report").

4. End to end Certification

[CERT 1]

A Safety Management Programme shall be an integral part of the design, manufacture, test, installation, operation and maintenance of a data link system.

[CERT 2]

The certification process shall include a full safety assessment and integration tests encompassing the airborne, communications and ground domains by the responsible bodies.

[CERT 3]

Where third party service providers are used for data link services, they must meet Service Level Agreements (SLA).

5. Security Requirements

[SER 1]

A Security Management Programme shall be an integral part of the design, manufacture, test, installation, operation and maintenance of a data link system.

[SER 2]

The Security Management Programme shall identify the means of containing the effects of security breaches internally and externally to the data link system, identify recovery actions and also mitigation procedures to prevent re-occurrence.

[SER 3]

A security policy shall be developed for data link systems.

[SER 4]

The data link system shall be protected against security violations in accordance with QOS requirements as described in the service descriptions.

[SER 5]

ICAO Annex 17 provisions should be applicable to all ATM data link systems.

[SER 6]

The airborne and ground systems shall be able to detect security breaches and alert the users with appropriate data security warnings.

[SER 7]

Ground data bases and recordings of data communications shall be protected against access by unauthorised persons.

6. Communications Requirements

6.1. Quality Of Service

[COMR 1]

The data link system shall meet quality of service requirements, as described for every service.

[COMR 2]

The data link system design shall ensure that the reliability, availability, continuity and maintainability targets identified as a result of the system safety analysis are met.

6.2. Priority Of Service

[COMR 3]

ATM data communications shall have priority over all other air/ground data communications.

6.3. Performance

[COMR 4]

The capacity of the data link system shall be such that the Quality of Service for each service is maintained in the case of simultaneous use of all services for all predicted traffic.

7. Recording and Retention Requirements

[RER 1]

Airborne recording shall be in accordance with the applicable regulations.

[RER 2]

A full and complete record of all uplink and downlink data link messages processed and received in ground systems shall be retained for 30 days for legal purposes, in compliance with ICAO regulations for voice recordings.

[RER 3]

Archive systems shall support, at a minimum, the ability to retrieve and replay the data communications record in accordance with one or more of the following criteria : specified time period; specified aircraft or group of aircraft; specified control position; specified message type.

8. Legal Considerations

[LER 1]

Downlink aircraft parameters should be considered as restricted information and protected as such by regulatory measures and legal agreements.

[LER 2]

In case of incident/accident the access to recordings of data communications shall be limited to the accident investigators under the same conditions as the data extracted from the aircraft Digital Flight Data Recorders.

[LER 3]

Studies should be conducted to assess the possible legal implications of the use by the controller of data link-derived information (e.g. PPD, ADAP, TCAS R/A) while issuing ATC clearances and instructions, as well as the possible obligation for the controller to use such information.

[LER 4]

Data communications should be subject to similar legal provisions as those applied to ATC voice communications.

Section 4 : Controller Pilot Data Link Communications (CPDLC) Introduction and Definitions

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1. Controller Pilot Data Link Communications

Controller Pilot Data Link Communications (CPDLC) is a means of communication between Controller and Aircrew, using data link for ATC communication.

The Controller is provided with the capability to issue altitude assignments, crossing constraints, lateral deviations, route changes and clearances, speed assignments, radio frequency assignments, and various requests for information. The Aircrew is provided with the capability to respond to messages, to request clearances and information, to report information, and to declare/rescind an emergency. The Aircrew is provided with the capability to request conditional clearances (downstream) and information from a downstream ATSU. A “free text” capability is provided to exchange information not conforming to defined formats.

The CPDLC function has been split into four operational data link services described in this document:

1. Clearance and Information Communications (CIC) Service.
2. ATC Communications Management (ACM) Service.
3. Departure Clearance (DCL) Service.
4. Downstream Clearances (DSC) Service.

These services are fully described in the following sections.

Other operational services using CPDLC will be the subject of further editions of this document.

All the CPDLC services contained in this document are compliant with the requirements contained in the “ICAO Manual of Air Traffic Services (ATS) Data Link Applications” except when specifically indicated.

2. Establishment and Termination of CPDLC Communications

The normal sequence of events for performing CPDLC exchanges, according to the “ICAO Manual of Air Traffic Services (ATS) Data Link Applications”, requires the following steps:

1. Aircraft’s logon,
2. CPDLC link establishment,
3. Performance of CPDLC exchanges, and
4. CPDLC link termination.

These steps are described in the next table.

Step	Operation
1	**Aircraft's Logon** The aircraft must logon to the ATSU with which it expects to perform CPDLC exchanges. This logon will be initiated manually by the Aircrew or automatically by the avionics upon notification of the next ATSU by the current ATSU. Its purpose is twofold: 1. To allow unambiguous association of the aircraft with flight plan information stored at the ATSU; 2. To allow the avionics and the ATSU systems to interchange technical data that will allow the activation of the data link (technical data on all the services requested by the aircraft and provided by the ATSU is automatically interchanged during the logon). In order to allow correct data link message addressing as well as Flight Plan Correlation (if required), the following information shall be provided by the Aircraft at data link Logon: 1. Aircraft Identification, as described in ICAO Flight Plan Item 7; 2. Departure Aerodrome, as described in ICAO Flight Plan Item 13; 3. Destination Aerodrome, as described in ICAO Flight Plan Item 16; 4. Aircraft Address: as described in the "ICAO Manual of Air Traffic Services Data Link Applications"; 5. Estimated Off-Block Time, as described in ICAO Flight Plan Item 13. *Note: This requirement is specific to the European airspace.*
2	**CPDLC link establishment** Two types of CPDLC links are possible : 1. **The Current ATSU Link (C-ATSU link).** This CPDLC link is established between the aircraft and the ATSU currently responsible for control of the aircraft (the C-ATSU). C-ATSU links are established as a result of the ATC Communications Management (ACM) Service. 2. **The Downstream ATSU Link (D-ATSU link).** This CPDLC link is established between the aircraft and an ATSU which may be responsible for control of the aircraft in the future - a Downstream ATSU (D-ATSU). D-ATSU links are established through the Downstream Clearances (DSC) Service.
3	**CPDLC exchanges** Once the CPDLC link is established the CPDLC exchanges are possible following the procedures specified in the service descriptions. If a C-ATSU link is established, then the Departure Clearance (DCL) Service, the Clearances and Information Communications (CIC) Service and the ATC Communications Management (ACM) Service are available as appropriate. If a D-ATSU link is established, the Downstream Clearances (DSC) Service is available with that D-ATSU. All CPDLC exchanges use the same CPDLC message format. This format is presented below in page 4.
4	**CPDLC link termination** This step ends the availability of the concerned services. The termination of the C-ATSU link is described in the ACM service. The termination of the D-ATSU link is described in the DSC service.

3. CPDLC Message Format

This subsection describes the ICAO message format used in all CPDLC exchanges through C-ATSU and D-ATSU links.

3.1. Message Structure

A CPDLC message is composed of a message header, and from one to five message elements.

	Field	Description
Message Header	Message Identification Number	assigned by the sending system sequentially and per destination (a different counter shall be used for each destination).
	Message Reference Number	for response messages only. The message reference number of a response message shall be identical to the message identification number of the received message to which it responds.
	Time Stamp	the time the message is dispatched by the originating user. It consists of the date (YYMMDD) and time (HHMMSS).
	Logical Acknowledgment Requirement	indicates whether a logical acknowledgment (LACK) is required for the message. The CIC, DCL, ACM and DSC services require a LACK for all messages (except for ERROR and LACK messages).
Message Elements	Message Element 1	valid Message Elements for each service are contained in the service descriptions.
	Message Element 2	
	Message Element 3	
	Message Element 4	
	Message Element 5	

3.2. Message Attributes

For each message element, Urgency, Alert, and Response attributes are specified in each service description.

Abbreviation	Attribute	Description
URG	Urgency	This attribute delineates the queuing requirements for received messages that are displayed to the end-user.
ALRT	Alert	This attribute delineates the type of alerting required upon message receipt.
RESP	Response	This attribute mandates response requirements for a given message element.

NOTE : For additional information on the use of these attributes, please refer to the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications".

3.2.1. Message Attribute Association Rules

When a message contains a single message element, the message attributes of the message are those of the message element.

When a message contains multiple message elements, the highest precedence message element attribute associated with any element in the message becomes the message attribute type for the entire message (message element precedence values are defined below). For example, a message containing multiple message elements where at least one element has a D (Distress) Urgency will have a D Urgency attribute (the D attribute has the highest precedence).

Any message that is considered a response message (i.e. it contains a message reference number) shall have message urgency and alert attributes not less than the message to which it responds to.

The following tables specify the possible values for the message element attributes and their precedence:

3.2.2. Urgency Values

Type	Description	Precedence
D	Distress	1
U	Urgent	2
N	Normal	3
L	Low	4

3.2.3. Alert Values

Type	Description	Precedence
H	High	1
M	Medium	2
L	Low	3
N	No alerting required	4

3.2.4. Response Values

3.2.4.1. Response Attributes for Down-Link Message Elements

Type	Valid Responses	Precedence
Y	Any CPDLC uplink message, LOGICAL ACKNOWLEDGMENT (only if required),	1
N	LOGICAL ACKNOWLEDGMENT (only if required), ERROR (if necessary, only when logical acknowledgment is required)	2

3.2.4.2. Response Attributes for Up-Link Message Elements

Type	Valid Responses	Precedence
W/U	WILCO, UNABLE, STANDBY permitted, LOGICAL ACKNOWLEDGMENT (only if required), ERROR (if necessary)	1
A/N	AFFIRM, NEGATIVE, STANDBY permitted, LOGICAL ACKNOWLEDGMENT (only if required), ERROR (if necessary)	2
R	ROGER, UNABLE, STANDBY permitted LOGICAL ACKNOWLEDGMENT (only if required), ERROR (if necessary)	3
Y	Any CPDLC downlink message, LOGICAL ACKNOWLEDGMENT (only if required)	4
N	LOGICAL ACKNOWLEDGMENT (only if required), ERROR (if necessary, only when logical acknowledgment is required)	5

3.3. Message Response Requirements

3.3.1. Responses to Multi-element Messages

Controllers and Aircrew can only respond to a received message in its entirety. This means for example, if 3 message elements are concatenated in a single message, any response given applies to the whole message, and not to any individual message element.

3.3.2. Closure Responses

Several messages can be received in response to a sent message. For example, in response to a message containing the message element “PROCEED DIRECT TO [position]” which has a W/U Response attribute, the ATSU could receive the following three consecutive responses:

1. a message containing a “LOGICAL ACKNOWLEDGMENT” message element;
2. a message containing the “STANDBY” message element, and
3. a message containing the “WILCO” message element.

If the ATSU receives any other response message after the reception of the “WILCO” message, this response shall be rejected and the aircraft shall be informed of the rejection (via an ERROR message).

The responses after which no other response messages shall be accepted (like the WILCO in the previous example) are referred to as **closure** responses.

The closure response messages for each message response category are given in the following table:

Response Type	Closure Responses
W/U	A response message containing at least a WILCO, UNABLE, or ERROR message element
A/N	A response message containing at least an AFFIRM, NEGATIVE, or ERROR message element
R	A response message containing at least a ROGER, UNABLE or ERROR message element
Y	The first response message sent from the aircraft that does not contain a STANDBY or LOGICAL ACKNOWLEDGMENT (only when required) The first response message sent by the ground that does not contain a STANDBY, LOGICAL ACKNOWLEDGMENT (only when required) or REQUEST DEFERRED message element from the ground system.
N	The only permitted response shall be a closure response message that contains a LOGICAL ACKNOWLEDGMENT when this has been required or an ERROR message element when a logical acknowledgment is required.

3.3.3. Manual Closures

Controllers and Aircrew shall have the capability to provide closure for all CPDLC messages, independent of closure message receipt. This functionality will be referred to as **manual closure**.

The sender and the receiver of a message shall be able to provide a manual closure response for it. Manual closures shall be notified to the other partner via a specific data link closure message (Uplink : MESSAGE REJECTED. REVERT TO VOICE; Downlink : MESSAGE REJECTED. REVERTING TO VOICE).

NOTE : The "ICAO Manual of Air Traffic Services (ATS) Data Link Applications" requires the availability of manual closures but it does not allow to notify manual closures to the other partner.

Section 5 : Clearances and Information Communications (CIC) Service

Service No.	Name	Abb.	Cat	References	Version No.
O-4	Clearances and Information Communications	CIC	CM	"ICAO Manual of Air Traffic Services (ATS) Data Link Applications"	2.0 16/5/97

Table of Contents

1. Scope and Objective

This section describes aircraft/C-ATSU air-ground data communication message exchange and procedures for operations within the European region for the following:

- Aircrew's reports and clearance requests;
- Controller's delivery of clearances, instructions and notifications to aircraft;
- Support and system messages.

The service description states the exchanges that could be conducted via data communications, the rules for the combination of voice and data link communications and abnormal mode requirements and procedures.

2. Expected Benefits, Anticipated Constraints, and Associated Human Factors

2.1 Expected Benefits

⇨ Reduction of the potential for communications errors between Aircrew and Controller.

⇨ Reduction in Controller voice communications workload, particularly for the executive Controller.

⇨ Enforcement of the use of standard phraseology.

⇨ Reduction in Aircrew voice communications workload (e.g. reduced hand-copy of clearances (when required) and information, reduced voice communications use).

⇨ Allows automatic preparation of clearance and information elements for Controller validation.

⇨ Reduction of voice channel load.

⇨ Allows more flexible execution of communications tasks.

⇨ Provision of an alternative means of communications.

⇨ Improvement of ATC sector team task sharing by permitting the planning Controller to take on some communications tasks.

2.2 Anticipated Constraints

⇨ Loss of Aircrew situational awareness due to the loss of the Aircrew capability to monitor all Controller communications with aircraft in the same sector.

⇨ Mixed voice and data communications working procedures.

⇨ Lack of sense of urgency provided by voice tone.

⇨ Aircrew unawareness of sector workload.

⇨ Controllers and Aircrew will have to cope with mixed data link equipped and non-equipped aircraft populations.

2.3 Associated Human Factors

⇨ Regardless of the level of system automation in use, Controllers and Aircrew should have the capability to review, validate and acknowledge (where appropriate) any message being delivered or received.

3. Service Operational Context

An aircraft under the control of an ATSU transmits reports, makes requests and receives clearances, instructions and notifications. The CIC service describes the dialogue procedures to be followed to perform these exchanges via air/ground data communications.

The data link messages supported by this service include the ones proposed in the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications" for the Package 1 of the CNS/ATM plus some additional messages proposed for Package 2. Those additional messages can be used under Package 1 as pre-formatted free text messages (message elements proposed for Package 2 are identified in subsection 8 below by the text N2 in the "Msg. Num." column.).

3.1 CIC Service Use

The CIC service is expected to be used:

1 when the follow up of the instruction is not time critical based on Aircrew and Controller judgement, or

2 as a backup to voice communications.

In the context of a mixed data-voice environment, specific Aircrew and Controller training will be required to ensure that the decision to use CIC or voice is appropriate to a given tactical situation.

3.2 Message Elements Classification

The message elements that can be used to compose CIC messages have been grouped in five classes, according to the criticality of the information exchanged. These classes are :

⇒ Class 1 : distress/emergency/urgent/ unlawful interference messages

The messages in this class refer to distress and emergency situations, as well as instructions to be executed immediately in order to preserve safety.

⇒ Class 2 : tactical messages

This class holds tactical control messages requiring a change in current flight parameters in real time.

⇒ Class 3 : strategic messages

Strategic control messages are those requiring a change in a flight parameter at a future point in time.

⇒ Class 4 : information messages

These are other messages not having any influence on flight parameters.

⇒ Class 5 : special messages

This class groups messages that may belong to several of the above categories (depending on their operational use) and system messages.

The frequency of use (FOU) of the CIC message elements has also been identified using the following codes:

1 Indicates message elements routinely used and/or expected to provide the maximum benefits for the CIC service.

2 Messages not frequently used but should be available for strategic planning, future system expansion and as back up to voice communications.

3 Messages not used for initiation of exchanges in the European airspace or which use is described in other data link services.

\- System message.

* Special message for which additional guidance is required.

The combination of frequency of use and criticality classification provides guidance on operational use and priority of the messages in relation to end to end system and HMI issues.

Subsection 8 below lists the message elements belonging to each class and their associated frequency of use.

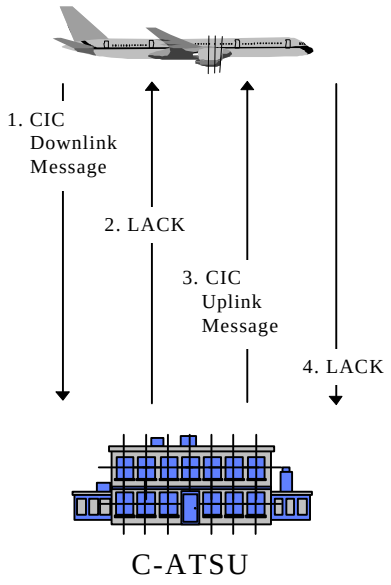
4. Overview of Operating Methods with and without Data Link

CIC dialogues between Aircrew and the controlling ATSU (C-ATSU) are composed of an iteration of the following exchanges:

4.1 Aircrew-initiated exchange (Downlink)

Step	Operating Method without Data Link	Operating Method with Data Link
1	The Aircrew sends a message via voice communications to the C-ATSU.	The Aircrew sends a CIC Downlink Message via data link to the C-ATSU.
2		The C-ATSU automatically transmits via data link a logical acknowledgement (LACK) to the aircraft indicating that the message is valid and will be displayed to the Controller.
3	The Controller transmits an appropriate response to the aircraft via voice communications.	If required [1], the Controller transmits via data link an appropriate CIC Uplink Message as a response to the received message. Prior to this response, the Controller may send a STANDBY response message to indicate that the request has been received and a response will be sent shortly.
4		The aircraft automatically transmits via data link a logical acknowledgement (LACK) to the C-ATSU indicating that the message is valid and will be displayed to the Aircrew.
5		If the response transmitted by the Controller in step 3 requires further response by the Aircrew, this message shall be considered as a Controller-initiated message, as described in the Uplink exchange in page 6.

4.1.1 Information Exchanges

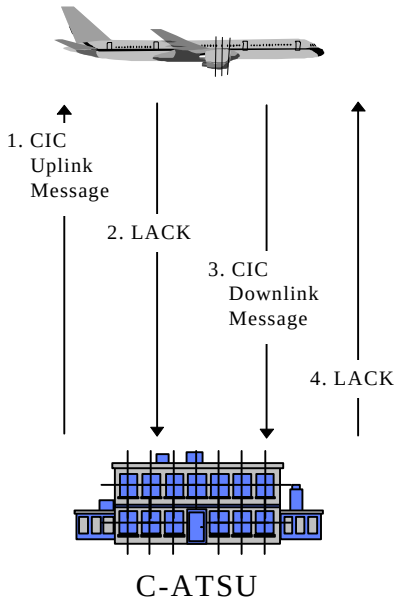


[1] Some of the messages that require a response when transmitted via voice communications, no longer require a response when transmitted via data link (the system generated logical acknowledgment is considered to be the response). These messages are identified in subsection 8 with a “N” RESP attribute.

4.2 Controller-initiated exchange (Uplink)

Step	Operating Method without Data Link	Operating Method with Data Link
1	The Controller sends a message via voice communications to the aircraft.	The Controller sends a CIC Uplink Message via data link to the aircraft.
2		The aircraft transmits via data link a logical acknowledgement (LACK) to the C-ATSU indicating that the message is valid and will be displayed to the Aircrew.
3	The Aircrew transmits an appropriate response to the C-ATSU via voice communications.	If required, the Aircrew transmits via data link a CIC Downlink Message as a response to the received message. Prior to the operational response, the Aircrew may send a STANDBY response message to indicate that the request has been received and an operational response will be sent shortly.
4		The C-ATSU transmits via data link a logical acknowledgement (LACK) to the Aircraft indicating that a valid response has been received and will be displayed to the Controller.
5		If the response transmitted by the Aircrew in step 3 requires further response by the Controller, this message shall be considered as an Aircrew-initiated message, as described in the Downlink exchange in page 5.

4.2.1 Information Exchanges



5. Detailed Service Operating Method with Data Link

5.1 Service Availability

This service shall be available during all flight phases.

5.1.1 Service Availability Constraints

This service provides exclusively the air/ground data link exchanges between an Aircraft and its C-ATSU. Exchanges with downstream ATSUs are defined in the Downstream Clearance (DSC) service.

The CIC service shall not be available during the transfer of ATC communications described in the ATC Communications Management (ACM) Service. Specifically, the CIC service shall no longer be available after the Voice Change Instruction (VCI) has been issued by the Controller (this instruction is described in the ACM service). It shall become available again if the Aircrew provides an Unable response to the VCI.

5.2 Service Description

The CIC operating method conforms to the existing voice communications operating method.

5.2.1 Normal Mode

5.2.1.1 Aircrew-initiated exchange (Downlink)

The normal sequence of events is:

Step	Operation
1	The Aircrew shall identify a situation requiring a data link message to be sent to the Controller. The Aircrew shall initiate a CIC Downlink Message by selecting message elements from the predefined set listed in subsection 8. The composed message shall be checked in accordance with message composition rules, as described in subsection 8.4, before it is sent via data link to the C-ATSU.
2	The C-ATSU shall automatically transmit via data link a logical acknowledgement (LACK) to the aircraft if the received messaged has been validated and is available for display to the Controller.
3	The Controller shall be notified of the received message. The Controller shall compose a response CIC Uplink Message by selecting message elements from the predefined set listed in subsection 8, if a response is required. *NOTE: Prior to the operational response, the Controller shall be able to send a response message containing the STANDBY message element to indicate that the request has been received and an operational response will be sent shortly.* The composed message shall be checked in accordance with message composition rules as described in subsection 8.4, before it is sent via data link to the aircraft.
4	If the response message: 1. is received before the expiration of the operational time-out (to = 2 min), and 2. has been validated, and 3. is available for display to the Aircrew, then the aircraft shall transmit via data link a logical acknowledgement (LACK) to the C-ATSU. All other cases are described in the abnormal mode subsection. *NOTE: When a STANDBY response message is sent prior to the operational response, the timer for the operational response (to) shall be disabled and two new timers shall be started:* *a) the standby operational timer (ts). On expiration of 'ts' the Controller shall be warned of the pending Standby.* *b) the standby termination timer (tt). On expiration of 'tt' the message "STANDBY TIMED-OUT" shall be automatically sent to the aircraft closing the exchange.* *These two timers shall be disabled if the Controller provides an operational response before their expiration.*
5	The Aircrew shall be notified of the received message. The received message shall be considered as a Controller-initiated message, as described in the Uplink exchange in page 8, when it requires a response.

5.2.1.2 Controller-initiated exchange (Uplink)

The normal sequence of events is:

Step	Operation
1	The Controller shall identify a situation requiring a data link message to be sent to the Aircrew. The Controller shall initiate a CIC Uplink Message by selecting message elements from the predefined set listed in subsection 8. The composed message shall be checked in accordance with message composition rules , as described in subsection 8.4, before it is sent via data link to the aircraft.
2	The aircraft shall transmit via data link a logical acknowledgement (LACK) to the C-ATSU if the received message has been validated and is available for display to the Aircrew.
3	The Aircrew shall be notified of the received message. The Aircrew shall compose a response CIC Downlink Message by selecting message elements from the predefined set listed in subsection 8, if a response is required. *NOTE: Prior to the operational response message, the Aircrew shall be able to send a response message containing the STANDBY message element to indicate that the request has been received and a response will be sent shortly.* The composed message shall be checked in accordance with message composition rules as described in subsection 8.4 before it is sent via data link to the C-ATSU.
4	If the response message: 1. is received before the expiration of the operational time-out (to = 2 min), and 2. has been validated, and 3. is available for display to the Controller, then the C-ATSU shall transmit via data link a logical acknowledgement (LACK) to the Aircraft. All other cases are described in the abnormal mode subsection. *NOTE: When a STANDBY response message is sent prior to the operational response, the timer for the operational response (to) shall be disabled and two new timers shall be started:* *a) the standby operational timer (ts). On expiration of 'ts' the Aircrew shall be warned of the pending Standby.* *b) the standby termination timer (tt). On expiration of 'tt' the message "STANDBY TIMED-OUT" shall be automatically sent to the ATSU closing the exchange.* *These two timers shall be disabled if the Aircrew provides an operational response before their expiration.*
5	The Controller shall be notified of the received message. The received message shall be considered as an Aircrew-initiated message, as described in the Downlink exchange in page 8, when it requires a response.

5.2.1.3 Sequence of services

The CIC service requires the previous establishment of the C-ATSU link provided by the ATC Communications Management (ACM) service.

5.2.1.4 Additional Guidelines

The display of messages by end systems shall be unambiguous and shall be in accordance with their message intent as described in PANS-RAC, ICAO Doc 4444.

Airborne and Ground systems shall be able to receive and process (including display of operational contents) all message elements defined in the ICAO Manual of Air Traffic Services (ATS) Data Link Applications.

The airborne systems should be able to adapt the HMI to the preferred message element subset defined for the European ICAO region and published in the relevant ICAO documentation. The airborne systems should be able to obtain the information on the applicable message elements subset at logon automatically.

5.2.2 Abnormal Mode

5.2.2.1 General Error Handling

Abnormal Event	Response
Doubt or ambiguity concerning a data link message.	Negotiation shall be carried-out via voice communications. Manual closure shall be provided for the message. Ground and airborne systems shall be updated with the operational contents of any voice transaction.
Incorrect message originator. In the CIC service, the aircraft shall only accept messages from the C-ATSU, and the C-ATSU shall only accept messages from an aircraft under its control.	The message shall be discarded and an ERROR response message shall be sent to the message originator.
Expiration of a technical response (tr = 20 sec) time-out without reception of a LACK or an ERROR message.	The Controller or Aircrew so notified should revert to voice to complete that dialogue. In case a valid LACK or ERROR message is received after the time-out, local implementation may permit further processing of the received message, but this processing should in no way obviate the need for Controller/Aircrew notification and voice contact.
Expiration of an operational time-out (to = 2 min) without reception of the operational response message.	The Aircrew or Controller so notified should revert to voice to complete that dialogue. In case a valid response is received after the operational time-out, an ERROR response message, indicating MESSAGE LATE shall be sent to the originator. Local implementation may permit further processing of the received message, but this processing should in no way obviate the need for Controller/Aircrew notification and voice contact.
Expiration of the Standby termination (tt) time-out without the sending of the operational response message.	The message “STANDBY TIMED-OUT” shall be automatically generated to close the exchange. The Aircrew or Controller so notified may revert to voice to complete that dialogue when appropriate.
Reception of an ERROR response message.	The Aircrew or Controller so notified should revert to voice to complete that dialogue and may attempt to re-establish the data link operations as appropriate.

Reception of an invalid message due to: 1. duplicate message identification number. (Catastrophic Failure)	The CPDLC link shall be aborted and the Controller and the Aircrew shall be informed that the link abortion reason is the duplication of message identification numbers. The Aircrew or Controller so notified should revert to voice to complete all dialogues open at the time of the link abortion.
Reception of an invalid message due to: 1. incorrect message reference number; 2. incorrect time stamp [2]; 3. logical acknowledgement not required.	The message shall be discarded and an ERROR response message shall be sent to the message originator (except to ERROR and LACK messages as described below). The Aircrew or Controller so notified shall revert to voice to complete that dialogue. If the invalid message received is a LACK or an ERROR, the invalid message shall be discarded but no ERROR response shall be generated.
Reception of a message that will not be processed further for whatever reason.	The message shall be discarded and an ERROR response message shall be sent to the message originator. Pre-formatted free text may be used to notify the cause of the error. The Aircrew or Controller so notified should revert to voice to complete that dialogue and may attempt to re-establish the data link operations as appropriate.
Reception of a message containing a time stamp that indicates that the logical acknowledgment (LACK) or an ERROR message can not reach the originator before the established time-out.	The received message shall be notified to the recipient Controller or Aircrew with an indication of the existence of a data link performance problem. No logical acknowledgment (LACK) or ERROR message shall be sent to the originator.
Response message received before the LACK to the request message.	The response message shall be processed as if a LACK had been received. If the LACK is received after the response message it shall be considered as an out of order message, the recipient system shall be advised and no ERROR response message shall be sent via the air/ground data link. *NOTE: This functionality is not supported in the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications".*

[2] A time stamp shall be considered incorrect when it designates a time in the future or 5 minutes before the current time. Local procedures may define a shorter time.

5.2.2.2 Aircrew-initiated exchange (Downlink)

This subsection contains service specific abnormal cases in addition to the general ones described above.

Step	Abnormal Event	Response
1	Incorrect message composed by the Aircrew due to: 1. Invalid combination of message elements, as described in subsection 8.4.	The Aircrew shall be informed of the error. The message shall not be sent.
2	Invalid message received at the C-ATSU due to: 1. Invalid combination of message elements, as described in subsection 8.4.	The message shall be discarded and an ERROR response message shall be sent to the aircraft. Free text shall be included in the ERROR message to indicate the cause of the error.
3	Incorrect response message composed by the Controller due to: 1. Invalid combination of message elements, as described in subsection 8.4. 2. Response message does not conform to what is required by the Response attribute of the received message (message response attributes [RESP] are specified in subsection 8.2).	The Controller shall be informed of the error. The message shall not be sent.
4	Invalid message received by the aircraft due to: 1. Invalid combination of message elements, as described in subsection 8.4. 2. Response message does not conform to what is required by the Response attribute of the received message.	The message shall be discarded and an ERROR response message shall be sent to the C-ATSU. Free text shall be included in the ERROR message to indicate the cause of the error.

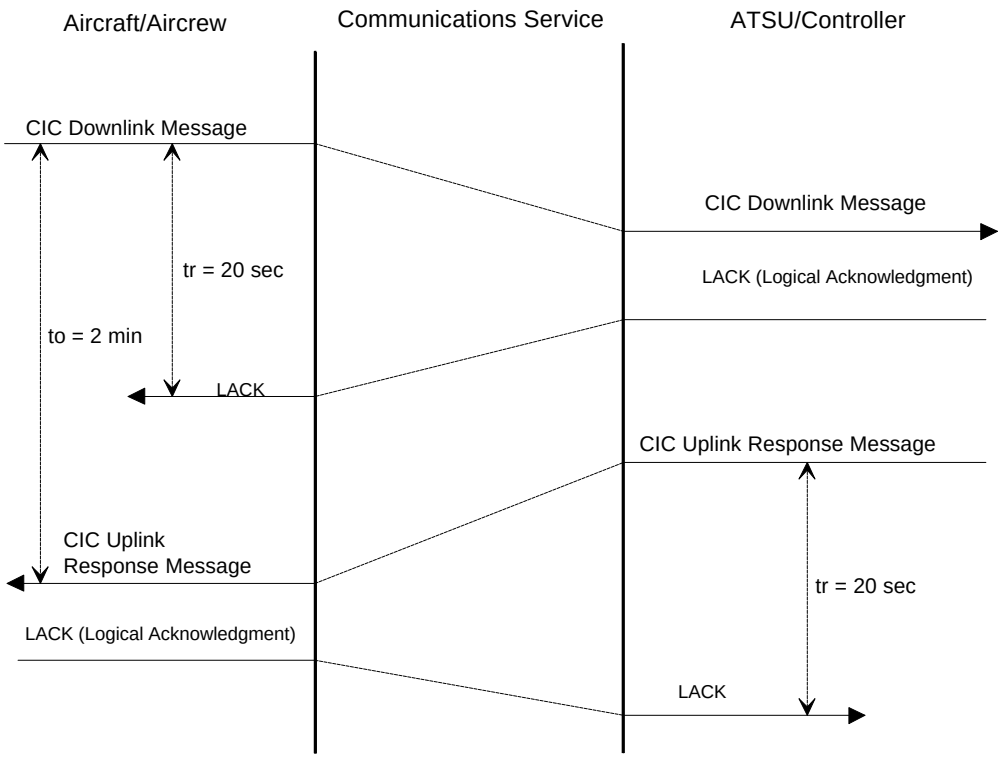
5.2.2.3 Controller-initiated exchange (Uplink)

Step	Abnormal Event	Response
1	Incorrect message composed by the Controller due to: 1. Invalid combination of message elements, as described in subsection 8.4.	The Controller shall be informed of the error. The message shall not be sent.
2	Invalid message received by the aircraft due to: 1. Invalid combination of message elements, as described in subsection 8.4.	The message shall be discarded and an ERROR response message shall be sent to the C-ATSU. Free text shall be included in the ERROR message to indicate the cause of the error.
3	Incorrect response message composed by the Aircrew due to: 1. Invalid combination of message elements, as described in subsection 8.4. 2. Response message does not conform to what is required by the Response attribute of the received message (message response attributes [RESP] are specified in subsection 8.2).	The Aircrew shall be informed of the error. The message shall not be sent.
4	Invalid message received by the C-ATSU due to: 1. Invalid combination of message elements, as described in subsection 8.4. 2. Response message does not conform to what is required by the Response attribute of the received message.	The message shall be discarded and an ERROR response message shall be sent to the aircraft. Free text shall be included in the ERROR message to indicate the cause of the error.

6. Time Sequence Diagrams

6.1 Aircrew-initiated exchange (Downlink)

6.1.1 Standard exchange



Logical Response Time-Out

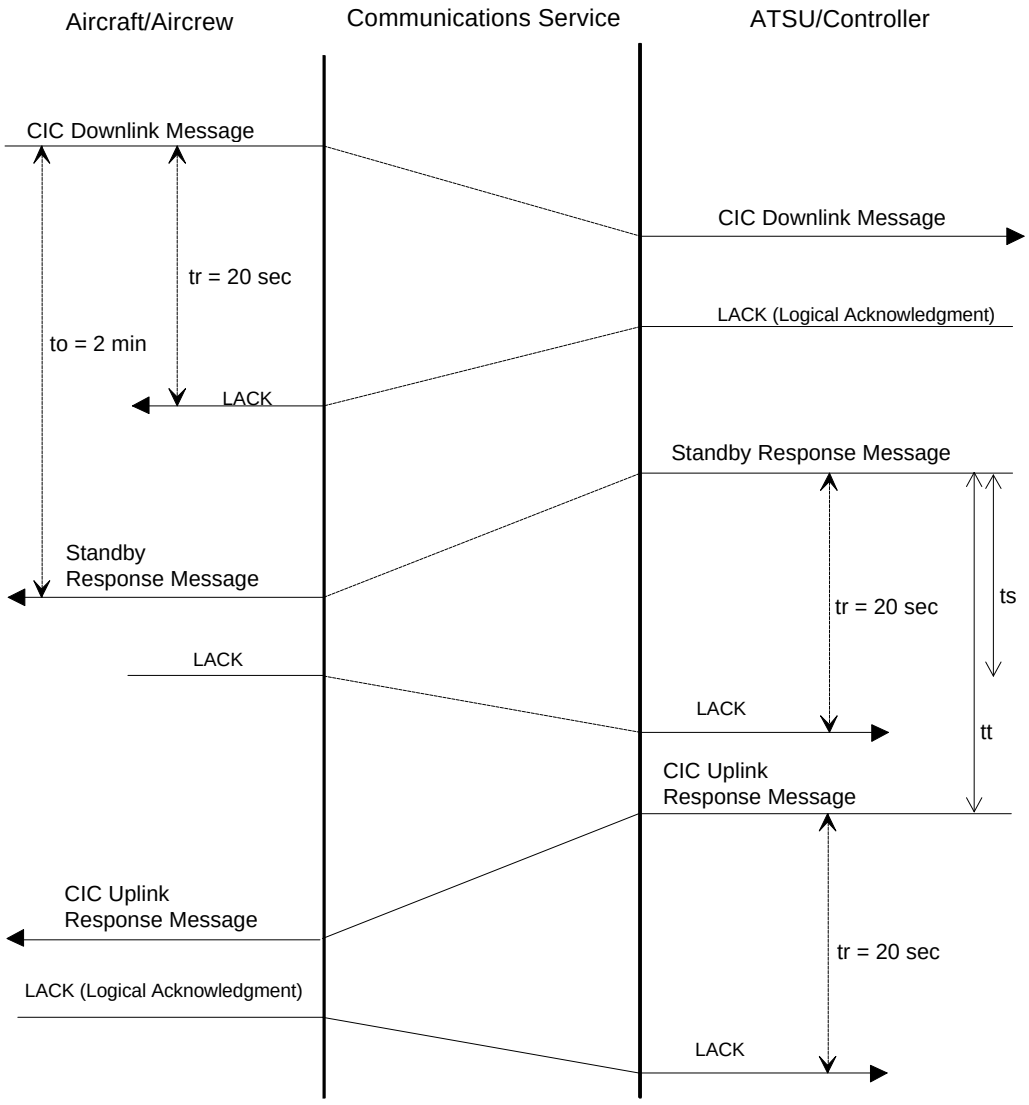
*The Logical Response time-out, represented as [**tr**] in the Time Sequence Diagram above, is the maximum end-to-end time expected from the moment the triggering event is issued from the originator and the moment the Logical Response (i.e. a LACK or an ERROR message) is received by the originator.*

Operational Response Time-Out

*The Operational Response time-out, represented as [**to**] in the Time Sequence Diagram above, is the maximum, end-to-end time expected from the moment the triggering event is issued from the originator and the moment the operational response is delivered to the originator.*

NOTE : When the CIC Uplink Response Message requires a response it shall be considered as a CIC Uplink Message which can be followed by a CIC Downlink Response Message as depicted in page 16.

6.1.2 Standby exchange



Standby Termination Time-Out

*The Standby Termination time-out, represented as [**tt**] in the Time Sequence Diagram above, is the maximum end-to-end time allowed from the moment the Standby message is sent and the moment the Operational Response is triggered by the Standby originator.*

Standby Operational Response Time-Out

*The Standby Operational Response time-out, represented as [**ts**] in the Time Sequence Diagram above, is the time after which the Standby message originator will receive a local warning of the pending Standby.*

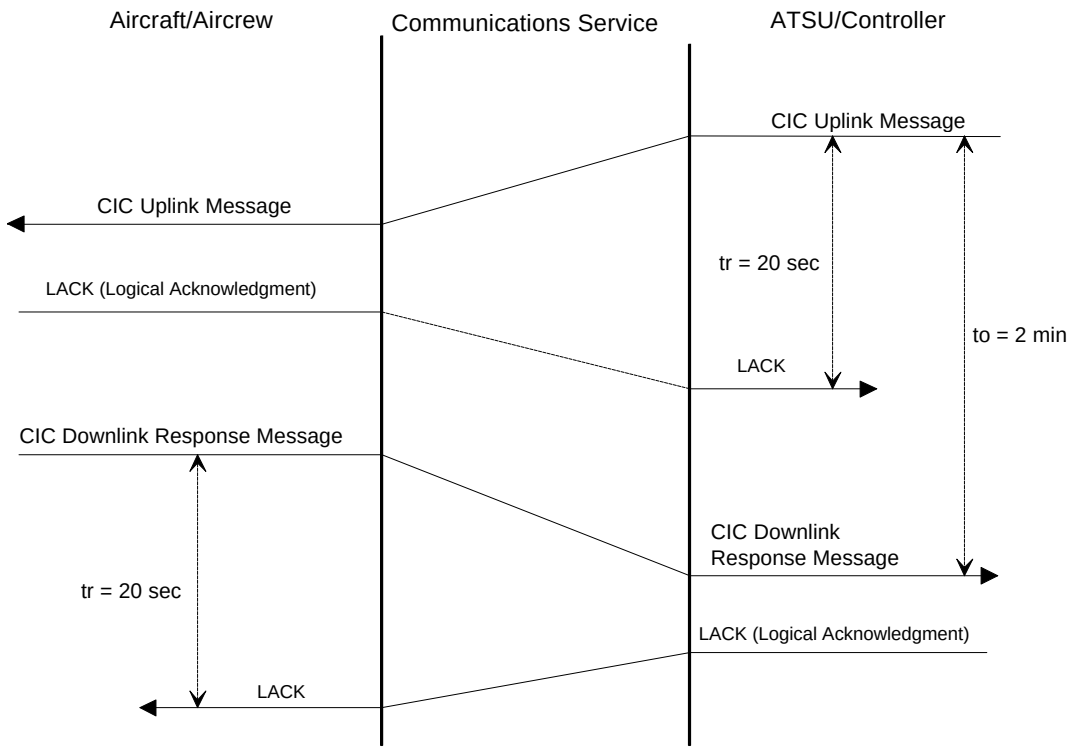
NOTE : The values of the Standby timers 'tt' and 'ts' are local implementation issues.

NOTE : The Standby Response Message should contain the STANDBY message element plus the following free text:

"IF NO RESPONSE IN x MINUTES REVERT TO VOICE PROCEDURES"
The value of x shall be set according to local procedures.

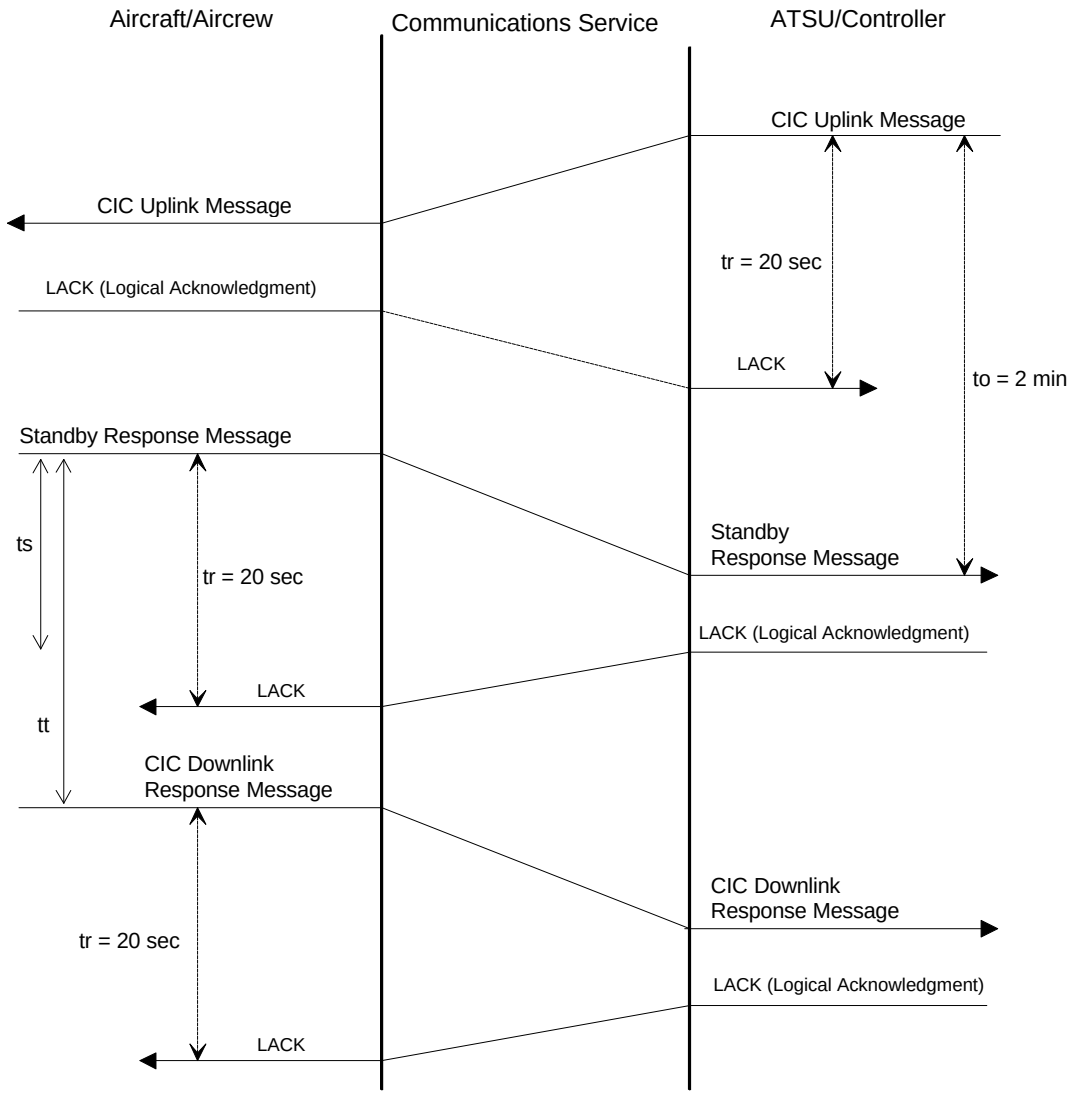
6.2 Controller-initiated exchange (Uplink)

6.2.1 Standard exchange



NOTE : When the CIC Downlink Response Message requires a response it shall be considered as a CIC Downlink Message which can be followed by a CIC Uplink Response Message as depicted in page 14.

6.2.2 Standby exchange



NOTE : The values of the Standby timers 'tt' and 'to' are local implementation issues.

6.3 Example of an Air Traffic Management (ATM) Dialogue

The following diagram illustrates a typical ATM dialogue as it is expected to be conducted via the air/ground data link.

The message contents, according to the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications" definitions, is shown in the Communications Service column. The following abbreviations are used for the description of the message header fields:

MID Message Identification Number.

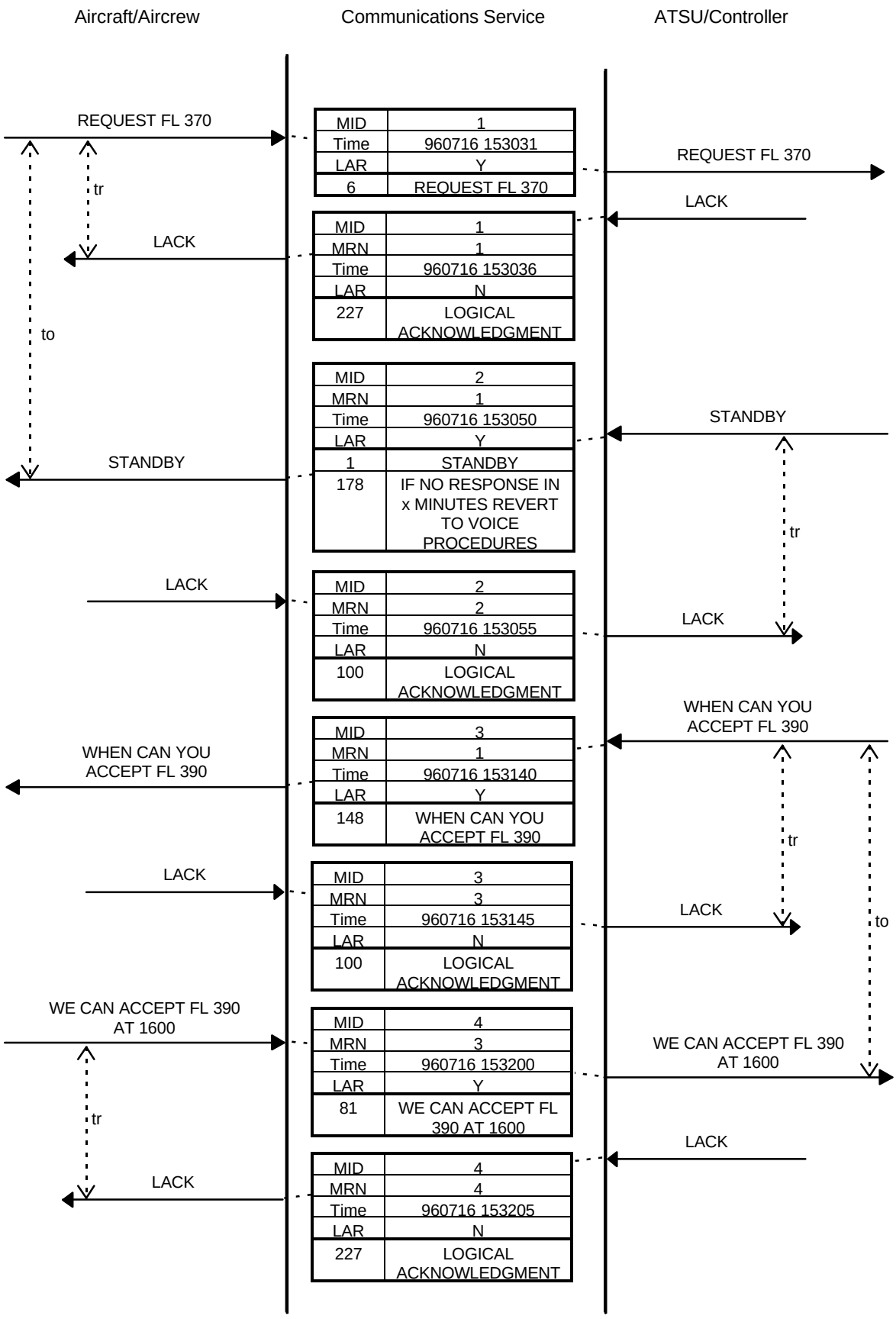
MRN Message Reference Number.

Time Time Stamp.

LAR Logical Acknowledgement Requirement.

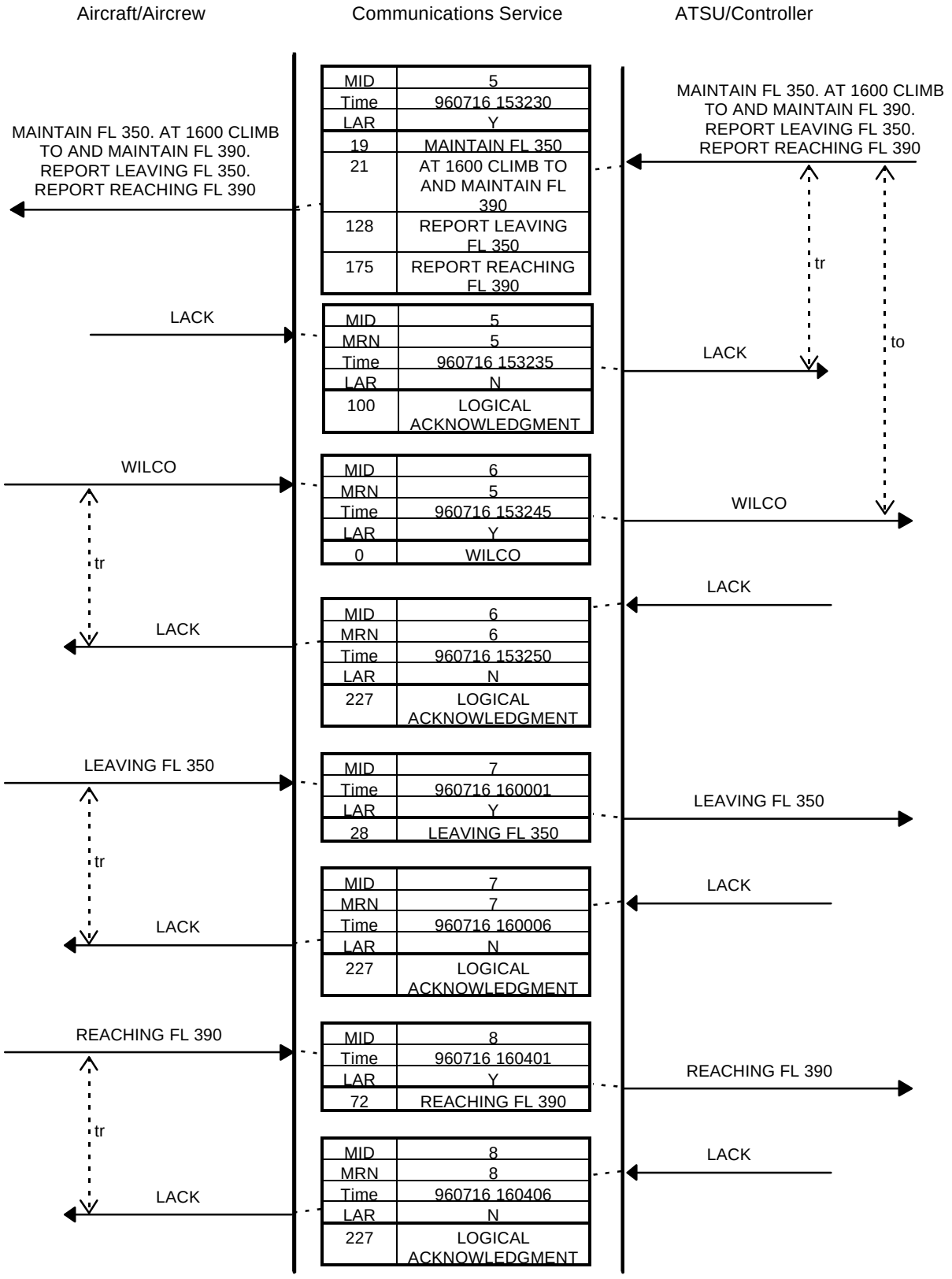
These fields are defined in Section 4 : CPDLC Introduction and Definitions.

The message elements contained in the message are preceded by their message number. These numbers have been assigned by the ICAO ADS Panel and are also used in the message element description tables in subsection 8 below.



The previous data link exchanges end with the LACK to the “WE CAN ACCEPT FL 390 AT 1600” message because this message does not require a response (as required by the message RESP attribute specified in the message element description tables in subsection 8).

The operational dialogue would continue with the following three data link exchanges:


Aircraft/Aircrew
Communications Service
ATSU/Controller
MAINTAIN FL 350. AT 1600 CLIMB TO AND MAINTAIN FL 390. REPORT LEAVING FL 350. REPORT REACHING FL 390
MID 5
Time 960716 153230
LAR Y
19 MAINTAIN FL 350
21 AT 1600 CLIMB TO AND MAINTAIN FL 390
128 REPORT LEAVING FL 350
175 REPORT REACHING FL 390
MAINTAIN FL 350. AT 1600 CLIMB TO AND MAINTAIN FL 390. REPORT LEAVING FL 350. REPORT REACHING FL 390
tr
to
LACK
MID 5
MRN 5
Time 960716 153235
LAR N
100 LOGICAL ACKNOWLEDGMENT
LACK
WILCO
MID 6
MRN 5
Time 960716 153245
LAR Y
0 WILCO
WILCO
tr
LACK
MID 6
MRN 6
Time 960716 153250
LAR N
227 LOGICAL ACKNOWLEDGMENT
LACK
LEAVING FL 350
MID 7
Time 960716 160001
LAR Y
28 LEAVING FL 350
LEAVING FL 350
tr
LACK
MID 7
MRN 7
Time 960716 160006
LAR N
227 LOGICAL ACKNOWLEDGMENT
LACK
REACHING FL 390
MID 8
Time 960716 160401
LAR Y
72 REACHING FL 390
REACHING FL 390
tr
LACK
MID 8
MRN 8
Time 960716 160406
LAR N
227 LOGICAL ACKNOWLEDGMENT
LACK

7. Quality Of Service Requirements

7.1 Class 1: Distress/Emergency/Urgent/Unlawful interference Messages

Message Category: category 1.

Communications Priority: 1.

Information Urgency: Urgency attributes for each message element are provided in subsection 8.2.

Information Security:

Data Origin Authentication: Normal

Access Control: C, M, A, D

Data Integrity: Maximum

7.2 Class 2: Tactical Messages

Message Category: category 2.

Communications Priority: 2.

Information Urgency: Urgency attributes for each message element are provided in subsection 8.2.

Information Security:

Data Origin Authentication: Normal

Access Control: C, M, A, D

Data Integrity: Maximum

7.3 Class 3: Strategic Messages

Message Category: category 3.

Communications Priority: 3.

Information Urgency: Urgency attributes for each message element are provided in subsection 8.2.

Information Security:

Data Origin Authentication: Normal

Access Control: C, M, A, D

Data Integrity: Maximum

7.4 Class 4: Information Messages

Message Category: category 4.

Communications Priority: 4.

Information Urgency: Urgency attributes for each message element are provided in subsection 8.2.

Information Security:

Data Origin Authentication: Normal

Access Control: M, A

Data Integrity: Maximum

NOTE : The "ICAO Manual of Air Traffic Services (ATS) Data Link Applications" requires that all messages have the same priority (Priority level 3) and it does not contain Information Security requirements.

8. Information Exchanges

The CIC Uplink Messages follow the message composition rules described in Section 4 : CPDLC Introduction and Definitions.

For operational efficiency and ease of use of CIC it is recommended to use the present subset of the CPDLC message elements for operations in the European ICAO region. Free text shall be used only in exceptional cases and shall when possible be pre-formatted.

NOTE : Messages with the text "N2" as a message number (Msg Num.) are not supported by the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications". But they can be implemented as pre-formatted Free text messages.

NOTE : The definitions of the data elements between the square brackets [ ] below are provided in Section 9 : CPDLC Data Glossary.

The following abbreviations are used in the message element tables:

Abbreviation	Description
Msg. Num	A unique number assigned to each message element by the ICAO ADS Panel.
FOU	Frequency of use, defined in subsection 3 above.
URG	Urgency Attribute, defined in Section 4.
ALRT	Alert Attribute, defined in Section 4.
RESP	Response Attribute, defined in Section 4.

8.1 CIC Message Class

In the next pages the class of each CIC message element is provided.

For a CIC message containing several message elements, the highest message element class in the message (i.e. the smallest class number) becomes the class for the entire message.

A CIC response message should at least have the class of the message it responds to.

8.2 CIC Uplink Message

The message elements that shall be used to compose CIC Uplink Messages are given in the tables below.

8.2.1 Class 1: Distress/Emergency/Urgent/Unlawful interference Messages

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
Responses/Acknowledgments						
235	Notification of receipt of unlawful interference message.	ROGER 7500	2	U	H	N

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
Vertical Clearances						
38	Urgent instruction to immediately climb to the specified level.	IMMEDIATELY CLIMB TO [level]	3	D	H	W/U
39	Urgent instruction to immediately descend to the specified level.	IMMEDIATELY DESCEND TO [level]	3	D	H	W/U
40	Urgent instruction to immediately stop a climb once the specified level is reached.	IMMEDIATELY STOP CLIMB AT [level]	3	D	H	W/U
41	Urgent instruction to immediately stop a descent once the specified level is reached.	IMMEDIATELY STOP DESCENT AT [level]	3	D	H	W/U
Route Modifications						
98	Instruction to turn immediately left or right as specified onto the specified heading.	IMMEDIATELY TURN [direction] HEADING [degrees]	3	D	H	W/U
Additional Messages						
230	The associated instruction is to be complied with immediately.	IMMEDIATELY	3	D	H	N

8.2.2 Class 2: Tactical Messages

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
Vertical Clearances						
19	Instruction to maintain the specified level.	MAINTAIN [level]	1	N	M	W/U
20	Instruction that a climb to a specified level is to commence and the level is to be maintained when reached.	CLIMB TO [level]	1	N	M	W/U
23	Instruction that a descent to a specified level is to commence and the level is to be maintained when reached.	DESCEND TO [level]	1	N	M	W/U
26	Instruction that a climb is to commence at a rate such that the specified level is reached at or before the specified time.	CLIMB TO REACH [level] BY [time]	2	N	M	W/U
27	Instruction that a climb is to commence at a rate such that the specified level is reached at or before the specified position.	CLIMB TO REACH [level] BY [position]	1	N	M	W/U

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
28	Instruction that a descent is to commence at a rate such that the specified level is reached at or before the specified time.	DESCEND TO REACH [level] BY [time]	2	N	M	W/U
29	Instruction that a descent is to commence at a rate such that the specified level is reached at or before the specified position.	DESCEND TO REACH [level] BY [position]	1	N	M	W/U
30	A level within the defined vertical range specified is to be maintained.	MAINTAIN BLOCK [level] TO [level]	2	N	M	W/U
31	Instruction that a climb to a level within the vertical range defined is to commence.	CLIMB TO AND MAINTAIN BLOCK [level] TO [level]	2	N	M	W/U
32	Instruction that a descent to a level within the vertical range defined is to commence.	DESCEND TO AND MAINTAIN BLOCK [level] TO [level]	2	N	M	W/U
34	A cruise climb is to commence and continue until the specified level is reached.	CRUISE CLIMB TO [level]	2	N	M	W/U
35	A cruise climb can commence once above the specified level.	CRUISE CLIMB ABOVE [level]	2	N	M	W/U
36	The climb to the specified level should be made at the aircraft's best rate.	EXPEDITE CLIMB TO [level]	3	U	M	W/U
37	The descent to the specified level should be made at the aircraft's best rate.	EXPEDITE DESCENT TO [level]	3	U	M	W/U
171	Instruction to climb at not less than the specified rate.	CLIMB AT [vertical rate] MINIMUM	3	N	M	W/U
172	Instruction to climb at not above the specified rate.	CLIMB AT [vertical rate] MAXIMUM	1	N	M	W/U
173	Instruction to descend at not less than the specified rate.	DESCEND AT [vertical rate] MINIMUM	1	N	M	W/U
174	Instruction to descend at not above the specified rate.	DESCEND AT [vertical rate] MAXIMUM	1	N	M	W/U
192	Instruction that a change of level is to continue, but at a rate such that the specified level is reached at or before the specified time.	REACH [level] BY [time]	2	N	M	W/U
209	Instruction that a change of level is to continue, but at a rate such that the specified level is reached at or before the specified position.	REACH [level] BY [position]	2	N	M	W/U
219	Instruction to stop the climb below the previously assigned level.	STOP CLIMB AT [level]	2	U	M	W/U

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
220	Instruction to stop the descent above the previously assigned level.	STOP DESCENT AT [level]	2	U	M	W/U
Lateral Offsets						
64	Instruction to fly a parallel track to the cleared route at a displacement of the specified distance in the specified direction.	OFFSET [distance offset] [direction] OF ROUTE	1	N	M	W/U
67	The cleared flight route is to be rejoined.	PROCEED BACK ON ROUTE	3	N	M	W/U
68	The cleared flight route is to be rejoined at or before the specified position.	REJOIN ROUTE BY [position]	2	N	M	W/U
69	The cleared flight route is to be rejoined at or before the specified time.	REJOIN ROUTE BY [time]	2	N	M	W/U
72	Instruction to resume own navigation following a period of tracking or heading clearances. May be used in conjunction with an instruction on how or where to rejoin the cleared route.	RESUME OWN NAVIGATION	1	N	M	W/U
Crossing Constraints						
46	The specified position is to be crossed at the specified level. This may require the aircraft to modify its climb or descent profile.	CROSS [position] AT [level]	1	N	M	W/U
47	The specified position is to be crossed at or above the specified level.	CROSS [position] AT OR ABOVE [level]	1	N	M	W/U
48	The specified position is to be crossed at or below the specified level.	CROSS [position] AT OR BELOW [level]	1	N	M	W/U
49	Instruction that the specified position is to be crossed at the specified level and that level is to be maintained when reached.	CROSS [position] AT AND MAINTAIN [level]	3	N	M	W/U
50	The specified position is to be crossed at a level between the specified levels.	CROSS [position] BETWEEN [level] AND [level]	2	N	M	W/U
51	The specified position is to be crossed at the specified time.	CROSS [position] AT [time]	2	N	M	W/U
52	The specified position is to be crossed at or before the specified time.	CROSS [position] AT OR BEFORE [time]	1	N	M	W/U

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
53	The specified position is to be crossed at or after the specified time.	CROSS [position] AT OR AFTER [time]	1	N	M	W/U
54	The specified position is to be crossed at a time between the specified times.	CROSS [position] BETWEEN [time] AND [time]	2	N	M	W/U
55	The specified position is to be crossed at the specified speed and the specified speed is to be maintained until further advised.	CROSS [position] AT [speed]	1	N	M	W/U
56	The specified position is to be crossed at a speed equal to or less than the specified speed and the specified speed or less is to be maintained until further advised.	CROSS [position] AT OR LESS THAN [speed]	2	N	M	W/U
57	The specified position is to be crossed at a speed equal to or greater than the specified speed and the specified speed or greater is to be maintained until further advised.	CROSS [position] AT OR GREATER THAN [speed]	2	N	M	W/U
58	The specified position is to be crossed at the specified time and at the specified level.	CROSS [position] AT [time] AT [level]	3	N	M	W/U
59	The specified position is to be crossed at or before the specified time and at the specified level.	CROSS [position] AT OR BEFORE [time] AT [level]	2	N	M	W/U
60	The specified position is to be crossed at or after the specified time and at the specified level.	CROSS [position] AT OR AFTER [time] AT [level]	2	N	M	W/U
61	Instruction that the specified position is to be crossed at the specified level and speed and the level and speed are to be maintained.	CROSS [position] AT AND MAINTAIN [level] AT [speed]	3	N	M	W/U
62	Instruction that at the specified time the specified position is to be crossed at the specified level and the level is to be maintained.	AT [time] CROSS [position] AT AND MAINTAIN [level]	3			
63	Instruction that at the specified time the specified position is to be crossed at the specified level and speed and the level and speed are to be maintained.	AT [time] CROSS [position] AT AND MAINTAIN [level] AT [speed]	3			
Route Modifications						

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
74	Instruction to proceed directly from its present position to the specified position.	PROCEED DIRECT TO [position]	1	N	M	W/U
79	Instruction to proceed to the specified position via the specified route.	CLEARED TO [position] VIA [route clearance]	1	N	M	W/U
80	Instruction to proceed via the specified route.	CLEARED [route clearance]	1	N	M	W/U
81	Instruction to proceed in accordance with the specified procedure.	CLEARED [procedure name]	1	N	M	W/U
82	Approval to deviate up to the specified distance from the cleared route in the specified direction.	CLEARED TO DEVIATE UP TO [distance offset] [direction] OF ROUTE	2	N	M	W/U
91	Instruction to enter a holding pattern with the specified characteristics at the specified position and level.	HOLD AT [position] MAINTAIN [level] INBOUND TRACK [degrees] [direction] TURNS [leg type]	1	N	M	W/U
92	Instruction to enter a holding pattern with the published characteristics at the specified position and level.	HOLD AT [position] AS PUBLISHED MAINTAIN [level]	3	N	M	W/U
94	Instruction to turn left or right as specified onto the specified heading.	TURN [direction] HEADING [degrees]	1	N	M	W/U
95	Instruction to turn left or right as specified onto the specified track.	TURN [direction] GROUND TRACK [degrees]	3	N	M	W/U
96	Instruction to continue to fly on the current heading.	CONTINUE PRESENT HEADING	1	N	M	W/U
97	Instruction to fly on the specified heading from the specified position.	AT [position] FLY HEADING [degrees]	1	N	M	W/U
190	Instruction to fly on the specified heading.	FLY HEADING [degrees]	1	N	M	W/U
215	Instruction to turn a specified number of degrees left or right.	TURN [direction][degrees]	1	N	M	W/U
221	Instruction to stop turn at the specified heading prior to reaching the previously assigned heading.	STOP TURN HEADING [degrees]	2	U	M	W/U
Speed Changes						
106	The specified speed is to be maintained.	MAINTAIN [speed]	1	N	M	W/U
107	The present speed is to be maintained.	MAINTAIN PRESENT SPEED	1	N	M	W/U

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
108	The specified speed or a greater speed is to be maintained.	MAINTAIN [speed] OR GREATER	1	N	M	W/U
109	The specified speed or a lesser speed is to be maintained.	MAINTAIN [speed] OR LESS	1	N	M	W/U
110	A speed within the specified range is to be maintained.	MAINTAIN [speed] TO [speed]	2	N	M	W/U
111	The present speed is to be increased to the specified speed and maintained until further advised.	INCREASE SPEED TO [speed]	1	N	M	W/U
112	The present speed is to be increased to the specified speed or greater, and maintained at or above the specified speed until further advised.	INCREASE SPEED TO [speed] OR GREATER	1	N	M	W/U
113	The present speed is to be reduced to the specified speed and maintained until further advised.	REDUCE SPEED TO [speed]	1	N	M	W/U
114	The present speed is to be reduced to the specified speed or less and maintained at or below the specified speed until further advised.	REDUCE SPEED TO [speed] OR LESS	1	N	M	W/U
115	The specified speed is not to be exceeded.	DO NOT EXCEED [speed]	2	N	M	W/U
116	Notification that the aircraft need no longer comply with the previously issued speed restriction.	RESUME NORMAL SPEED	1	N	M	W/U
189	The present speed is to be changed to the specified speed.	ADJUST SPEED TO [speed]	3	N	M	W/U
223	Instruction to reduce present speed to the minimum safe approach speed	REDUCE TO MINIMUM APPROACH SPEED	1	N	M	W/U

8.2.3 Class 3: Strategic Messages

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
Vertical Clearances						
21	Instruction that at the specified time, a climb to the specified level is to commence and once reached the specified level is to be maintained.	AT [time] CLIMB TO [level]	2	N	M	W/U

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
22	Instruction that at the specified position, a climb to the specified level is to commence and once reached the specified level is to be maintained.	AT [position] CLIMB TO [level]	1	N	M	W/U
24	Instruction that at a specified time a descent to a specified level is to commence and once reached the specified level is to be maintained.	AT [time] DESCEND TO [level]	2	N	M	W/U
25	Instruction that at the specified position a descent to the specified level is to commence and when the specified level is reached it is to be maintained.	AT [position] DESCEND TO [level]	1	N	M	W/U
185	Instruction that after passing the specified position, a climb to the specified level is to commence and once reached the specified level is to be maintained.	AFTER PASSING [position] CLIMB TO [level]	1	N	M	W/U
186	Instruction that after passing the specified position, a descent to the specified level is to commence and once reached the specified level is to be maintained.	AFTER PASSING [position] DESCEND TO [level]	1	N	M	W/U
Lateral Offsets						
65	Instruction to fly a parallel track to the cleared route at a displacement of the specified distance in the specified direction and commencing at the specified position.	AT [position] OFFSET [distance offset] [direction] OF ROUTE	1	N	M	W/U
66	Instruction to fly a parallel track to the cleared route at a displacement of the specified distance in the specified direction and commencing at the specified time.	AT [time] OFFSET [distance offset] [direction] OF ROUTE	2	N	M	W/U
Route Modifications						
75	Instruction to proceed, when able, directly to the specified position.	WHEN ABLE PROCEED DIRECT TO [position]	1	N	M	W/U
76	Instruction to proceed, at the specified time, directly to the specified position.	AT [time] PROCEED DIRECT TO [position]	2	N	M	W/U
77	Instruction to proceed, at the specified position, directly to the next specified position.	AT [position] PROCEED DIRECT TO [position]	1	N	M	W/U

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
78	Instruction to proceed, upon reaching the specified level, directly to the specified position.	AT [level] PROCEED DIRECT TO [position]	1	N	M	W/U
83	Instruction to proceed from the specified position via the specified route.	AT [position] CLEARED [route clearance]	1	N	M	W/U
84	Instruction to proceed from the specified position via the specified procedure.	AT [position] CLEARED [procedure name]	1	N	M	W/U
Speed Changes						
188	After passing the specified position the specified speed is to be maintained.	AFTER PASSING [position] MAINTAIN [speed]	2	N	M	W/U
222	Notification that the aircraft may keep its preferred speed without restriction.	NO SPEED RESTRICTION	1	L	L	R
Surveillance Requests						
123	The specified code (SSR code) is to be selected.	SQUAWK [code]	1	N	M	W/U
124	The SSR transponder responses are to be disabled.	STOP SQUAWK	3	N	M	W/U
125	The SSR transponder responses should include level information.	SQUAWK MODE CHARLIE	3	N	M	W/U
126	The SSR transponder responses should no longer include level information.	STOP SQUAWK MODE CHARLIE	2	N	M	W/U
179	The `ident' function on the SSR transponder is to be actuated.	SQUAWK IDENT	1	N	M	W/U
Report/Confirmation Requests						
127	Instruction to report when the aircraft is back on the cleared route.	REPORT BACK ON ROUTE	3	N	L	W/U
128	Instruction to report when the aircraft has left the specified level.	REPORT LEAVING [level]	2	N	L	W/U
129	Instruction to report when the aircraft is in level flight at the specified level.	REPORT MAINTAINING [level]	2	N	L	W/U
130	Instruction to report when the aircraft has passed the specified position.	REPORT PASSING [position]	2	N	L	W/U
131	Instruction to report the amount of fuel remaining and the number of persons on board.	REPORT REMAINING FUEL AND PERSONS ON BOARD	3	U	M	Y

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
132	Instruction to report the present position.	REPORT POSITION	2	N	M	Y
133	Instruction to report the present level.	REPORT PRESENT LEVEL	2	N	M	Y
134	Instruction to report the requested speed.	REPORT [speed type] [speed type] [speed type] SPEED	2	N	M	Y
135	Instruction to confirm and acknowledge the currently assigned level.	CONFIRM ASSIGNED LEVEL	3	N	L	Y
136	Instruction to confirm and acknowledge the currently assigned speed.	CONFIRM ASSIGNED SPEED	3	N	L	Y
137	Instruction to confirm and acknowledge the currently assigned route.	CONFIRM ASSIGNED ROUTE	3	N	L	Y
138	Instruction to confirm the previously reported time over the last reported waypoint.	CONFIRM TIME OVER REPORTED WAYPOINT	3	N	L	Y
139	Instruction to confirm the identity of the previously reported waypoint.	CONFIRM REPORTED WAYPOINT	3	N	L	Y
140	Instruction to confirm the identity of the next waypoint.	CONFIRM NEXT WAYPOINT	3	N	L	Y
141	Instruction to confirm the previously reported estimated time at the next waypoint.	CONFIRM NEXT WAYPOINT ETA	3	N	L	Y
142	Instruction to confirm the identity of the next but one waypoint.	CONFIRM ENSUING WAYPOINT	3	N	L	Y
143	The request was not understood. It should be clarified and resubmitted.	CONFIRM REQUEST	3	N	L	Y
144	Instruction to report the selected (SSR) code.	CONFIRM SQUAWK	2	N	L	Y
145	Instruction to report the present heading.	REPORT HEADING	2	N	M	Y
146	Instruction to report the present ground track.	REPORT GROUND TRACK	3	N	M	Y
147	Instruction to make a position report.	REQUEST POSITION REPORT	3	N	M	Y
175	Instruction to report when the aircraft has reached the specified level.	REPORT REACHING [level]	2	N	L	W/U
180	Instruction to report when the aircraft is within the specified vertical range.	REPORT REACHING BLOCK [level] TO [level]	2	N	L	W/U

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
181	Instruction to report the present distance to or from the specified position.	REPORT DISTANCE [to/from] [position]	3	N	M	Y
182	Instruction to report the identification code of the last ATIS received.	CONFIRM ATIS CODE	3	N	L	Y
184	Instruction to report at the specified time the distance to or from the specified position.	AT TIME [time] REPORT DISTANCE [to/from] [position]	3	N	L	Y
216	Instruction to file a flight plan.	REQUEST FLIGHT PLAN	3	N	M	Y
217	Instruction to report that the aircraft has landed.	REPORT ARRIVAL	3	N	M	Y
228	Instruction to report the estimated time of arrival at the specified position.	REPORT ETA [position]	2	L	L	Y
229	Instruction to report the preferred alternate aerodrome for landing.	REPORT ALTERNATE AERODROME	2	L	L	Y
231	Instruction to indicate the pilot's preferred level.	STATE PREFERRED LEVEL	2	L	L	Y
232	Instruction to indicate the pilot's preferred time and/ or position to commence descent to the aerodrome of intended arrival.	STATE TOP OF DESCENT	2	L	L	Y
Air Traffic Advisories						
155	ATS advisory that radar contact has been established at the specified position.	RADAR CONTACT [position]	3	N	M	R
156	ATS advisory that radar contact has been lost.	RADAR CONTACT LOST	3	N	M	R
193	Indication that radar identification has been lost.	IDENTIFICATION LOST	3	N	M	R
210	ATS advisory that the aircraft has been identified on radar at the specified position.	IDENTIFIED [position]	3	N	M	R
214	ATS advisory that indicates the RVR value for the specified runway.	RUNWAY [runway] VISUAL RANGE [rvr]	2	N	M	R
224	ATS advisory that no delay is expected.	NO DELAY EXPECTED	1	N	L	R
225	ATS advisory that the expected delay has not been determined.	DELAY NOT DETERMINED	1	N	L	R
226	ATS advisory that the aircraft may expect to be cleared to commence its approach procedure at the specified time.	EXPECTED APPROACH TIME [time]	1	N	L	R

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
NOTE :	*Additional Air Traffic Advisory messages to report on weather conditions (e.g. REPORTED TURBULENCE, REPORTED ICING, etc.) are being introduced in the ICAO Manual of ATS Data Link Applications but were not ready at the time of the publication of this document.*					
		Negotiation Requests				
148	Request for the earliest time at which the specified level can be accepted.	WHEN CAN YOU ACCEPT [level]	2	N	L	Y
149	Instruction to report whether or not the specified level can be accepted at the specified position.	CAN YOU ACCEPT [level] AT [position]	2	N	L	A/N
150	Instruction to report whether or not the specified level can be accepted at the specified time.	CAN YOU ACCEPT [level] AT [time]	2	N	L	A/N
151	Instruction to report the earliest time when the specified speed can be accepted.	WHEN CAN YOU ACCEPT [speed]	2	N	L	Y
152	Instruction to report the earliest time when the specified offset track can be accepted.	WHEN CAN YOU ACCEPT [distance offset] [direction] OFFSET	2	N	L	Y

8.2.4 Class 4: Information Messages

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
		Vertical Clearances				
6	Notification that a level change instruction should be expected.	EXPECT [level]	3	L	L	R
7	Notification that an instruction should be expected for the aircraft to commence climb at the specified time.	EXPECT CLIMB AT [time]	2	L	L	R
8	Notification that an instruction should be expected for the aircraft to commence climb at the specified position.	EXPECT CLIMB AT [position]	2	L	L	R
9	Notification that an instruction should be expected for the aircraft to commence descent at the specified time.	EXPECT DESCENT AT [time]	2	L	L	R
10	Notification that an instruction should be expected for the aircraft to commence descent at the specified position.	EXPECT DESCENT AT [position]	2	L	L	R

11	Notification that an instruction should be expected for the aircraft to commence cruise climb at the specified time.	EXPECT CRUISE CLIMB AT [time]	2	L	L	R
12	Notification that an instruction should be expected for the aircraft to commence cruise climb at the specified position.	EXPECT CRUISE CLIMB AT [position]	2	L	L	R
13	Notification that an instruction should be expected for the aircraft to commence climb at the specified time to the specified level.	AT [time] EXPECT CLIMB TO [level]	2	L	L	R
14	Notification that an instruction should be expected for the aircraft to commence climb at the specified position to the specified level.	AT [position] EXPECT CLIMB TO [level]	2	L	L	R
15	Notification that an instruction should be expected for the aircraft to commence descent at the specified time to the specified level.	AT [time] EXPECT DESCENT TO [level]	2	L	L	R
16	Notification that an instruction should be expected for the aircraft to commence descent at the specified position to the specified level.	AT [position] EXPECT DESCENT TO [level]	2	L	L	R
17	Notification that an instruction should be expected for the aircraft to commence cruise climb at the specified time to the specified level.	AT [time] EXPECT CRUISE CLIMB TO [level]	2	L	L	R
18	Notification that an instruction should be expected for the aircraft to commence cruise climb at the specified position to the specified level.	AT [position] EXPECT CRUISE CLIMB TO [level]	2	L	L	R
Crossing Constraints						
42	Notification that a level change instruction should be expected which will require the specified position to be crossed at the specified level.	EXPECT TO CROSS [position] AT [level]	2	L	L	R
43	Notification that a level change instruction should be expected which will require the specified position to be crossed at or above the specified level.	EXPECT TO CROSS [position] AT OR ABOVE [level]	2	L	L	R
44	Notification that a level change instruction should be expected which will require the specified position to be crossed at or below the specified level.	EXPECT TO CROSS [position] AT OR BELOW [level]	2	L	L	R

45	Notification that a level change instruction should be expected which will require the specified position to be crossed at the specified level which is to be maintained subsequently.	EXPECT TO CROSS [position] AT AND MAINTAIN [level]	3	L	L	R
Lateral Offsets						
70	Notification that a clearance may be issued to enable the aircraft to rejoin the cleared route at or before the specified position.	EXPECT BACK ON ROUTE BY [position]	3	L	L	R
71	Notification that a clearance may be issued to enable the aircraft to rejoin the cleared route at or before the specified time.	EXPECT BACK ON ROUTE BY [time]	3	L	L	R
Route Modifications						
85	Notification that a clearance to fly on the specified route may be issued.	EXPECT [route clearance]	3	L	L	R
86	Notification that a clearance to fly on the specified route from the specified position may be issued.	AT [position] EXPECT [route clearance]	3	L	L	R
87	Notification that a clearance to fly directly to the specified position may be issued.	EXPECT DIRECT TO [position]	2	L	L	R
88	Notification that a clearance to fly directly from the first specified position to the next specified position may be issued.	AT [position] EXPECT DIRECT TO [position]	2	L	L	R
89	Notification that a clearance to fly directly to the specified position commencing at the specified time may be issued.	AT [time] EXPECT DIRECT TO [position]	3	L	L	R
90	Notification that a clearance to fly directly to the specified position commencing when the specified level is reached may be issued.	AT [level] EXPECT DIRECT TO [position]	3	L	L	R
93	Notification that an onwards clearance may be issued at the specified time.	EXPECT FURTHER CLEARANCE AT [time]	1	L	L	R
99	Notification that a clearance may be issued for the aircraft to fly the specified procedure.	EXPECT [procedure name]	2	L	L	R
236	Instruction to leave controlled airspace.	LEAVE CONTROLLED AIRSPACE	3	N	M	W/U
Speed Changes						

100	Notification that a speed instruction may be issued to be effective at the specified time.	AT [time] EXPECT [speed]	3	L	L	R
101	Notification that a speed instruction may be issued to be effective at the specified position.	AT [position] EXPECT [speed]	2	L	L	R
102	Notification that a speed instruction may be issued to be effective at the specified level.	AT [level] EXPECT [speed]	2	L	L	R
103	Notification that a speed range instruction may be issued to be effective at the specified time.	AT [time] EXPECT [speed] TO [speed]	3	L	L	R
104	Notification that a speed range instruction may be issued to be effective at the specified position.	AT [position] EXPECT [speed] TO [speed]	3	L	L	R
105	Notification that a speed range instruction may be issued to be effective at the specified level.	AT [level] EXPECT [speed] TO [speed]	3	L	L	R
Air Traffic Advisories						
153	ATS advisory that the altimeter setting should be the specified setting.	ALTIMETER [altimeter]	2	N	L	R
154	ATS advisory that the radar service is terminated.	RADAR SERVICE TERMINATED	3	N	L	R
158	ATS advisory that the ATIS information identified by the specified code is the current ATIS information.	ATIS [atis code]	1	N	L	R
191	ATS advisory that the aircraft is entering airspace in which no air traffic services are provided and all existing air traffic services are terminated.	ALL ATS TERMINATED	3	N	M	R
212	ATS advisory that the specified ATIS information at the specified airport is current.	[facility designation] ATIS [atis code] CURRENT	3	N	L	R
213	ATS advisory that the specified altimeter setting relates to the specified facility.	[facility designation] ALTIMETER [altimeter]	3	N	L	R
N2	ATS advisory that the previously advised approach time has been revised.	REVISED EXPECTED APPROACH TIME [time]	1	N	L	R

8.2.5 Class 5: Special Messages

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
Responses/Acknowledgments						
0	Indicates that ATS cannot comply with the request.	UNABLE	1	N	M	N
1	Indicates that ATS has received the message and will respond.	STANDBY	1	N	L	N
2	Indicates that ATS has received the request but it has been deferred until later.	REQUEST DEFERRED	3	N	L	N
3	Indicates that ATS has received and understood the message.	ROGER	1	N	L	N
4	Yes.	AFFIRM	1	N	L	N
5	No.	NEGATIVE	1	N	L	N
159	A system generated message that the ground system has detected an error.	ERROR [error information]	-	U	M	
162	Notification that the ground system does not support this message.	SERVICE UNAVAILABLE	-	L	L	N
211	Indicates that the ATS has received the request and has passed it to the Next Control Authority.	REQUEST FORWARDED	3		L	N
218	Indicates to the pilot that the request has already been received on the ground.	REQUEST ALREADY RECEIVED	-	L	N	N
227	Confirmation to the aircraft system that the ground system has received the message to which the logical acknowledgment refers and found it acceptable for display to the responsible person.	LOGICAL ACKNOWLEDGMENT	-	N	M	N
237	Indicates that the request cannot be responded to by the current unit, and that it should be requested from the next unit.	REQUEST AGAIN WITH NEXT UNIT	2	N	L	N
Message Additions						
164	The associated instruction may be complied with at any future time.	WHEN READY	2	L	N	N
165	Used to link two messages, indicating the proper order of execution of clearances/ instructions.	THEN	3	L	N	N
166	The associated instruction is issued due to traffic considerations.	DUE TO [traffic type] TRAFFIC	-	L	N	N

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
167	The associated instruction is issued due to airspace restrictions.	DUE TO AIRSPACE RESTRICTION	2	L	N	N
177	Used in conjunction with a clearance/instruction to indicate that the operator may execute when prepared to do so.	AT PILOTS DISCRETION	3	L	L	N
Other Messages						
168	The indicated communication should be ignored.	DISREGARD	3	U	M	R
176	Notification that the operator is responsible for maintaining separation from other traffic and is also responsible for maintaining Visual Meteorological Conditions.	MAINTAIN OWN SEPARATION AND VMC	3	N	M	W/U
Free Text						
169		[free text]	-	N	L	R
170		[free text]	-	D	H	R
178		[free text]	-	N	L	N
183		[free text]	-	N	M	N
187		[free text]	-	L	N	N
194		[free text]	-	N	L	Y
195		[free text]	-	L	L	R
196		[free text]	-	N	M	W/U
197		[free text]	-	U	M	W/U
198		[free text]	-	D	H	W/U
199		[free text]	-	N	M	W/U
200		[free text]	-	L	L	R
201		[free text]	-	N	M	W/U
202		[free text]	-	D	H	W/U
203		[free text]	-	N	M	R
204		[free text]	-	N	M	Y
205		[free text]	-	N	M	A/N
206		[free text]	-	L	N	Y
207		[free text]	-	L	L	Y
208		[free text]	-	L	L	N
Air Traffic Advisories						
157	A continuous transmission is detected on the specified frequency. Check the microphone button.	CHECK STUCK MICROPHONE [frequency]	*	U	M	N

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
System Management Messages						
163	Notification to the pilot of an ATSU identifier.	[facility designation]	-	L	N	N
234	Notification that the ground system does not have a flight plan for that aircraft.	FLIGHT PLAN NOT HELD	3	L	L	N
N2	Indicates to the pilot that the message has been rejected and voice contact should be established..	MESSAGE REJECTED. REVERT TO VOICE	-	N	M	N
N2	Indicates to the pilot that the message was timed out by the ground.	MESSAGE LATE	-	N	M	N
N2	Notification to the pilot that the operational timing has elapsed to respond to a ‘STANDBY’ message.	STANDBY TIMED OUT	-	N	M	N

8.3 CIC Downlink Message

The message elements that shall be used to compose a CIC Downlink Messages are given in the tables below.

8.3.1 Class 1: Distress/Emergency/Urgent/Unlawful interference Messages

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
Emergency Messages						
55	Urgency prefix.	PAN PAN PAN	2	U	H	Y*
56	Distress prefix.	MAYDAY MAYDAY MAYDAY	2	D	H	Y*
57	Notification of fuel remaining and number of persons on board.	[remaining fuel] OF FUEL REMAINING AND [persons on board] PERSONS ON BOARD	3	U	H	Y*
58	Notification that the pilot wishes to cancel the emergency condition.	CANCEL EMERGENCY	2	U	M	Y*
61	Notification that the aircraft is descending to the specified level due to emergency.	DESCENDING TO [level]	2	U	H	N
112	Indicates specifically that the aircraft is being subjected to unlawful interference.	SQUAWKING 7500	*	U	H	Y*
N2	Emergency postfix.	DUE TO EMERGENCY	2	U	H	Y

NOTE : The downlink messages with the response attribute Y have a response attribute of N in the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications".*

8.3.2 Class 2: Tactical Messages

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
Vertical Requests						
6	Request to fly at the specified level.	REQUEST [level]	3	N	L	Y
7	Request to fly at a level within the specified vertical range.	REQUEST BLOCK [level] TO [level]	2	N	L	Y
8	Request to cruise climb to the specified level.	REQUEST CRUISE CLIMB TO [level]	2	N	L	Y
9	Request to climb to the specified level.	REQUEST CLIMB TO [level]	1	N	L	Y

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
10	Request to descend to the specified level.	REQUEST DESCENT TO [level]	1	N	L	Y
69	Request that a descent be approved on a see-and-avoid basis.	REQUEST VMC DESCENT	3	2	L	Y
Lateral Offset Requests						
15	Request that a parallel track, offset from the cleared track by the specified distance in the specified direction, be approved.	REQUEST OFFSET [distance offset] [direction] OF ROUTE	2	N	L	Y
Speed Requests						
18	Request to fly at the specified speed.	REQUEST [speed]	1	N	L	Y
19	Request to fly within the specified speed range.	REQUEST [speed] TO [speed]	2	N	L	Y
Route Modification Requests						
26	Request for a weather deviation to the specified position via the specified route.	REQUEST WEATHER DEVIATION TO [position] VIA [route clearance]	2	N	M	Y
27	Request for a weather deviation up to the specified distance off track in the specified direction.	REQUEST WEATHER DEVIATION UP TO [distance offset] [direction] OF ROUTE	2	N	M	Y
70	Request a clearance to adopt the specified heading.	REQUEST HEADING [degrees]	1	N	L	Y
71	Request a clearance to adopt the specified ground track.	REQUEST GROUND TRACK [degrees]	3	N	L	Y
Reports						
28	Notification of leaving the specified level.	LEAVING [level]	2	N	L	N
29	Notification of climbing to the specified level.	CLIMBING TO [level]	2	N	L	N
30	Notification of descending to the specified level.	DESCENDING TO [level]	2	N	L	N
31	Notification of passing the specified position.	PASSING [position]	2	N	L	N
41	The aircraft has regained the cleared route.	BACK ON ROUTE	2	N	M	N
59	Notification that the aircraft is diverting to the specified position via the specified route.	DIVERTING TO [position] VIA [route clearance]	2	U	H	N
60	Notification that the aircraft is deviating the specified distance in the specified direction off the cleared route and maintaining a parallel track.	OFFSETTING [distance offset] [direction] OF ROUTE	2	U	H	N

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
72	Notification that the aircraft has reached the specified level.	REACHING [level]	2	N	L	N
76	Notification that the aircraft has reached a level within the specified vertical range.	REACHING BLOCK [level] TO [level]	2	N	L	N
78	At the specified time, the aircraft's position was as specified.	AT [time] [distance] [to/from] [position]	3	N	L	N
80	Notification that the aircraft is deviating from the cleared route by the specified distance in the specified direction.	DEVIATING [distance offset] [direction] OFF ROUTE	2	U	H	N
103	Allows the aircraft operator to indicate that he has cancelled IFR flight plan.	CANCELLING IFR	3	N	L	Y

8.3.3 Class 3: Strategic Messages

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
Vertical Requests						
11	Request that at the specified position a climb to the specified level be approved.	AT [position] REQUEST CLIMB TO [level]	2	N	L	Y
12	Request that at the specified position a descent to the specified level be approved.	AT [position] REQUEST DESCENT TO [level]	2	N	L	Y
13	Request that at the specified time a climb to the specified level be approved.	AT [time] REQUEST CLIMB TO [level]	2	N	L	Y
14	Request that at the specified time a descent to the specified level be approved.	AT [time] REQUEST DESCENT TO [level]	2	N	L	Y
Lateral Offset Requests						
16	Request that a parallel track, offset from the cleared track by the specified distance in the specified direction, be approved from the specified position.	AT [position] REQUEST OFFSET [distance offset] [direction] OF ROUTE	2	N	L	Y
17	Request that a parallel track, offset from the cleared track by the specified distance in the specified direction, be approved from the specified time.	AT [time] REQUEST OFFSET [distance offset] [direction] OF ROUTE	2	N	L	Y
Voice Contact Requests						

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
20	Request for voice contact.	REQUEST VOICE CONTACT	3	N	L	Y
21	Request for voice contact on the specified frequency.	REQUEST VOICE CONTACT [frequency]	2	N	L	Y
Route Modification Requests						
22	Request to track from the present position direct to the specified position.	REQUEST DIRECT TO [position]	1	N	L	Y
23	Request for the specified procedure clearance.	REQUEST [procedure name]	2	N	L	Y
24	Request for a route clearance.	REQUEST CLEARANCE [route clearance]	1	N	L	Y
25	Request for a clearance.	REQUEST [clearance type] CLEARANCE	2	N	L	Y
N2	Request for the description of holding procedures.	REQUEST HOLDING INSTRUCTIONS	2	N	L	Y
Other Requests						
101	Allows the aircraft operator to indicate a desire for termination of CPDLC service with the Current Data Authority.	REQUEST END OF SERVICE	-	L	L	Y
Negotiation Responses						
81	We can accept the specified level at the specified time.	WE CAN ACCEPT [level] AT [time]	2	L	L	N
82	We cannot accept the specified level.	WE CANNOT ACCEPT [level]	3	L	L	N
83	We can accept the specified speed at the specified time.	WE CAN ACCEPT [speed] AT [time]	2	L	L	N
84	We cannot accept the specified speed.	WE CANNOT ACCEPT [speed]	3	L	L	N
85	We can accept a parallel track offset the specified distance in the specified direction at the specified time.	WE CAN ACCEPT [distance offset] [direction] at [time]	2	L	L	N
86	We cannot accept a parallel track offset the specified distance in the specified direction.	WE CANNOT ACCEPT [distance offset] [direction]	3	L	L	N
Reports						
32	Notification of the present level.	PRESENT LEVEL [level]	3	N	L	N
33	Notification of the present position.	PRESENT POSITION [position]	3	N	L	N
34	Notification of the present speed.	PRESENT SPEED [speed]	3	N	L	N
35	Notification of the present heading in degrees.	PRESENT HEADING [degrees]	3	N	L	N

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
36	Notification of the present ground track in degrees.	PRESENT GROUND TRACK [degrees]	3	N	L	N
37	Notification that the aircraft is maintaining the specified level.	LEVEL [level]	3	N	L	N
38	Read-back of the assigned level.	ASSIGNED LEVEL [level]	3	N	M	N
39	Read-back of the assigned speed.	ASSIGNED SPEED [speed]	3	N	M	N
40	Read-back of the assigned route.	ASSIGNED ROUTE [route clearance]	3	N	M	N
42	The next waypoint is the specified position.	NEXT WAYPOINT [position]	3	N	L	N
43	The ETA at the next waypoint is as specified.	NEXT WAYPOINT ETA [time]	3	N	L	N
44	The next but one waypoint is the specified position.	ENSUING WAYPOINT [position]	3	N	L	N
45	Clarification of previously reported waypoint passage.	REPORTED WAYPOINT [position]	3	N	L	N
46	Clarification of time over previously reported waypoint.	REPORTED WAYPOINT [time]	3	N	L	N
47	The specified (SSR) code has been selected.	SQUAWKING [code]	3	N	L	N
48	Position report.	POSITION REPORT [position report]	2	N	M	N
77	Read-back of the assigned vertical range.	ASSIGNED BLOCK [level] TO [level]	3	N	M	N
79	The code of the latest ATIS received is as specified.	ATIS [atis code]	3	N	L	N
102	Used to report that an aircraft has landed.	LANDING REPORT	-	N	N	N
104	Notification of estimated time of arrival at the specified position.	ETA [position][time]	1	L	L	N
105	Notification of the alternative aerodrome for landing.	ALTERNATE AERODROME [airport]	2	L	L	N
106	Notification of the preferred level.	PREFERRED LEVEL [level]	2	L	L	N
108	Notification that de-icing action has been completed.	DE-ICING COMPLETE	2	L	L	N
109	Notification of the preferred time to commence descent for approach.	TOP OF DESCENT [time]	2	L	L	N
110	Notification of the preferred position to commence descent for approach.	TOP OF DESCENT [position]	2	L	L	N

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
111	Notification of the preferred time and position to commence descent for approach.	TOP OF DESCENT [time] [position]	3	L	L	N
113	Notification of the requested speed.	[speed type] [speed type] [speed type] SPEED [speed]	3	N	L	N
NOTE :	*Additional Reports on weather conditions (e.g. TURBULENCE, ICING, etc.) are being introduced in the ICAO Manual of ATS Data Link Applications but were not ready at the time of the publication of this document.*					

8.3.4 Class 4: Information Messages

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
Negotiation Responses						
49	Request for the earliest time at which a clearance to the specified speed can be expected.	WHEN CAN WE EXPECT [speed]	2	L	L	Y
50	Request for the earliest time at which a clearance to a speed within the specified range can be expected.	WHEN CAN WE EXPECT [speed] TO [speed]	2	L	L	Y
51	Request for the earliest time at which a clearance to regain the planned route can be expected.	WHEN CAN WE EXPECT BACK ON ROUTE	3	L	L	Y
52	Request for the earliest time at which a clearance to descend can be expected.	WHEN CAN WE EXPECT LOWER LEVEL	2	L	L	Y
53	Request for the earliest time at which a clearance to climb can be expected.	WHEN CAN WE EXPECT HIGHER LEVEL	2	L	L	Y
54	Request for the earliest time at which a clearance to cruise climb to the specified level can be expected.	WHEN CAN WE EXPECT CRUISE CLIMB TO [level]	2	L	L	Y
87	Request for the earliest time at which a clearance to climb to the specified level can be expected.	WHEN CAN WE EXPECT CLIMB TO [level]	2	L	L	Y
88	Request for the earliest time at which a clearance to descend to the specified level can be expected.	WHEN CAN WE EXPECT DESCENT TO [level]	2	L	L	Y

8.3.5 Class 5: Special Messages

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
Message Additions						
65	Used to explain reasons for aircraft operator's message.	DUE TO WEATHER		L	L	N
66	Used to explain reasons for aircraft operator's message.	DUE TO AIRCRAFT PERFORMANCE	1	L	L	N
74	States a desire by the aircraft operator to provide his/her own separation and remain in VMC.	REQUEST TO MAINTAIN OWN SEPARATION AND VMC	3	L	L	Y
75	Used in conjunction with another message to indicate that the operator wishes to execute request when the pilot is prepared to do so.	AT PILOTS DISCRETION	3	L	L	N
Responses						
0	The instruction is understood and will be complied with.	WILCO	1	N	M	N
1	The instruction cannot be complied with.	UNABLE	1	N	M	N
2	Wait for a reply.	STANDBY	1	N	M	N
3	Message received and understood.	ROGER	1	N	M	N
4	Yes.	AFFIRM	1	N	M	N
5	No.	NEGATIVE	1	N	M	N
62	A system generated message that the avionics has detected an error.	ERROR [error information]	-	U	L	N
100	Confirmation to the aircraft system that the ground system has received the message to which the logical acknowledgment refers and found it acceptable for display to the responsible person.	LOGICAL ACKNOWLEDGMENT	-	N	M	N
N2	Request to confirm the previously sent clearance.	CONFIRM CLEARANCE	2	N	M	Y
System Management Messages						
73	A system generated message indicating the software version number.	[version number]	-	L	L	N
N2	Indicates to the controller that the message was timed out by the aircraft.	MESSAGE LATE	-	N	L	N
N2	Indicates to the controller that the message has been rejected and voice contact should be established.	MESSAGE REJECTED. REVERTING TO VOICE	-	N	L	N

Msg Num.	Message Intent/Use	Message Element	FOU	URG	ALRT	RESP
Free Text						
67		[free text]	-	N	L	N
68		[free text]	-	D	H	Y
90		[free text]	-	N	M	N
91		[free text]	-	N	L	Y
92		[free text]	-	L	L	Y
93		[free text]	-	U	H	N
94		[free text]	-	D	H	N
95		[free text]	-	U	M	N
96		[free text]	-	U	L	N
97		[free text]	-	L	L	N
98		[free text]	-	N	N	N

8.4 CIC Message Validity Checks

The message validity checks have been introduced in order to provide for the automatic detection of operationally meaningless data link messages that can be composed when several CIC message elements are grouped into one single CIC message. This validity check should reduce the occurrence of wrong messages which will bring benefits to users through a gain in time and a lesser chance of misunderstandings.

The following cases of combination of message elements should result in invalid messages:

1. Combination of two contradictory message elements in the same message, e.g.:
    - climb / descend
    - above / below
    - squawk / stop squawk

1- Combination of two incompatible message elements in the same message, e.g.:

- when can you accept... / can you accept...
- identified / radar service terminated
- contact / monitor

1 Combination of two or more of the following message elements in the same message:

- WILCO
- UNABLE
- STANDBY
- ROGER
- AFFIRM
- NEGATIVE
- CONFIRM CLEARANCE
- REQUEST DEFERRED
- REQUEST FORWARDED
- REQUEST ALREADY RECEIVED

9. Additional Guidance

The previous subsections introduced a classification of the CIC message elements according to their frequency of use. In order to provide additional guidance to end-systems and airborne HMI designers and to facilitate the operational use of CIC by the Aircrew, the frequency of use categories of the downlink message elements will be detailed further as follows:

1a Routine Responses.

1b Message elements routinely used as initiation of exchanges and/or expected to provide the maximum benefits.

2p Messages not frequently used but should be available for strategic planning.

2e Messages envisaged for future system expansion.

2b Messages required as back up to voice communications.

3a Messages not used for initiation of exchanges in the European airspace.

3b Messages described in or supported by other data link ATS services

FOU	Downlink Message Element
1a ROUTINE RESPONSES	
1a	WILCO
1a	UNABLE
1a	STANDBY
1a	ROGER
1a	AFFIRM
1a	NEGATIVE
1b ROUTINE	
1b	REQUEST CLIMB TO [level]
1b	REQUEST DESCENT TO [level]
1b	REQUEST [speed]
1b	REQUEST DIRECT TO [position]
1b	REQUEST CLEARANCE [route clearance]
1b	REQUEST HEADING [degrees]
1b	ETA [position][time]
1b	DUE TO WEATHER
1b	DUE TO AIRCRAFT PERFORMANCE
2p PLANNING	
2p	AT [position] REQUEST CLIMB TO [level]
2p	AT [position] REQUEST DESCENT TO [level]
2p	AT [time] REQUEST CLIMB TO [level]
2p	AT [time] REQUEST DESCENT TO [level]
2p	REQUEST OFFSET [distance offset] [direction] OF ROUTE
2p	AT [position] REQUEST OFFSET [distance offset] [direction] OF ROUTE

FOU	Downlink Message Element
2p	AT [time] REQUEST OFFSET [distance offset] [direction] OF ROUTE
2p	REQUEST [procedure name]
2p	REQUEST [clearance type] CLEARANCE
2p	REQUEST WEATHER DEVIATION TO [position] VIA [route clearance]
2p	REQUEST WEATHER DEVIATION UP TO [distance offset] [direction] OF ROUTE
2p	WHEN CAN WE EXPECT [speed]
2p	WHEN CAN WE EXPECT LOWER LEVEL
2p	WHEN CAN WE EXPECT HIGHER LEVEL
2p	WHEN CAN WE EXPECT CLIMB TO [level]
2p	WHEN CAN WE EXPECT DESCENT TO [level]
2p	WE CAN ACCEPT [level] AT [time]
2p	WE CAN ACCEPT [speed] AT [time]
2p	WE CAN ACCEPT [distance offset] [direction] at [time]
2e PLANNING EXTENSION	
2e	REQUEST BLOCK [level] TO [level]
2e	REQUEST CRUISE CLIMB TO [level]
1/2e	REQUEST [speed] TO [speed]
2e	WHEN CAN WE EXPECT [speed] TO [speed]
2e	WHEN CAN WE EXPECT CRUISE CLIMB TO [level]
2b BACK UP	
2b	DE-ICING COMPLETE (on ground only)
2b	REQUEST VOICE CONTACT [frequency] (g/a)
2b	LEAVING [level] (a)
2b	REACHING [level] (a)
2b	CLIMBING TO [level] (a)
2b	DESCENDING TO [level] (a)
2b	PASSING [position] (a)
2b	POSITION REPORT [position report] (a)
2b	OFFSETTING [distance offset] [direction] OF ROUTE (a)
2b	DEVIATING [distance offset] [direction] OFF ROUTE (a)
2b	BACK ON ROUTE (a)
2b	PAN PAN PAN (g/a)
2b	MAYDAY MAYDAY MAYDAY (g/a)
2b	CANCEL EMERGENCY (g/a)
2b	DIVERTING TO [position] VIA [route clearance] (a)
2b	LANDING REPORT(on ground only)
-	[free text] (g/a)

FOU	Downlink Message Element
2b	ALTERNATE AERODROME [airport] (g/a) PPD
2b	PREFERRED LEVEL [level] (g/a) PPD
2b	TOP OF DESCENT [time] (a) PPD
2b	TOP OF DESCENT [position] (a) PPD
2b/e	REACHING BLOCK [level] TO [level] (a)
*	SQUAWKING 7500
3a SUPPLEMENTAL	
3a	REQUEST [level]
3a	REQUEST VOICE CONTACT
3a	WHEN CAN WE EXPECT BACK ON ROUTE
3a	[remaining fuel] OF FUEL REMAINING AND [persons on board] PERSONS ON BOARD
3a	REQUEST VMC DESCENT
3a	REQUEST GROUND TRACK [degrees]
3a	REQUEST TO MAINTAIN OWN SEPARATION AND VMC
3a	AT PILOTS DISCRETION
3b	ASSIGNED BLOCK [level] TO [level]
3a	AT [time] [distance] [to/from] [position]
3a	ATIS [atis code]
3a	WE CANNOT ACCEPT [level]
3a	WE CANNOT ACCEPT [speed]
3a	WE CANNOT ACCEPT [distance offset] [direction]
3a	MONITORING [unit name] [frequency]
3a	CANCELLING IFR
3a	TOP OF DESCENT [time] [position]
3a	[speed type] [speed type] [speed type] SPEED [speed]
-	[free text]
-	[free text]
-	[free text]
-	[free text]
-	[free text]
-	[free text]
-	[free text]
-	[free text]
3b SUPPLEMENTAL	
3b	PRESENT LEVEL [level]
3b	PRESENT POSITION [position]

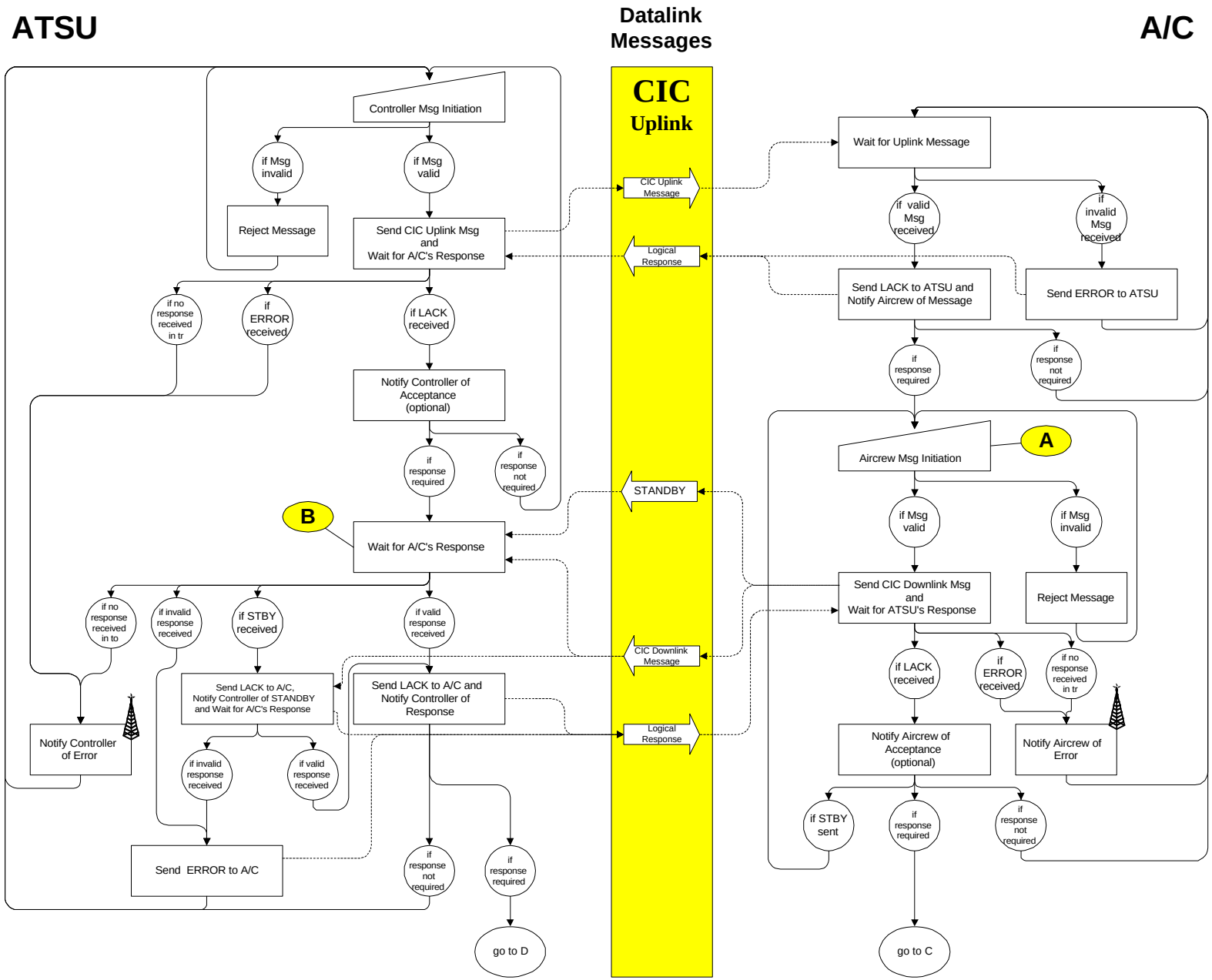
FOU	Downlink Message Element
3b	PRESENT SPEED [speed]
3b	PRESENT HEADING [degrees]
3b	PRESENT GROUND TRACK [degrees]
3b	LEVEL [level]
3b	ASSIGNED LEVEL [level]
3b	ASSIGNED SPEED [speed]
3b	ASSIGNED ROUTE [route clearance]
3b	NEXT WAYPOINT [position]
3b	NEXT WAYPOINT ETA [time]
3b	ENSUING WAYPOINT [position]
3b	REPORTED WAYPOINT [position]
3b	REPORTED WAYPOINT [time]
3b	SQUAWKING [code]

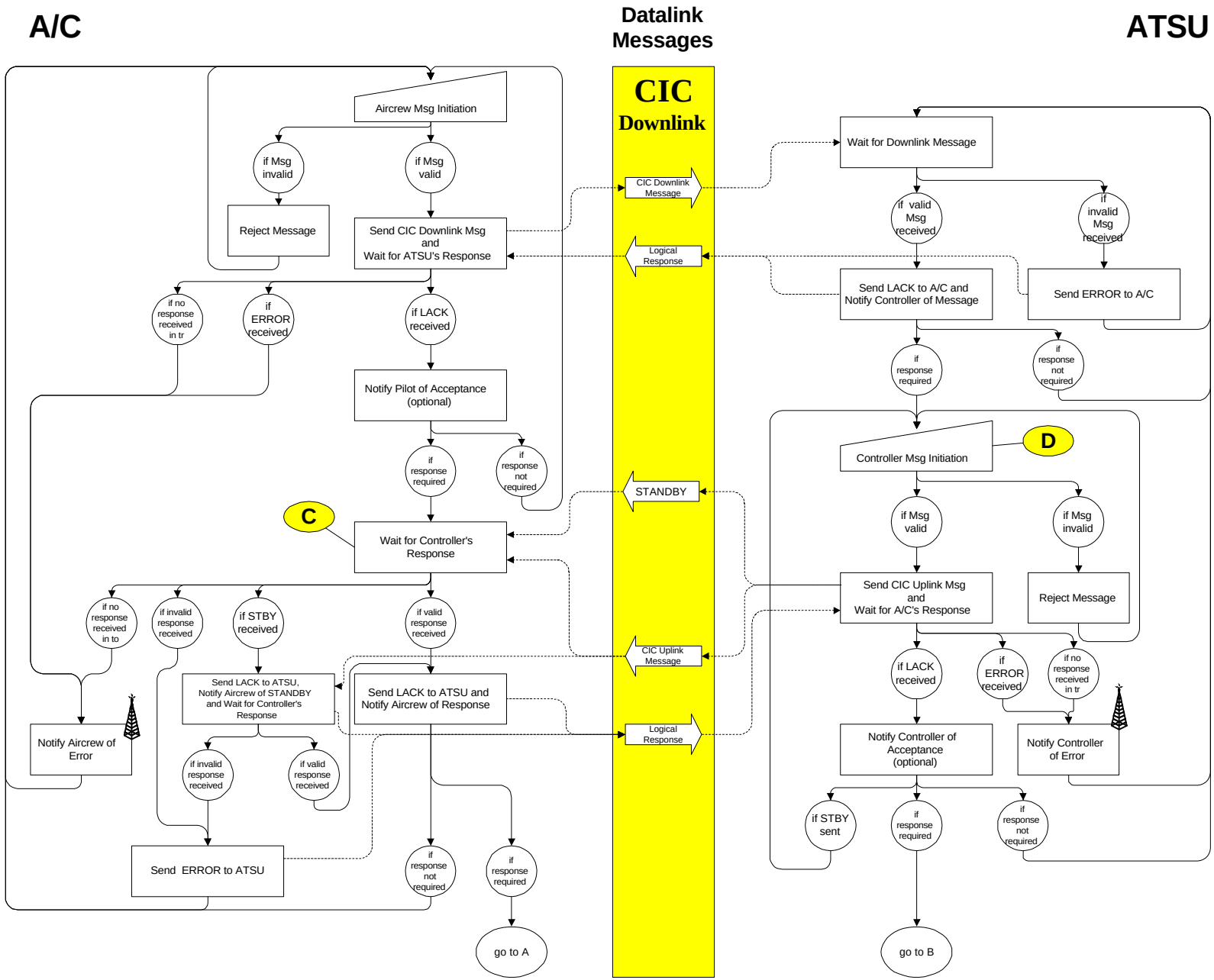
10. Event Sequence Diagrams

The diagrams in this subsection provide an overview of the main normal and abnormal sequence of events within the CIC service.

Two diagrams are provided: the first one shows the CIC uplink message exchange and the second shows CIC downlink message exchange.

Please refer to Appendix B for a description of the symbology used in these diagrams.


ATSU
Datalink Messages
A/C
CIC Uplink
Controller Msg Initiation
if Msg invalid
if Msg valid
Reject Message
Send CIC Uplink Msg and Wait for A/C's Response
if no response received in tr
if ERROR received
if LACK received
Notify Controller of Acceptance (optional)
if response required
if response not required
B
Wait for A/C's Response
if no response received in to
if invalid response received
if STBY received
if valid response received
Send LACK to A/C, Notify Controller of STANDBY and Wait for A/C's Response
Send LACK to A/C and Notify Controller of Response
Notify Controller of Error
if invalid response received
if valid response received
Send ERROR to A/C
if response not required
if response required
go to D
CIC Uplink Message
Logical Response
STANDBY
CIC Downlink Message
Logical Response
Wait for Uplink Message
if valid Msg received
if invalid Msg received
Send LACK to ATSU and Notify Aircrew of Message
Send ERROR to ATSU
if response required
if response not required
A
Aircrew Msg Initiation
if Msg valid
if Msg invalid
Send CIC Downlink Msg and Wait for ATSU's Response
Reject Message
if LACK received
if ERROR received
if no response received in tr
Notify Aircrew of Acceptance (optional)
Notify Aircrew of Error
if STBY sent
if response required
if response not required
go to C


A/C
Datalink Messages
ATSU
CIC Downlink
Aircrew Msg Initiation
if Msg invalid
if Msg valid
Reject Message
Send CIC Downlink Msg and Wait for ATSU's Response
if no response received in tr
if ERROR received
if LACK received
Notify Pilot of Acceptance (optional)
if response required
if response not required
C
Wait for Controller's Response
if no response received in to
if invalid response received
if STBY received
if valid response received
Send LACK to ATSU, Notify Aircrew of STANDBY and Wait for Controller's Response
Send LACK to ATSU and Notify Aircrew of Response
Notify Aircrew of Error
if invalid response received
if valid response received
Send ERROR to ATSU
if response not required
if response required
go to A
CIC Downlink Message
Logical Response
STANDBY
CIC Uplink Message
Logical Response
Wait for Downlink Message
if valid Msg received
if invalid Msg received
Send LACK to A/C and Notify Controller of Message
Send ERROR to A/C
if response required
if response not required
D
Controller Msg Initiation
if Msg valid
if Msg invalid
Send CIC Uplink Msg and Wait for A/C's Response
Reject Message
if LACK received
if ERROR received
if no response received in tr
Notify Controller of Acceptance (optional)
Notify Controller of Error
if STBY sent
if response required
if response not required
go to B

Section 6: ATC Communications Management (ACM) Service

Service No.	Name	Abb.	Cat	References	Version No.
O-5	ATC Communications Management	ACM	CM	"ICAO Manual of Air Traffic Services (ATS) Data Link Applications"	2.0 15/6/97

Table of Contents

1. Scope and Objective

When a flight is about to be transferred from one sector/ATSU to another sector/ATSU, the Aircrew is instructed to change to the voice channel of the next sector/ATSU so that it can take control of the flight.

The ACM Service provides automated assistance to the Aircrew and current and next Controllers for conducting this transfer of ATC communications. The ACM Service encompasses the transfer of **all** Controller/Aircrew communications, both the voice channel and the data communications channel.

The ACM service is compliant with the guidelines contained in the ICAO Manual for ATS Data Link Applications, except when specifically stated so.

The ACM service contains exclusively the air/ground data link exchanges between an Aircraft, its T-ATSU (the transferring ATSU) and its R-ATSU (the next ATSU to take control of the flight). Exchanges with Downstream ATSUs (D-ATSUs) are defined in the Downstream Clearance (DSC) service.

2. Expected Benefits, Anticipated Constraints, and Associated Human Factors

2.1. Expected Benefits

- ⇨ Increased safety by reducing the potential for erroneous frequency changes (increased accuracy and reduced errors).
- ⇨ Reduction of voice channel load (voice frequency congestion).
- ⇨ Reduction of voice workload for both Aircrew and Controller.
- ⇨ Increased ensurance of positive communications contact at all times.
- ⇨ Avoidance of late transfer of communications.
- ⇨ Avoidance of retransmissions caused by misunderstanding of frequency values.
- ⇨ Better, more flexible pacing of communications tasks, for both Controller and Aircrew.
- ⇨ More efficient use of Airspace due to more time being allocated to providing a better service to user aircraft, rather than routine communications tasks.
- ⇨ Reduced Controller time stress/memory burden.

2.2. Anticipated Constraints

- ⇨ Reduction of voice communications reduces situational awareness for both Aircrew and Controller.
- ⇨ This Service, and data link in general, may have limited utilisation for time-critical or urgent situations.
- ⇨ Depending upon the final implementation of the ACM Service, procedures may be required to ensure that Aircrew comply with instructions, and Controllers issue instructions, only after the full ground-air-ground ‘handshake’ has been accomplished.

2.3. Associated Human Factors

- ⇨ Regardless of the level of system automation in use, Controllers and Aircrew shall have the capability to review, validate and acknowledge any frequency change message being delivered or received.

3. Service Operational Context

When the current sector/ATSU decides that the flight should be transferred to the next sector/ATSU, the transfer of communications procedure is initiated. This can take place either at the discretion of the current sector/ATSU, or at the request of the receiving sector/ATSU.

4. Overview of Operating Methods with and without Data Link

4.1. ACM Service Configurations

The following Overview describes the ACM Service when both the Transferring ATSU (T-ATSU) and the Receiving ATSU (R-ATSU) are CPDLC-equipped. Variations in the Service Operating Method arising from a non-CPDLC-equipped T-ATSU or R-ATSU consist purely of the substitution of some air/ground data communications exchanges with voice exchanges. These variations are described in the Detailed Service Description subsection, and graphically displayed in the Information Exchange Diagrams.

The following two operating methods are presented below:

Communications transfer instructed via data link:

With this operating method, both the voice and the data communications channels are transferred using data link.

Communications transfer instructed via voice and data link:

With this operating method the voice communications channel is transferred using voice and the data link communications channel is transferred using data link.

4.2. Information Exchange Diagram Conventions

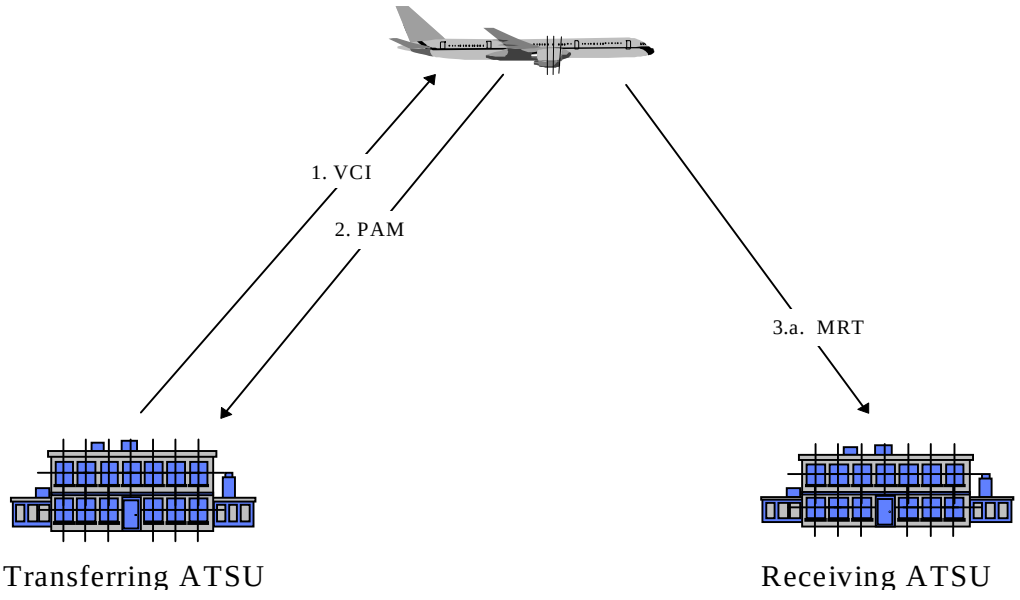
All of the air/ground data exchanges in the following diagrams require Logical Responses, as reflected in the detailed service descriptions and the Time Sequence Diagrams below. The positive/negative Logical Responses (LACK and ERROR, respectively) have been removed from the following overview, to make it more readable.

4.3. T-ATSU and R-ATSU equipped for CPDLC

4.3.1. Communications transfer instructed via data link

Step	Operating Method without Data Link	Operating Method with Data Link
1	Using voice, the T-ATSU provides the R-ATSU identification and voice channel to the Aircrew, and instructs the Aircrew to contact or monitor the R-ATSU.	The T-ATSU Controller instructs the aircraft to monitor or contact the R-ATSU on its voice and data channels by sending the ATC Voice Change Instruction (VCI) via data link.
2	The Aircrew acknowledges the message by voice readback. The T-ATSU verifies the readback and corrects any errors.	The Aircrew manually acknowledges the instruction to transfer voice and data communications to the R-ATSU by sending the Pilot Acknowledgment Message (PAM) to the T-ATSU via data link.
3	The Aircrew selects the R-ATSU's voice channel, and contacts or monitors the R-ATSU, as previously instructed. The R-ATSU Controller acknowledges the Aircrew's voice contact (if appropriate).	3.a The Aircrew manually activates the new voice channel and triggers a CPDLC 'Monitoring R/T' exchange to the R-ATSU (MRT). 3.b The Aircrew contacts the R-ATSU on its voice channel, when required. The R-ATSU Controller acknowledges the Aircrew's voice contact (if appropriate).

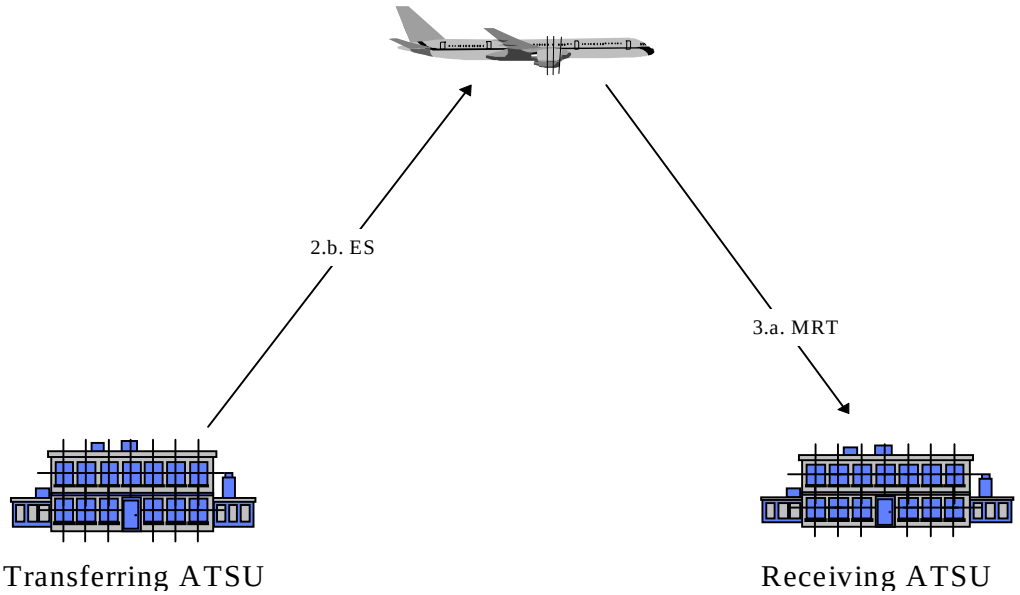
4.3.1.1. Information Exchange Diagram



4.3.2. Communications transfer instructed via voice and data link

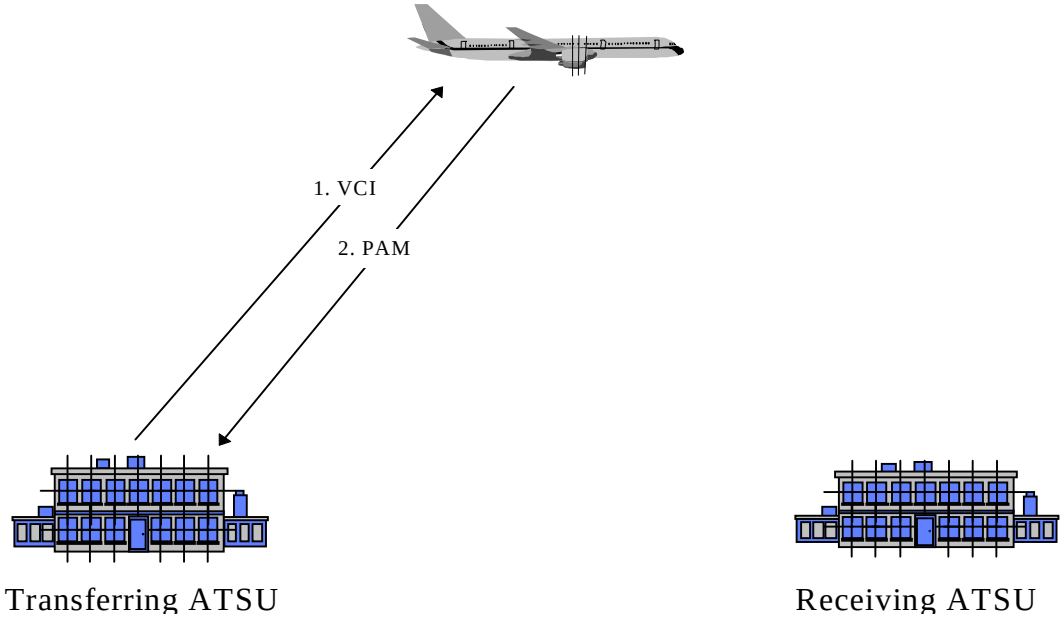
Step	Operating Method without Data Link	Operating Method with Data Link
1	Using voice, the T-ATSU provides the R-ATSU identification and voice channel to the Aircrew, and instructs the Aircrew to contact or monitor the R-ATSU.	The T-ATSU Controller instructs the aircraft to monitor or contact the R-ATSU on its voice channel via voice communications.
2	The Aircrew acknowledges the message by voice readback. The T-ATSU verifies the readback and corrects any errors.	2.a The Aircrew acknowledges the instruction by voice readback. 2.b The T-ATSU Controller manually triggers the indication that CPDLC exchanges with the T-ATSU shall be terminated (ES exchange).
3	The Aircrew selects the R-ATSU's voice channel, and contacts or monitors the R-ATSU, as previously instructed. The R-ATSU Controller acknowledges the Aircrew's voice contact (if appropriate).	3.a The Aircrew manually activates the new voice channel and sends the 'Monitoring R/T' (MRT) message to the R-ATSU via data link . 3.b The Aircrew contacts the R-ATSU on its voice channel, when required. The R-ATSU Controller acknowledges the Aircrew's voice contact (if appropriate).

4.3.2.1. Information Exchange Diagram

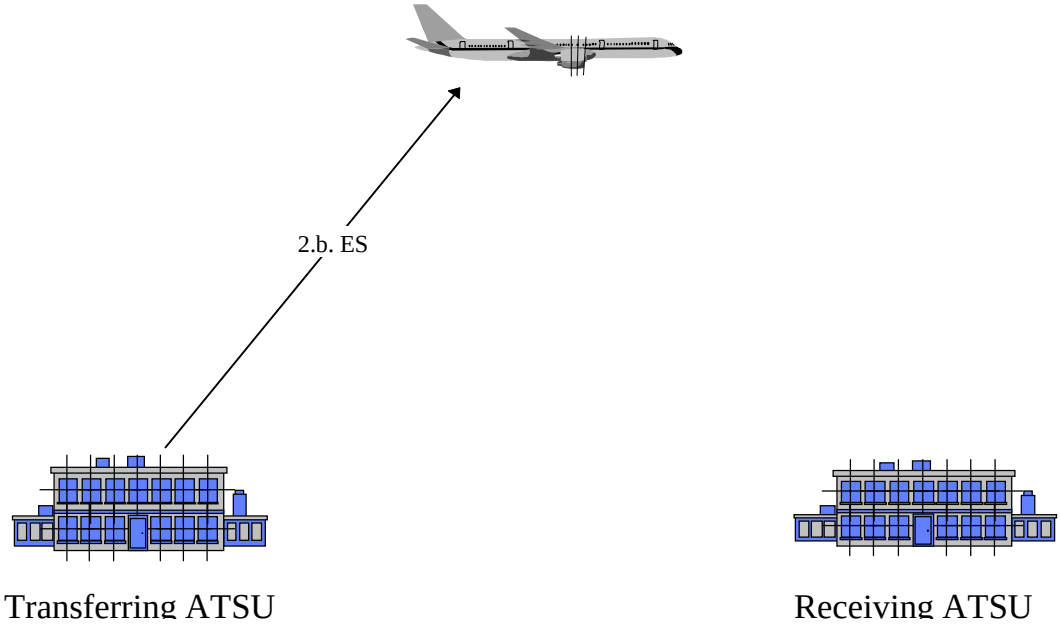


4.4. R-ATSU not equipped for CPDLC

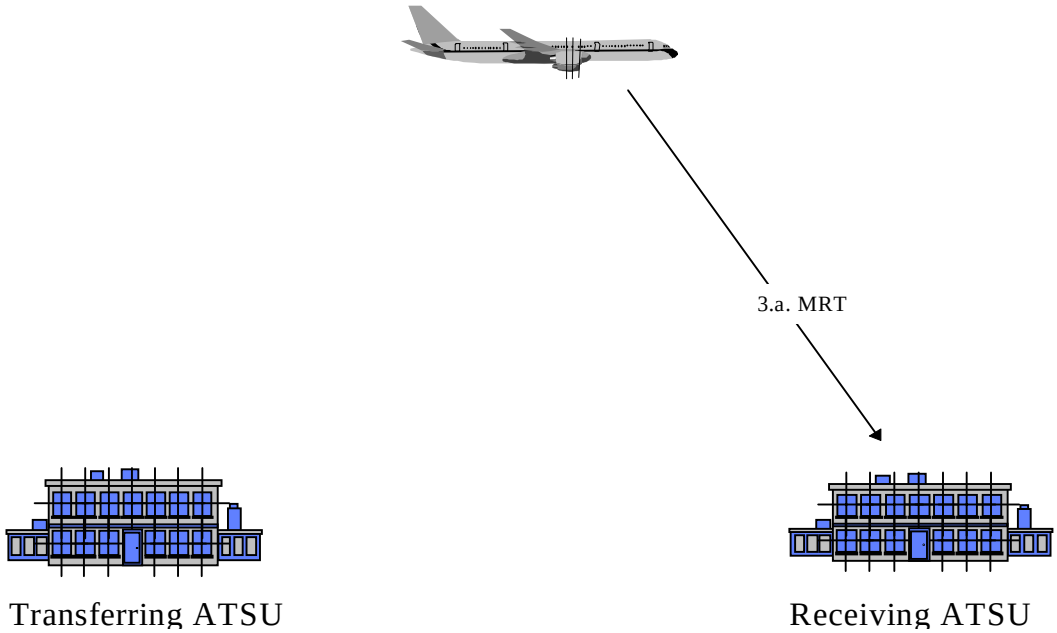
4.4.1. Communications transfer instructed via data link



4.4.2. Communications transfer instructed via voice and data link

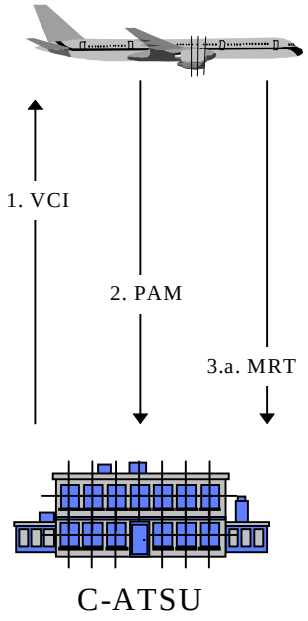


4.5. T-ATSU not equipped for CPDLC

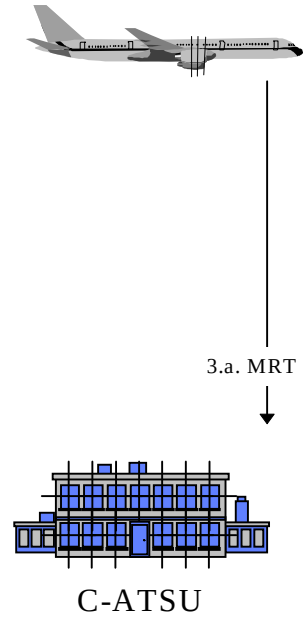


4.6. Transfer of Communications Within the Same ATSU

4.6.1. Communications transfer instructed via data link



4.6.2. Communications transfer instructed via voice and data link



5. Detailed Service Operating Method with Data Link

5.1. General ACM Requirements

[ACM.1]

The ACM service shall provide a transparent transfer of data communications, in synchronisation with the transfer of voice communications.

[ACM.2]

The ACM service shall retain the operational principle that there is only one controlling authority (i.e. only one ATSU can communicate with voice and/or data link with one specific aircraft for CIC exchanges), and that the controlling authority is correctly and unambiguously determined.

[ACM.3]

The ACM service shall maintain existing cockpit control and operational awareness over which ATSUs are communicating with the Aircrew, a procedure within current, voice-only operations which should not change with the introduction of Controller/Aircrew data communications.

[ACM.4]

The ACM service shall be able to operate without ground/ground data communications.

[ACM.5]

The ACM Service shall support the following configurations:

1. both the T-ATSU and the R-ATSU are equipped for air/ground data link;
2. only the T-ATSU is equipped for air/ground data link;
3. only the R-ATSU is equipped for air/ground data link;
4. transfers within one ATSU (e.g. to change from one sector to another within the same ATSU).

[ACM.6]

The ACM service shall allow the use of voice combined with data link to effect the communications transfer in all of the above configurations in accordance with local procedures.

[ACM.7]

When technical messages are combined with the ACM operational messages herewith described, this shall have no impact on the operational behaviour of the service.

[ACM.8]

The T-ATSU shall be responsible for the notification of the identity of the R-ATSU to the aircraft.

Note: This notification could be performed prior to the sending of the VCI or the ES.

[ACM.9]

The data link system shall ensure that data communications shall be transferred to the R-ATSU selected by the T-ATSU.

[ACM.10]

Aircrew shall be informed at all times of the status of the data communications with the T-ATSU and the R-ATSU.

[ACM.11]

T-ATSU and R-ATSU Controllers shall be informed at all times of the status of the data communications with the aircraft.

5.2. T-ATSU and R-ATSU equipped for CPDLC

5.2.1. Service Availability

This service shall be available during all flight phases.

5.2.2. Service Description

5.2.2.1. Normal Mode

5.2.2.1.1. Communications transfer instructed via data link

Step	Operation
1	At his own discretion or on request of the R-ATSU Controller, the T-ATSU Controller shall instruct the Aircrew to change ATC communications to the R-ATSU. The Controller shall instruct the Aircrew to change both voice and data communications by manually triggering a single data link instruction to change both voice and data communications: the ATC Voice Change Instruction (VCI). The treatment of the VCI when there are CPDLC messages awaiting a response at the moment it is triggered is described in subsection 5.2.2.1.3 below. If the VCI is valid, and will be displayed to the Aircrew, the aircraft shall transfer a LACK to the T-ATSU. In all other cases, the aircraft transfers an ERROR notification.
2	Using the Pilot Acknowledgement Message (PAM) information exchange, the Aircrew shall manually acknowledge the T-ATSU instruction to transfer communications. This PAM applies to both voice and data communications transfer. The Aircrew may acknowledge the VCI using a PAM containing a “Wilco” or “Unable” indication. If the PAM is valid and will be displayed to the Controller, the T-ATSU shall transfer a LACK to the aircraft. In all other cases, the T-ATSU shall transfer an ERROR notification. If the Aircrew acknowledges the instruction with “Unable”, CPDLC shall still be enabled with the T-ATSU and shall be disabled with the R-ATSU.. In this case the Aircrew shall establish voice contact with the T-ATSU Controller. Provided the Aircrew has acknowledged the VCI with a Wilco, CPDLC with the T-ATSU shall be automatically terminated and CPDLC with the R-ATSU shall be automatically established. . The Aircrew shall have the capability to manually trigger the transfer of data communications to the R-ATSU. As a result of this step, both the T-ATSU Controller and the Aircrew shall receive an indication that they can no longer exchange CPDLC messages and the R-ATSU Controller and the Aircrew shall receive an indication that they can exchange CPDLC messages.
3	a) The Aircrew shall manually load the new voice channel, activate and monitor it, and trigger a data link notification to the R-ATSU Controller that it is monitoring the requested voice channel (Monitoring R/T {MRT}). *NOTE: If appropriate equipment is available, the R-ATSU frequency should be automatically loaded into transmitter stand-by mode at the end of Step ‘2’, and the PAM and the MRT should be triggered automatically when the Aircrew activates this channel.* If the MRT is valid and will be displayed to the Controller, the R-ATSU shall transfer a LACK to the aircraft. In all other cases, the R-ATSU shall transfer an ERROR notification. As a result of this step, the R-ATSU Controller shall receive the indication that the exchange of voice and CPDLC messages with the Aircrew is now possible. b) If the T-ATSU Voice Channel Instruction to the Aircrew was to ‘contact’, rather than ‘monitor’, the Aircrew shall establish voice contact with the R-ATSU Controller on the new voice channel, and the R-ATSU Controller shall acknowledge that contact.

5.2.2.1.2. Communications transfer instructed via voice and data link

Step	Operation
1	At his own discretion or on request of the R-ATSU Controller, the T-ATSU Controller shall instruct the Aircrew to change ATC communications to the R-ATSU. The Controller shall instruct the Aircrew to change voice channels using voice.
2	a) The Aircrew shall acknowledge the instruction via a voice readback. b) Provided the Aircrew has accepted the communications transfer instruction, the Controller shall manually trigger the End Service (ES) data link notification to the Aircrew, indicating that all further data communications shall be with the R-ATSU. If the Aircrew did not accept the communications transfer instruction, the Controller shall not transmit the ES so that CPDLC with the T-ATSU is maintained. The treatment of the End Service (ES) when there are CPDLC messages awaiting a response is described in subsection 5.2.2.1.3 below. c) On reception of the ES the aircraft shall automatically terminate CPDLC with the T-ATSU. CPDLC with the R-ATSU shall be automatically established once CPDLC with the T-ATSU is terminated. The Aircrew shall have the capability to manually trigger the transfer of data communications to the R-ATSU. As a result of this step, both the T-ATSU Controller and the Aircrew shall receive an indication that they can no longer exchange CPDLC messages and the R-ATSU Controller and the Aircrew shall receive an indication that they can activate the exchange of CPDLC messages.
3	a) The Aircrew shall manually load the new voice channel, activate and monitor it, and trigger a data link notification to the R-ATSU Controller that it is monitoring the requested voice channel (Monitoring R/T {MRT}). *NOTE: If appropriate equipment is available, the R-ATSU frequency should be automatically loaded into transmitter stand-by mode at the end of Step '2', and the PAM and the MRT should be triggered automatically when the Aircrew activates this channel.* If the MRT is valid and will be displayed to the Controller, the R-ATSU shall transfer a LACK to the aircraft. In all other cases, the R-ATSU shall transfer an ERROR notification. b) If the T-ATSU Voice Channel Instruction to the Aircrew was to 'contact', rather than 'monitor', the Aircrew shall establish voice contact with the R-ATSU Controller on the new voice channel, and the R-ATSU Controller shall acknowledge that contact.

5.2.2.1.3. Transfer of data Communications with CPDLC messages awaiting a response

When the transfer of communications is within one ATSU, the treatment of messages awaiting response is left to local implementation.

When the transfer of communications involves two different ATSUs, five cases are possible:

1. Uplinked clearances have not been acknowledged by the Aircrew:

   In this case, when the VCI or the ES is triggered the Controller shall be informed of the pending clearances and shall have the capability to confirm the transfer of communications. The Controller may chose to wait for the responses to the clearances or trigger the confirmation of the transfer of communications. This confirmation shall perform the closure of all clearances and the sending of the VCI (or the ES when the voice channel change was instructed via voice).

2. Uplinked requests have not been responded by the Aircrew:

A “DISREGARD” message for the requests shall be automatically uplinked, the requests shall be locally closed and the VCI (or the ES when the voice channel change was instructed via voice) shall be sent.

3. Uplinked STANDBYs have not been closed by the Controller:

   The message “REQUEST AGAIN WITH NEXT UNIT [unit name]” shall be automatically uplinked closing the open exchanges. Then the VCI (or the ES when the voice channel change was instructed via voice) shall be sent.

4. Downlinked requests have not been responded by the Controller:

   The message “REQUEST AGAIN WITH NEXT UNIT [unit name]” shall be automatically uplinked closing the open exchanges. Then the VCI (or the ES when the voice channel change was instructed via voice) shall be sent.

5. Downlinked STANDBYs have not been closed by the Aircrew:

   For the STANDBYs downlinked in response to requests: A “DISREGARD” message for the requests shall be automatically uplinked, the requests shall be locally closed and the VCI (or the ES when the voice channel change was instructed via voice) shall be sent.

   For the STANDBYs downlinked in response to clearances: When the VCI (or the ES when the voice channel change was instructed via voice) is triggered the Controller shall be informed of the pending clearances and shall have the capability to confirm the transfer of communications. This confirmation shall trigger the closure of all clearances and the sending of the VCI (or the ES when the voice channel change was instructed via voice).

NOTE : : The closure described in cases 1, 2 and 3 are not supported by the “ICAO Manual of Air Traffic Services (ATS) Data Link Applications

5.2.2.1.4. Sequence of services

The ACM service requires a preceding Service for flight identification (i.e. correlation of flight plan with flight) and receipt of the required addressing and aircraft functional capability information.

NOTE : In the “ICAO Manual of Air Traffic Services (ATS) Data Link Applications” the flight identification service is referred to as Data Link Initiation Capability (DLIC).

In order to ensure independence of any ground/ground data communications services, aircraft shall be capable of providing all required addressing and other data to the R-ATSU, at least upon notification of the R-ATSU’s identity.

5.2.2.1.5. Additional Guidelines

Ground/ground Data Exchanges in support of the ACM Service

ATSUs may elect to implement and use ground/ground data exchanges in support of the ACM Service, subject to bilateral agreements, local procedures, and local infrastructure. Such ground/ground exchanges are not required for successful completion of the ACM Service, and are therefore not addressed further in this Service Description. Further information on these and other ground/ground data exchanges can be found in the ICAO Manual for ATS Data Link Applications, ATS Inter-facility Data Communications (AIDC) section, and any applicable regional supplementary material.

5.2.2.2. Abnormal Mode

5.2.2.2.1. General Error Handling

The General Error Handling requirements described in subsection 5.2.2.1 of the Clearances and Information Communications (CIC) service are also applicable to the ACM service.

5.2.2.2.2. Specific Error Handling Requirements

Step	Abnormal Event	Response
1	Reception of a data link message from the R-ATSU before CPDLC with the R-ATSU is established	The message shall be discarded and the R-ATSU shall be informed of the rejection by an ERROR message that contains the message element number 63 : NOT CURRENT DATA AUTHORITY.
1	Incorrect VCI composed by the Controller due to: 1. wrong combination of message elements (see subsection 8). 2. a VCI has already been sent to the aircraft and has not yet been acknowledged by the Aircrew. 3. an ES has already been sent to the aircraft.	Controller shall be informed of the error. Message not sent.
1	Reception of an invalid VCI by the aircraft due to: 1. the originator is other than the aircraft's T-ATSU. 2. wrong combination of message elements (see subsection 8). 3. the time stamp of the message containing the VCI indicates that it is older than a previously received VCI from the T-ATSU.	The aircraft shall discard the received VCI, and advise the originator of the reason for the rejection with an ERROR notification. The following message elements shall be used to indicate the cause of the error: 1. "NOT CURRENT DATA AUTHORITY", Message element 63, plus "CURRENT DATA AUTHORITY [facility designation]". 2. "MESSAGE REJECTED : INVALID INSTRUCTION". 3. "MESSAGE REJECTED : SUPERSEDED INSTRUCTION".
2	Incorrect Aircrew acknowledgment (PAM) composed by the Aircrew due to: 1. wrong combination of message elements (see subsection 8).	Aircrew shall be informed of the error. Message not sent.
2	Reception of an invalid Aircrew acknowledgment (PAM) due to: 1. wrong combination of message elements (see subsection 8).	The message shall be discarded and an ERROR response message shall be sent to the Aircraft. The following message elements shall be used to indicate the cause of the error: 1. "MESSAGE REJECTED : INVALID ACKNOWLEDGMENT. WILCO/ UNABLE EXPECTED".
2	Aircraft and R-ATSU unable to perform CPDLC.	Aircrew and the R-ATSU Controller shall be informed of the error and the suitable course of action to be effected.
1	Incorrect ES composed by the Controller due to: 1. a VCI has already been sent to the aircraft and has not yet been acknowledged by the Aircrew. 2. an ES has already been sent to the aircraft.	Controller shall be informed of the error. Message not sent.
3	Aircrew triggers the MRT before CPDLC with the T-ATSU is terminated.	CPDLC with the T-ATSU shall be terminated, CPDLC with the R-ATSU shall be established and the MRT shall be sent.

Step	Abnormal Event	Response
3	Incorrect Monitoring R/T (MRT) message composed by the Aircrew due to: 1. wrong combination of message elements (see subsection 8).	Aircrew shall be informed of the error. Message not sent.
3	Reception of an invalid Monitoring R/T (MRT) message at the R-ATSU due to: 1. wrong combination of message elements (see subsection 8).	The message shall be discarded and an ERROR response message shall be sent to the Aircraft. The following message element shall be used to indicate the cause of the error: 1. "MESSAGE REJECTED : INVALID VOICE CHANGE MESSAGE".
3	Reception of an invalid Monitoring R/T (MRT) message at the R-ATSU due to: 1. The MRT contains a voice channel identifier other than the one associated with the R-ATSU Controller who will conduct voice communications with the flight.	The R-ATSU shall: a) notify the Controller of the error, and make the voice channel identifier contained in the MRT available for review by the Controller, on request, and b) notify the aircraft of the correct voice channel identifier using a VCI message.
3	Reception of an invalid Monitoring R/T (MRT) message at the R-ATSU due to: 1. The MRT contains an ICAO unit name other than the one associated with the R-ATSU Controller who will conduct voice communications with the flight.	The R-ATSU shall: a) notify the Controller of the error, who will revert to voice, if appropriate. b) notify the aircraft of the error via an ERROR message.

5.3. T-ATSU not equipped for CPDLC

In this case:

- ⇨ the Aircrew shall manually request the establishment of CPDLC with the R-ATSU (step 1) at a parameter time before the boundary.
- ⇨ after the Aircrew has provided a voice Wilco response to the frequency change instruction transmitted via voice by the T-ATSU Controller, the service shall continue with step 3.a.

5.4. R-ATSU not equipped for CPDLC

In this case:

- ⇨ no CPDLC exchanges shall take place between the aircraft and the R-ATSU.

All Steps and Abnormal modes are adjusted accordingly.

5.5. Transfer of communications within one ATSU

In this case :

- ⇨ in Step 2, no ES is required;

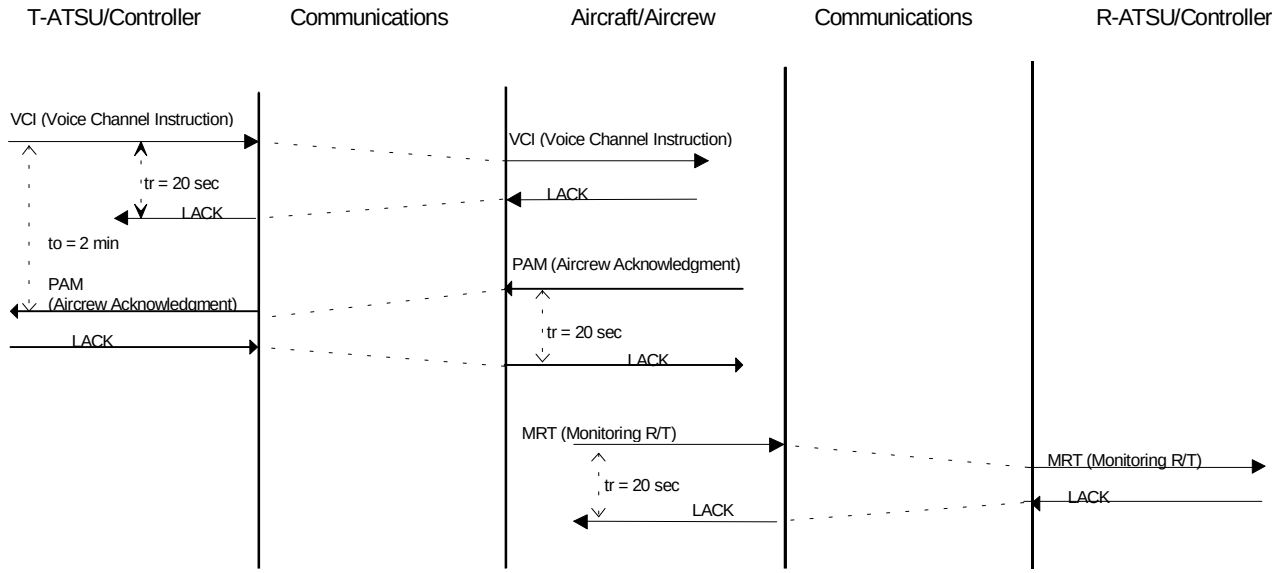
All Steps and Abnormal Modes for the ACM Service are modified accordingly.

NOTE : When the transfer of communications within sectors of one ATSU is performed via voice, the Aircrew must still trigger the sending of the MRT to conclude the transfer.

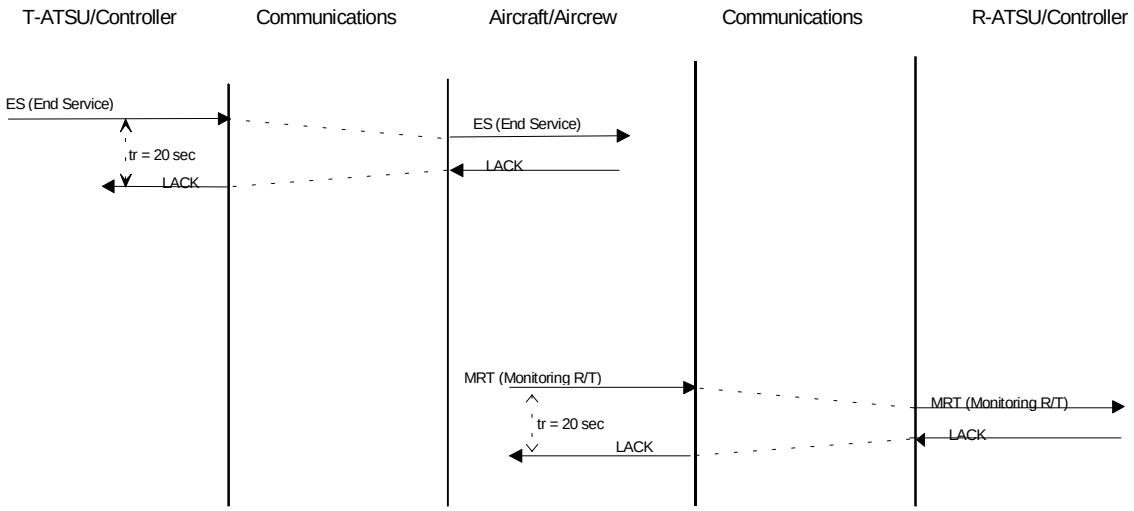
6. Time Sequence Diagrams

6.1. T-ATSU and R-ATSU equipped for CPDLC

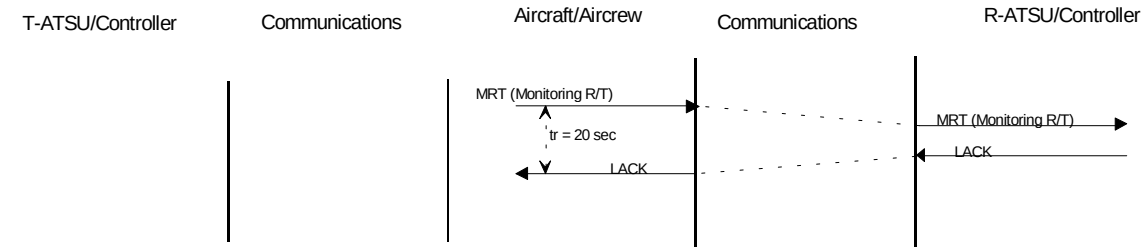
6.1.1. Communications transfer instructed via data link



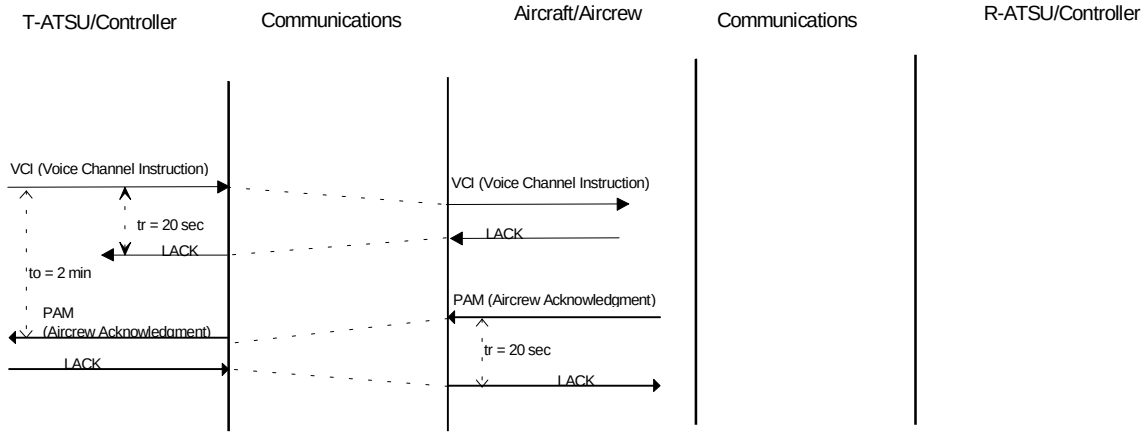
6.1.2. Communications transfer instructed via voice and data link



6.2. T-ATSU not equipped for CPDLC



6.3. R-ATSU not equipped for CPDLC



7. Quality Of Service Requirements

Message Category: ACM messages are Category 3 messages.

Communications Priority: 3.

Information Urgency:. Urgency attributes are given for each message element in subsection 8.

Information Security:

Data Origin Authentication: Normal

Access Control: M, A, D

Data Integrity: Medium

8. Information Exchanges

The ACM Messages follow the message composition rules described in Section 4 : CPDLC Introduction and Definitions.

The message elements that shall be used to compose ACM messages are given in the tables below. The following element type categories are used in those tables:

M Mandatory;

I/A If Applicable;

O Optional.

These categories are defined in Appendix B : Service Definition Template.

NOTE : Messages with the text "N2" as a message number (Msg Num.) are not supported by the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications". But they can be implemented as pre-formatted Free text messages.

NOTE : The definitions of the data elements between the square brackets [ ] below are provided in Section 9 : CPDLC Data Glossary.

8.1. ATC Voice Change Instruction (VCI)

The VCI message contains the instruction to change data and voice communications channels. It shall be composed of the following message elements:

Element Type	Msg Num.	Message Element	URG	ALRT	RESP
O	117	CONTACT [unit name] [frequency]	N	M	W/U
O	120	MONITOR [unit name] [frequency]	N	M	W/U
O	N2	CONTACT ME AGAIN ON [frequency]	N	M	W/U
O	N2	MONITOR ME AGAIN ON [frequency]	N	M	W/U
O	118	AT [position] CONTACT [unit name] [frequency]	N	M	W/U
O	119	AT [time] CONTACT [unit name] [frequency]	N	M	W/U
O	121	AT [position] MONITOR [unit name] [frequency]	N	M	W/U
O	122	AT [time] MONITOR [unit name] [frequency]	N	M	W/U

A message containing both CONTACT and MONITOR message element shall be an invalid message. Messages containing more than one CONTACT or MONITOR message elements shall also be invalid messages.

The instructions containing 'AT [position]' and 'AT [time]' can be used only for transfers of communications within one ATSU or when the R-ATSU is not CPDLC capable.

8.2. End Service (ES)

The ES message contains the indication that all further data exchanges will be with the R-ATSU. It shall be composed of the following message elements:

Element Type	Msg Num.	Message Element	URG	ALRT	RESP
M	161	END SERVICE	L	N	N

8.3. Aircrew Acknowledgement (PAM)

The PAM message contains the Aircrew acknowledgement to the VCI instruction. One and only one of the following message elements can be used to compose a PAM:

Element Type	Msg Num.	Message Element	URG	ALRT	RESP
O	0	WILCO	N	M	N
O	1	UNABLE	N	M	N

A message containing both the Wilco and Unable message elements shall be an invalid message.

8.4. Monitoring R/T (MRT)

The MRT informs the R-ATSU Controller that the Aircrew is monitoring the R-ATSU's voice channel. The MRT shall contain exclusively the following message elements:

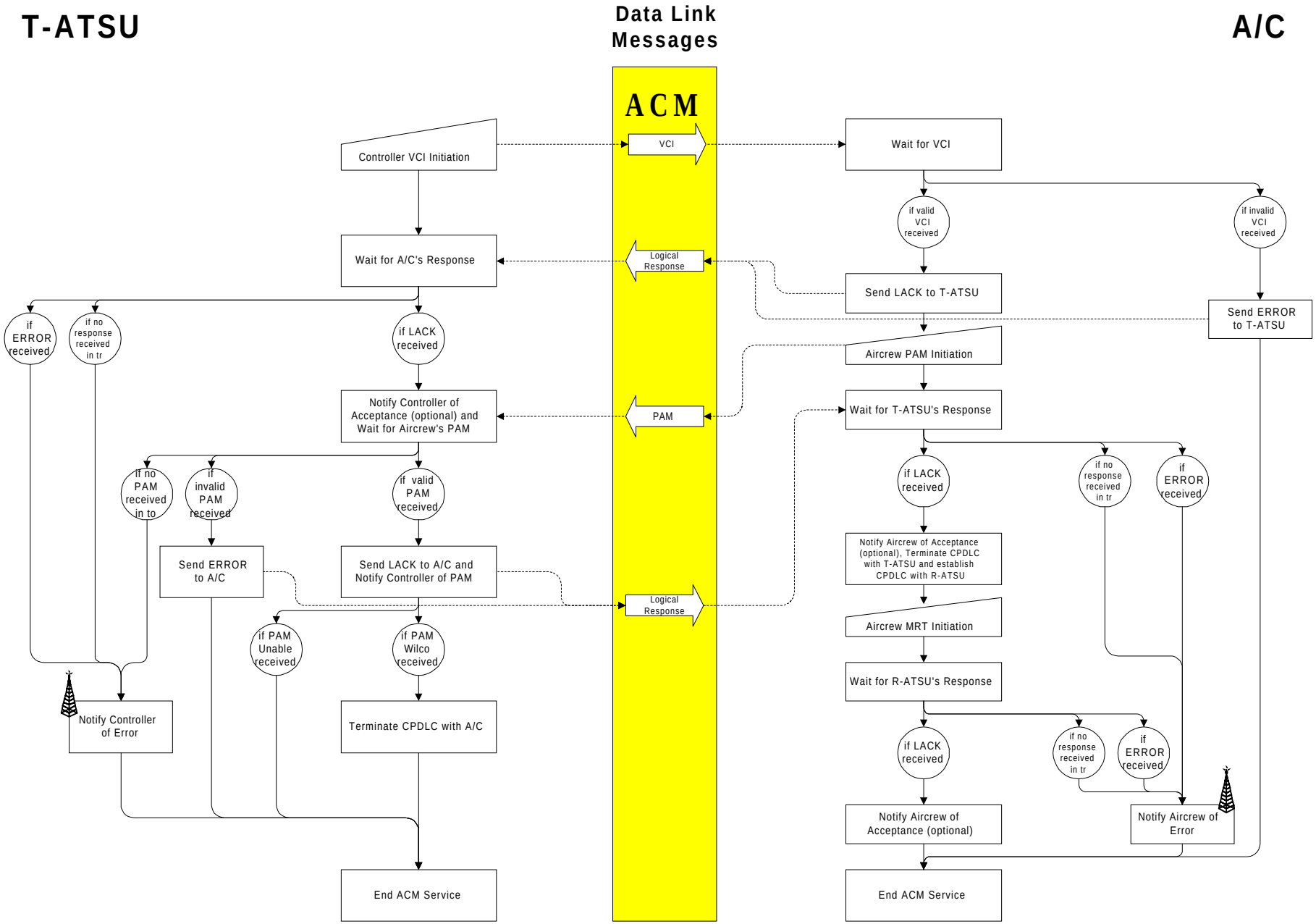
Element Type	Msg Num.	Message Element	URG	ALRT	RESP
M	89	MONITORING [unit name] [frequency]	U	M	N

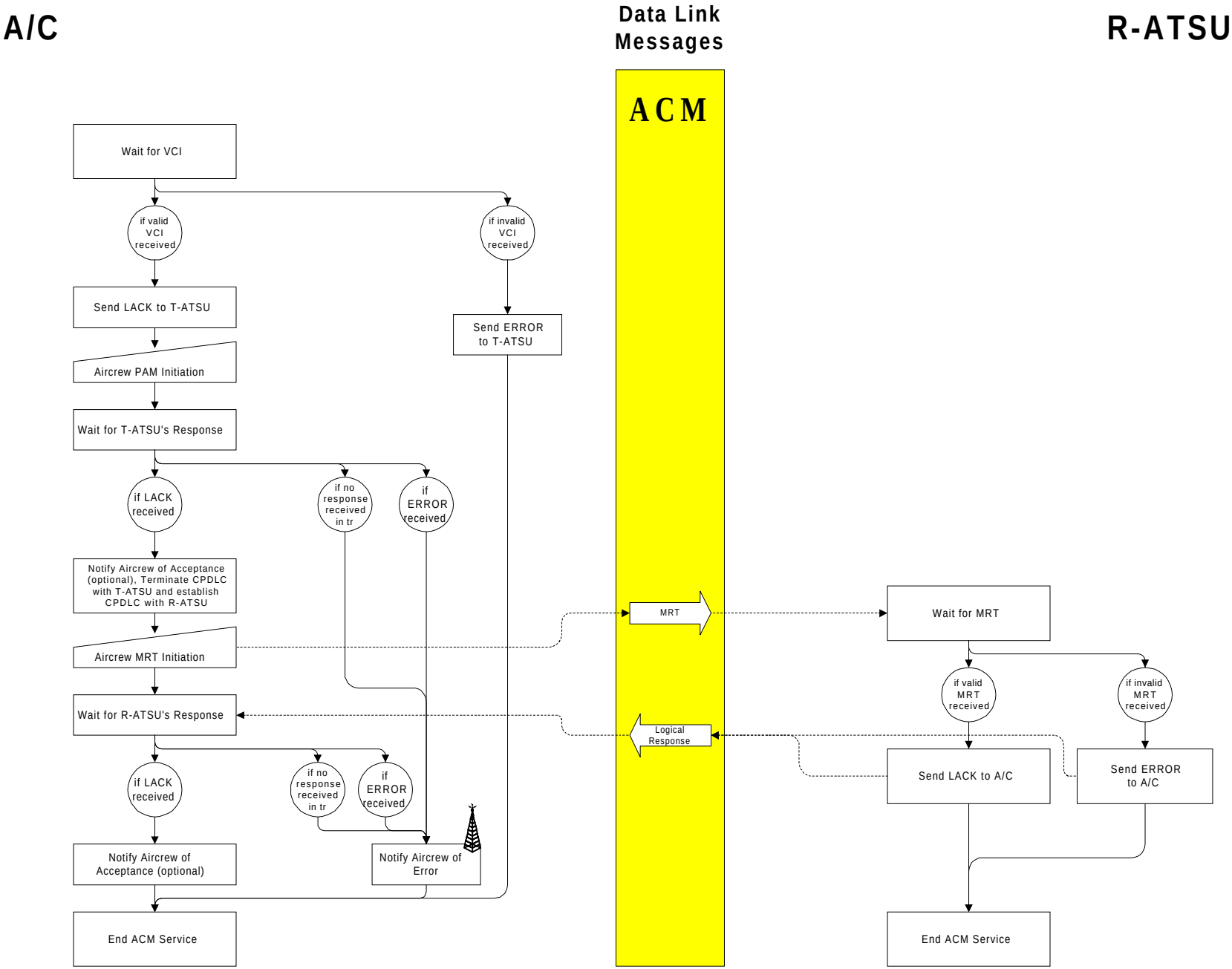
9. Event Sequence Diagrams

The diagrams in this subsection provide an overview of the main normal and abnormal sequences of events within the ACM service for the operational scenario in which T-ATSU and R-ATSU are equipped for CPDLC and the communications transfer is instructed via data link.

Two diagrams are provided: the first one shows the messages exchanged between the T-ATSU and the aircraft and the second shows the messages exchanged between the aircraft and the R-ATSU. Note that the aircraft diagram is the same in both cases.

Please refer to Appendix B for a description of the symbology used in these diagrams.


T-ATSU
Data Link Messages
A/C
ACM
Controller VCI Initiation
VCI
Wait for VCI
Wait for A/C's Response
Logical Response
if valid VCI received
if invalid VCI received
Send LACK to T-ATSU
Send ERROR to T-ATSU
if ERROR received
if no response received in tr
if LACK received
Aircrew PAM Initiation
Notify Controller of Acceptance (optional) and Wait for Aircrew's PAM
PAM
Wait for T-ATSU's Response
if no PAM received in to
if invalid PAM received
if valid PAM received
if LACK received
if no response received in tr
if ERROR received
Send ERROR to A/C
Send LACK to A/C and Notify Controller of PAM
Notify Aircrew of Acceptance (optional), Terminate CPDLC with T-ATSU and establish CPDLC with R-ATSU
Logical Response
Aircrew MRT Initiation
if PAM Unable received
if PAM Wilco received
Wait for R-ATSU's Response
Notify Controller of Error
Terminate CPDLC with A/C
if LACK received
if no response received in tr
if ERROR received
Notify Aircrew of Acceptance (optional)
Notify Aircrew of Error
End ACM Service
End ACM Service


A/C
Data Link Messages
R-ATSU
ACM
Wait for VCI
if valid VCI received
if invalid VCI received
Send LACK to T-ATSU
Send ERROR to T-ATSU
Aircrew PAM Initiation
Wait for T-ATSU's Response
if LACK received
if no response received in tr
if ERROR received
Notify Aircrew of Acceptance (optional), Terminate CPDLC with T-ATSU and establish CPDLC with R-ATSU
MRT
Wait for MRT
Aircrew MRT Initiation
Wait for R-ATSU's Response
Logical Response
if valid MRT received
if invalid MRT received
if LACK received
if no response received in tr
if ERROR received
Send LACK to A/C
Send ERROR to A/C
Notify Aircrew of Acceptance (optional)
Notify Aircrew of Error
End ACM Service
End ACM Service

Section 7: Downstream Clearance (DSC) Service

Service No.	Name	Abb.	Cat	References	Version No.
O-6	Downstream Clearance Service	DSC	CM	"ICAO Manual of Air Traffic Services (ATS) Data Link Applications"	2.0 16/5/97

Table of Contents

1. Scope and Objective

Aircrew, in specific instances, need to obtain clearances or information from ATSUs which may be responsible for control of the aircraft in the future, but are not yet in control of it. Such 'downstream' clearances and information are often provided through ground/ground co-ordination, but are also obtained via direct contact with the 'Downstream' ATSU (D-ATSU) in certain circumstances (e.g., when ground/ground communication are unavailable or inefficient, due to the size of the airspace, due to the complexity of the route structure, or due to meteorological conditions).

Unless otherwise co-ordinated, downstream clearances or information have no effect on the aircraft's profile within the current and any later controlling ATSU (C-ATSU) airspace, prior to actual transfer of control to the D-ATSU. If established, direct contact with the C-ATSU is maintained by the Aircrew, and is unaffected by communication with the D-ATSU. The need for the C-ATSU to be made aware of the information obtained from the D-ATSU will be governed by local procedures.

The Downstream Clearance (DSC) Service provides assistance for requesting and obtaining D-ATSU clearances or information, using air/ground data link.

The DSC service can only be initiated by the Aircrew.

The availability of voice communications with the D-ATSU Controller is required for the DSC service, except when not practicable (e.g. out of voice range) and as determined by local procedures.

2. Expected Benefits, Anticipated Constraints, and Associated Human Factors

2.1. Expected Benefits

- ⇨ Reduction of the potential for communications errors between Aircrew and Controller.
- ⇨ Reduction of voice channel load (voice frequency congestion);
- ⇨ Reduction of voice communications workload for both Aircrew and Controller;
- ⇨ Added Aircrew flexibility for requesting and receiving clearances or information;
- ⇨ Better, more flexible pacing of communications tasks for the Aircrew;
- ⇨ Improved support for Aircrew flight planning and task management.
- ⇨ Provision of a flexible planning capability for the D-ATSU.
- ⇨ Reduction in Aircrew workload (e.g. reduced hand-copy of clearances and information).
- ⇨ Reduction of the need for ground-to ground co-ordination between adjacent centers in cases where a clearance must be delivered before the aircraft enters into the airspace where it is applicable (e.g. oceanic clearance).
- ⇨ Reduction in flight plan data entry errors by Aircrew.
- ⇨ Provides communications with ATSU's out of voice communications range.

2.2. Anticipated Constraints

- ⇨ Asynchronous mode of operation.
- ⇨ Aircrew unawareness of sector workload.
- ⇨ Controllers will have to cope with mixed data link equipped and non-equipped aircraft populations.

2.3. Associated Human Factors

⇨ Regardless of the level of system automation in use, Controllers and Aircrew shall have the capability to review, validate and acknowledge any message being delivered or received.

⇨ The avionics shall provide a display of data link messages exchanged with the D-ATSU clearly differentiated from the messages exchanged with the C-ATSU.

3. Service Operational Context

3.1. Operational responsibility

Procedures and system support must be put in place to permit Aircrew to have controlled data link access to an ATSU other than the C-ATSU. This capability will be based on the following two levels of ATSU operational access to Controller/Aircrew data link exchanges:

a) *Current ATSU (C-ATSU)*: As the ATSU currently responsible for control of the aircraft, with authority to exchange all CPDLC messages with that aircraft;

b) *Downstream ATSU (D-ATSU)*: As an ATSU which is expected to be responsible for control of the aircraft in the future, but which is not yet responsible for its control, with authority to exchange a limited sub-set of data link messages with that aircraft, none of which could be construed by either the Aircrew or the avionics as affecting the immediate control of the aircraft.

c) The C-ATSU and the D-ATSU must not be the same ATSU.

3.2. Operational Procedures and System Support

D-ATSU operational access to Controller/Aircrew exchanges will be strictly controlled through operational procedures. The following operational principles will be observed in relation to D-ATSU operational access to Controller/Aircrew data link exchanges:

A. There could be more than one Downstream clearance link at any one time.

B. To maintain Aircrew situational awareness and communication access security, avionics will provide Aircrew with the ability to:

1. Maintain control and awareness over C-ATSU access, including transfer of that access from one ATSU to another. According to procedures, this transfer will be conducted in accordance with C-ATSU directives.

2. Maintain control and awareness over D-ATSU access. D-ATSU Controller/Aircrew data link access will only be established via Aircrew request.

3. Clearly and unambiguously differentiate between messages from the C-ATSU and messages from a D-ATSU.

C. Any data link message sent via a D-ATSU link must be readily identifiable as such on the display of both the sender and the recipient of the message.

D. D-ATSU Controller/Aircrew message use should be controlled through ICAO regional operational procedures and published in AIPs for each case.

E. There will be procedures that prevent the Aircrew from executing a clearance received via a Downstream clearance link until the aircraft enters the airspace of the control authority from which the Downstream clearance was received. If the information an airborne air user receives via a Downstream clearance link requires action while still in the airspace of the current control authority, the clearance for such action must be obtained from that current control authority.

F. The ground system must have the ability to reject any request for DSC.

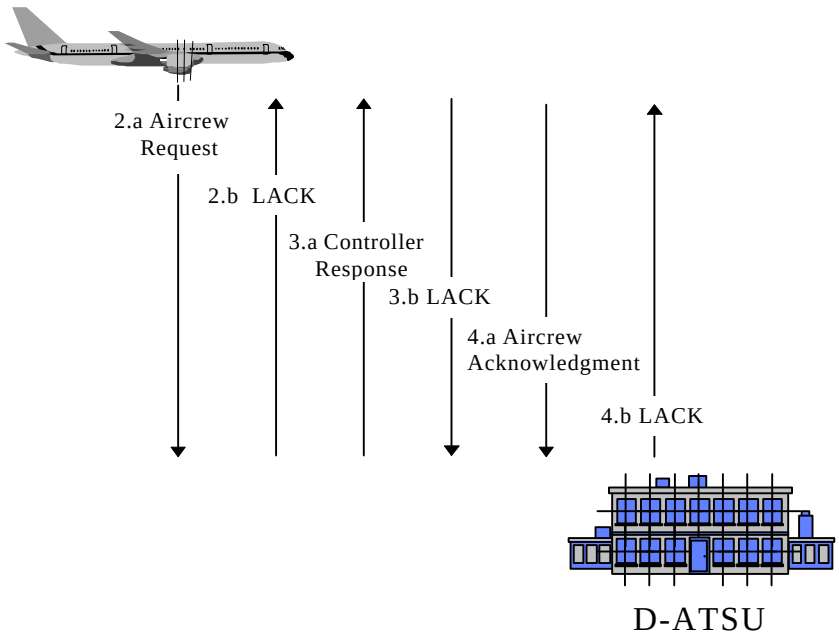
4. Overview Operating Methods with and without Data Link

In the current operational ATC environment, Aircrew contact a D-ATSU, while maintaining communications contact with the C-ATSU, in order to obtain a clearance or information concerning the aircraft's future flight profile. Such contacts are always initiated by the Aircrew, and can be conducted either via a second voice channel or, where suitable facilities are available, via air/ground data link (i.e. Oceanic Clearance Message (OCM)).

Step	Operating Method without Data Link	Operating Method with Data Link
1	The Aircrew prepares to begin ATC communications with the D-ATSU.	The Aircrew establishes a CPDLC link with the D-ATSU.
2	The Aircrew contacts the D-ATSU via voice to request the clearance or information related to D-ATSU airspace, advising any applicable preferences.	The Aircrew transmits via the D-ATSU link the clearance or information request related to D-ATSU airspace, advising any applicable preferences..
3	The D-ATSU provides the Aircrew with the requested clearance or information via voice.	The D-ATSU provides the Aircrew with the requested clearance or information, via data link.
4	The Aircrew acknowledges the clearance or information via voice.	The Aircrew acknowledges the clearance or information via data link.
5		The Aircrew terminates the D-ATSU link, unless the D-ATSU requires that the link should remain active for the provision of other clearances or re-clearances.

NOTE : An alternative operating method without Data Link is the following : The C-ATSU requests and obtains the clearance for the Aircraft from the D-ATSU, and then transmits it to the Aircrew.

4.1. Information Exchange Diagram



5. Detailed Service Operating Method with Data Link

5.1. Service Availability

The DSC service shall be available in all flight phases.

The DSC service shall not be available with the C-ATSU when the aircraft has a C-ATSU link established (i.e. the CIC and DSC services shall not be simultaneously active with the same ATSU).

5.2. Service Description

5.2.1. Normal Mode

The DSC is a service within the CPDLC application. Unless specifically indicated, DSC uses all generic CPDLC functionality, including message handling as well as operational and performance requirements as described in the CIC service.

The DSC operating method conforms to the existing operating method. The normal sequence of events is:

Step	Operation
1	According to ICAO operational procedures, published in AIPs, the Aircrew shall manually request the establishment of a CPDLC link. The aircraft should be able to establish D-ATSU links with more than one D-ATSU at any time *(NOTE: Not allowed by the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications" which limits the number of D-ATSU links to only one at any one time).* As a result of this step, both the D-ATSU Controller (if appropriate) and the Aircrew shall receive an indication that the aircraft and the D-ATSU are capable of exchanging downstream CPDLC messages
2, 3 and 4	Once the D-ATSU link is established, DSC exchanges follow the same rules as the CIC exchanges described in the CIC service, except for the DSC message composition rules stated in page 7. *(NOTE: This is not allowed by the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications" which only allows for exchanges initiated by the Aircrew. D-ATSU initiated exchanges are also required for the delivery of re-clearances.)*
5	According to ICAO operational procedures, published in AIPs, the Aircrew shall request the termination of the D-ATSU link. According to ICAO operational procedures, published in AIPs, the D-ATSU shall be able to reject the D-ATSU link termination request when a re-clearance or additional information is to be sent by the D-ATSU. In this case the D-ATSU should notify the Aircrew of the rejection and the reason for it. If the D-ATSU link termination is accepted by the D-ATSU, both the D-ATSU Controller (if appropriate) and the Aircrew shall receive an indication that the aircraft and the D-ATSU are no longer capable of exchanging downstream CPDLC messages.

5.2.1.1. Sequence of Services

The DSC service requires a preceding Service for flight plan flight identification (i.e. correlation of flight plan with flight) and receipt of the required addressing and aircraft functional capability information.

In order to ensure independence of any ground/ground data communications services, aircraft shall be capable of providing all required addressing and other data to the D-ATSU.

5.2.1.2. Additional Guidelines

Not applicable.

5.2.2. Abnormal Mode

5.2.2.1. General Error Handling Requirements

Since the DSC exchanges follow the same rules as the CIC exchanges, all the Error Handling Requirements described in the Clearance and Information Communications (CIC) service are also applicable to the DSC service with the following exception:

1. Reversion to voice shall be performed according to ICAO operational procedures, published in AIPs. When no reversion to voice is possible, Aircrew and Controllers shall have the capability to re-attempt the data link transmissions.

5.2.2.2. Specific Error Handling Requirements

Step	Abnormal Event	Response
1	Incorrect D-ATSU link request composed by the Aircrew due to: 1. a D-ATSU link is already established with the requested ATSU. 2. the requested ATSU is the aircraft's C-ATSU.	The request shall be rejected and the Aircrew informed of the error.
1	Invalid D-ATSU link request received by an ATSU due to: 1. the ATSU does not provide the DSC service. 2. The ATSU is the aircraft's C-ATSU.	The request shall be rejected and the Aircrew shall be informed of the reason of the rejection.
1	Aircraft and D-ATSU are unable to establish a D-ATSU link for whatever reason.	The Aircrew and the D-ATSU shall be notified of the reason when possible. The notification to the Aircrew shall indicate whether to re-attempt the D-ATSU link request or not.
2, 3 and 4	Invalid message element transmitted over the D-ATSU link (prohibited message elements are listed in subsection 8. Additional restrictions on the ATSU supported message elements can be introduced and published in AIPs)	The message shall be discarded and an ERROR response message shall be sent to the originator. The following pre-formatted free text shall be included in the message: "MESSAGE REJECTED : INVALID DSC MESSAGE"
2, 3 and 4	D-ATSU becomes the C-ATSU.	The aircraft shall terminate the D-ATSU link. The Aircrew and the C-ATSU shall be notified of the automatic D-ATSU link termination.

6. Time Sequence Diagram

DSC exchanges follow the same rules as the CIC exchanges (including Standby exchanges) with the only limitation of the message composition rules stated in Subsection 8 below. Therefore, please refer to the CIC service description in section 5 for the time sequence diagram.

7. Quality Of Service Requirements

Message Category: DSC messages are Category 4 messages.

Communications Priority: 4.

Information Urgency:. Urgency attributes are associated to the message elements in subsection 8.

Information Security:

Data Origin Authentication: Normal

Access Control: M, A

Data Integrity: Maximum

8. Information Exchanges

The DSC Messages follow the message composition rules described in Section 4 : CPDLC Introduction and Definitions.

All message elements contained in the Clearance and Information Communications (CIC) service can be used to compose a DSC message. The following table indicates the message elements from the CIC message element set which shall be prohibited from inclusion in isolation in any DSC message. They may be concatenated with appropriate DSC message elements with caution.

Message Type		Message Element Number	
		ADSP Prohibited	Additional
Uplink	Vertical Clearances	19, 20, 23, 26, 27, 28, 29, 30, 192, 209, 31, 32, 34, 36, 37, 38, 39, 40, 41	6, 7, 9, 11, 13, 15, 17, 35, 171, 172, 173, 174, 219, 220, 236
	Lateral Offsets	67, 68, 69, 72	64, 70, 71
	Route Modifications	74, 75, 33, 82, 94, 95, 215, 190, 96, 97, 221, 98	73, 76, 77, 78, 80, 81, 87, 89, 90, 91, 92, 93
	Speed Changes	106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 189, 223, 222	100, 102, 103, 105
	Contact/Monitor Surveillance Requests	123, 124, 125, 126, 179	117, 118, 119, 120, 121, 122,
	Report/Confirmation Requests		127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 145, 146, 175, 180, 181, 182, 184, 217
	Air Traffic Advisories	154, 155, 156, 210, 193, 191	153, 157, 213, 214
	Responses/Acknowledgments		211, 218, 235
	System Management Messages	160, 161	233, 234
	Additional Messages	164, 230, 176, 177	165, 166, 167, 168
Downlink	Vertical Requests	6, 7, 8, 9, 10, 69	
	Lateral Offset Requests	15	
	Contact/Monitor Surveillance Requests		20, 89
	Route Modification Requests	26, 27, 70, 71	22
	Reports		28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40,41, 42, 43, 44, 45, 46, 48, 72, 76, 77, 78, 102, 109, 110, 111
	Negotiation Requests		51, 52, 53, 54, 87, 88
	Emergency Messages		55, 56, 57, 58, 59, 60, 61, 80, 112
	System Management Messages	63,99,107	
	Additional Messages	74, 103	65, 66, 75, 108

9. Event Sequence Diagrams

Once the D-ATSU link is established, DSC event sequences are the same as the CIC event sequences. Please refer to the CIC service description in section 5 for the events sequences diagrams.

Section 8 : Departure Clearance (DCL) Service

Service No.	Name	Abb.	Cat	References	Version No.
O-1	Departure Clearance	DCL	CG	"ICAO Manual of Air Traffic Services (ATS) Data Link Applications"	2.0 16/5/97

Table of Contents

1. Scope and Objective

A flight due to depart from an airfield must first obtain departure information and clearance from the Controlling Air Traffic Services Unit (C-ATSU). The Departure Clearance (DCL) Service provides automated assistance for requesting and delivering departure information and clearance, with the objective of reducing Aircrew and Controller workload and diminishing clearance delivery delays.

2. Expected Benefits, Anticipated Constraints, and Associated Human Factors

2.1. Expected Benefits

- ⇨ Reduction of the potential for communications errors between Aircrew and Controller.
- ⇨ Reduction in Aircrew workload (e.g. reduced hand-copy of clearances and information, reduced voice communications monitoring and use).
- ⇨ Reduction in Controller workload (e.g. reduced voice communications and monitoring, Controller can treat clearances in sequential order at his own pace, rather than being forced to immediately deal with requests as they arrive).
- ⇨ Automatic validation of flight plan in the C-ATSU.
- ⇨ Automatic preparation of clearance and information elements (e.g. departure time, ATIS designator) for Controller validation.
- ⇨ Reduction of channel load.
- ⇨ Reduction of ground delay.
- ⇨ Increase in dialogue flexibility in case of non-routine communications.

2.2. Anticipated Constraints

- ⇨ Controllers and Aircrew will have to cope with mixed data link equipped and non-equipped aircraft populations.

2.3. Associated Human Factors

- ⇨ In cases where the Controller and Aircrew are involved in the DCL Service, regardless of the level of automation of the system in use, it must be ensured that Controllers and Aircrew have the opportunity to review, validate, and acknowledge any clearances being delivered or received.

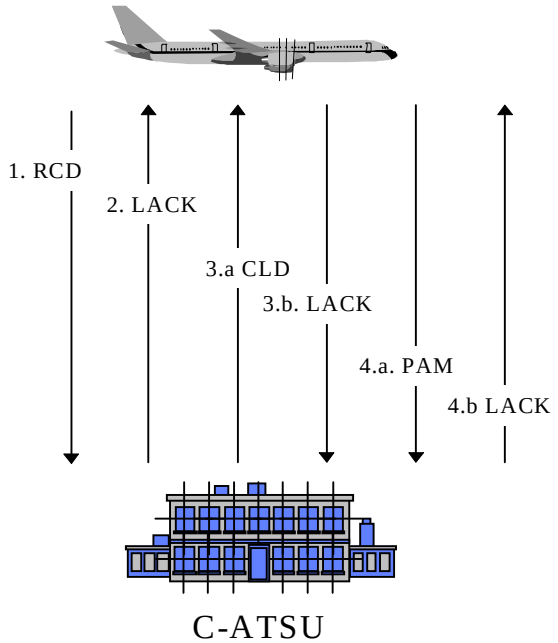
3. Service Operational Context

Where local procedures or flight category require, flights intending to depart from an airport must first obtain a departure clearance from the C-ATSU. The process can only be accomplished if the flight operator has filed a flight plan with the appropriate ATM authority. The departure clearance may contain information relative to the take off phase of flight (e.g. take-off runway and Standard Instrument Departure (SID), Secondary Surveillance Radar (SSR) code, departure slot, next contact frequency).

4. Overview of Operating Methods with and without Data Link

Step	Operating Method without Data Link	Operating Method with Data Link
1	The Aircrew calls and requests a departure clearance using voice communications, generally prior to start-up.	Aircrew transmits a DCL Request (RCD) to the C-ATSU via Data link.
2	The Controller acknowledges the request and formulates the clearance based on available flight plan data and in accordance with the allocated slot time of departure, if any. The clearance is merged with existing flight plan data, either at the Controller's workstation or within local flight data processing systems.	The C-ATSU transfers a logical acknowledgment (LACK) to the aircraft indicating acceptance of the DCL Request (RCD). The DCL is composed by the C-ATSU based on flight related data and data received in the DCL Request (RCD).
3	The Controller delivers the clearance to the Aircrew using voice communications.	a) The C-ATSU transmits the composed DCL Clearance (CLD) to the aircraft via Data link. b) The Aircraft transmits a logical acknowledgment (LACK) to the C-ATSU indicating acceptance of the CLD.
4	The Aircrew acknowledges the clearance via a full Readback on voice communications	a) The Aircrew verifies the operational contents of the DCL message, and transmits a response message (PAM) via Data link. b) The C-ATSU transfers a logical acknowledgment (LACK) to the aircraft indicating acceptance of the PAM.

4.1. Information Exchange Diagram



5. Detailed Service Operating Method with Data Link

5.1. Service Availability

5.1.1. Initiation of the Service

The DCL service is initiated on the first DCL request (RCD) effected at a suitable time prior to Estimated Off Block Time (EOBT).

5.1.2. Termination of the Service

The DCL service shall be completed prior to the aircraft leaving the holding point for the flight's take-off runway.

5.1.3. Explanatory material

1) The departure clearance service **shall** be available from a time period (see note) prior to the EOBT (or engine start-up request) until the time the aircraft commences movement under its own power.

   NOTE: The time period will depend on many factors such as airport procedures, airline procedures, slot time, traffic density, SSR code allocation,..it is advisable not to initiate a request more than 30 minutes prior to EOBT. Requests made shortly prior to EOBT, about 10 minutes, will be less likely to be revised.

2) If local procedures permit, the departure clearance service **should** also be available from the time the aircraft commences movement under its own power until the aircraft leaves the holding point for the flight's take-off runway. The use will be restricted to revisions of granted clearances normally initiated by the C-ATSU.

Commentary

In applying the above described availability, consideration must be given to the different operational meaning of the services as follows :

Operational use 1 (standard availability) :

The aircraft is in the non-active flight phase (pre-flight).

Air Traffic control is under the Ground movement planning phase (clearance delivery).

Operational use 2 (extended availability) :

The aircraft is in the active flight phase (taxiing).

Air traffic control is in the Ground movement control Phase (Control of Aircraft moving on the apron and aircraft, vehicles, persons and obstructions on the maneuvering area).

5.2. Service Description

5.2.1. Normal Mode

The DCL operating method conforms to the existing operating method; in particular the DCL is processed directly between C-ATSU and aircraft. The normal sequence of events is:

Step	Operation
1	When the flight is within a specified parameter time of its estimated time of engine start-up, the Aircrew shall transmit a DCL Request (RCD) to the C-ATSU.
2	If the DCL Request (RCD) is valid and a corresponding flight plan is available in the C-ATSU, the C-ATSU shall transfer a logical acknowledgment (LACK) to the aircraft indicating acceptance of the DCL Request (RCD) including the amount of time expected before the DCL Clearance (CLD) message if different from [to1 = 5 minutes]. *NOTE: The inclusion of the expected time for delivery of the message in the LACK is not supported in the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications".* In all other cases the C-ATSU shall transfer an ERROR response message indicating the reason for rejection (see abnormal mode subsection).
3	a) The C-ATSU shall be able to send a STANDBY response message to indicate that the request has been received and a response will be sent shortly. When a STANDBY response message is sent prior to the DCL Clearance (CLD), the timer for the operational response (to) shall be disabled and two new timers shall be started: 1) the standby operational timer (ts). On expiration of 'ts' the Controller shall be warned of the pending Standby. 2) the standby termination timer (tt). On expiration of 'tt' the message "STANDBY TIMED-OUT" shall be automatically sent to the aircraft closing the exchange. These two standby timers shall be disabled if the Controller provides the DCL Clearance (CLD) before their expiration. b) The C-ATSU shall transmit the composed DCL Clearance (CLD) to the aircraft. *NOTE 1 - Controller involvement in composition and validation of the DCL is subject to local procedures* c) If the CLD : 1. is received before the expiration of the operational time-out (to) or the standby termination timer (tt) when a Standby was sent, and 2. is a valid message, and 3. will be displayed to the Aircrew, then the aircraft shall transmit via data link a logical acknowledgement (LACK) to the C-ATSU. In all other cases the aircraft shall transfer an ERROR response message indicating the reason for rejection (see abnormal mode subsection).

4	a) The Aircrew shall be able to send a Standby response to indicate that the clearance has been received and a response will be sent shortly. When a STANDBY response message is sent prior to a Wilco/Unable Acknowledgment, the timer for the operational response (to) shall be disabled and two new timers shall be started: 1) the standby operational timer (ts). On expiration of 'ts' the Aircrew shall be warned of the pending Standby. 2) the standby termination timer (tt). On expiration of 'tt' the message "STANDBY TIMED-OUT" shall be automatically sent to the C-ATSU closing the exchange. These two timers shall be disabled if the Aircrew provides a Wilco/Unable Acknowledgment before their expiration. b) The Aircrew shall verify the operational contents of the DCL message, and if the Aircrew accepts and can comply with the operational contents, the Aircrew shall transmit an Aircrew Acknowledgment (PAM) containing a "Wilco" indication. If the Aircrew is unable to accept the operational contents, the Aircrew shall transmit a PAM message containing an "Unable" indication and establish voice communications contact with the C-ATSU. *NOTE 1 - Aircrew Request for Reclearance: After receipt of a DCL Clearance (CLD) message the Aircrew may request a reclearance by data link following transmission of a PAM by triggering:* *1. a new RCD, when a complete new clearance is requested, or* *2. a Request EOBT Change (REC) message, when only a change in EOBT is requested.* *The Controller shall then respond to the reclearance request with one of the following:* *1. a new CLD, when a complete new departure clearance is required, or* *2. a Revised EOBT (RET) message when only the EOBT is changed and all other elements of the previously sent CLD remain unchanged.* *An appropriate alerting mechanism shall be in place on the ground in case of an "Unable" indication or reopening of a clearance request dialogue.* *NOTE 2 - C-ATSU Initiation of a Reclearance: The C-ATSU may send another DCL Clearance (reclearance) (CLD), in case of revision of the clearance contents prior to the aircraft leaving the holding point of the takeoff runway. This may also occur prior to receipt of a response message (PAM) to a previously sent DCL Clearance (CLD). If the aircraft receives a new DCL Clearance (CLD) message while treating a previously received DCL Clearance (CLD), the aircraft shall cancel treatment of the previous DCL Clearance (CLD) and begin treatment of the newly received DCL Clearance (CLD). In this case an appropriate alerting mechanism shall be in place on board the aircraft.* *When the Departure Clearance (CLD) is further to a previous clearance (case of reclearance), the DCL Clearance (CLD) message shall contain the Reclearance Number data field containing the clearance version number applicable to this aircraft.* b) If the PAM : 1. is received before the expiration of the operational time-out (to) or the standby termination timer (tt) when a Standby was sent, and 2. is a valid message, and 3. will be displayed to the Controller, then the C-ATSU shall transmit via data link a logical acknowledgement (LACK) to the Aircraft. In all other cases the C-ATSU shall transfer an ERROR response message indicating the reason for rejection (see abnormal mode subsection).

5.2.1.1. Sequence of services

The DCL service requires the previous establishment of the C-ATSU CPDLC link provided by the ATC Communications Management (ACM) service.

5.2.1.2. Additional guidelines

Sequencing of replies to DCL Requests (RCD) is normally based on the sequence of reception and queuing of the requests and presentation to the Controller.

The C-ATSU shall be capable of treating clearance requests in accordance with established priorities (e.g. ambulance flights, slot allocations). Treatment of priorities shall be effected such that DCL delivery delay is minimised.

5.2.2. Abnormal Mode

The General Error Handling Requirements described in subsection 5.2.2.1 of the Clearance and Information Communications (CIC) service are also applicable to the DCL service.

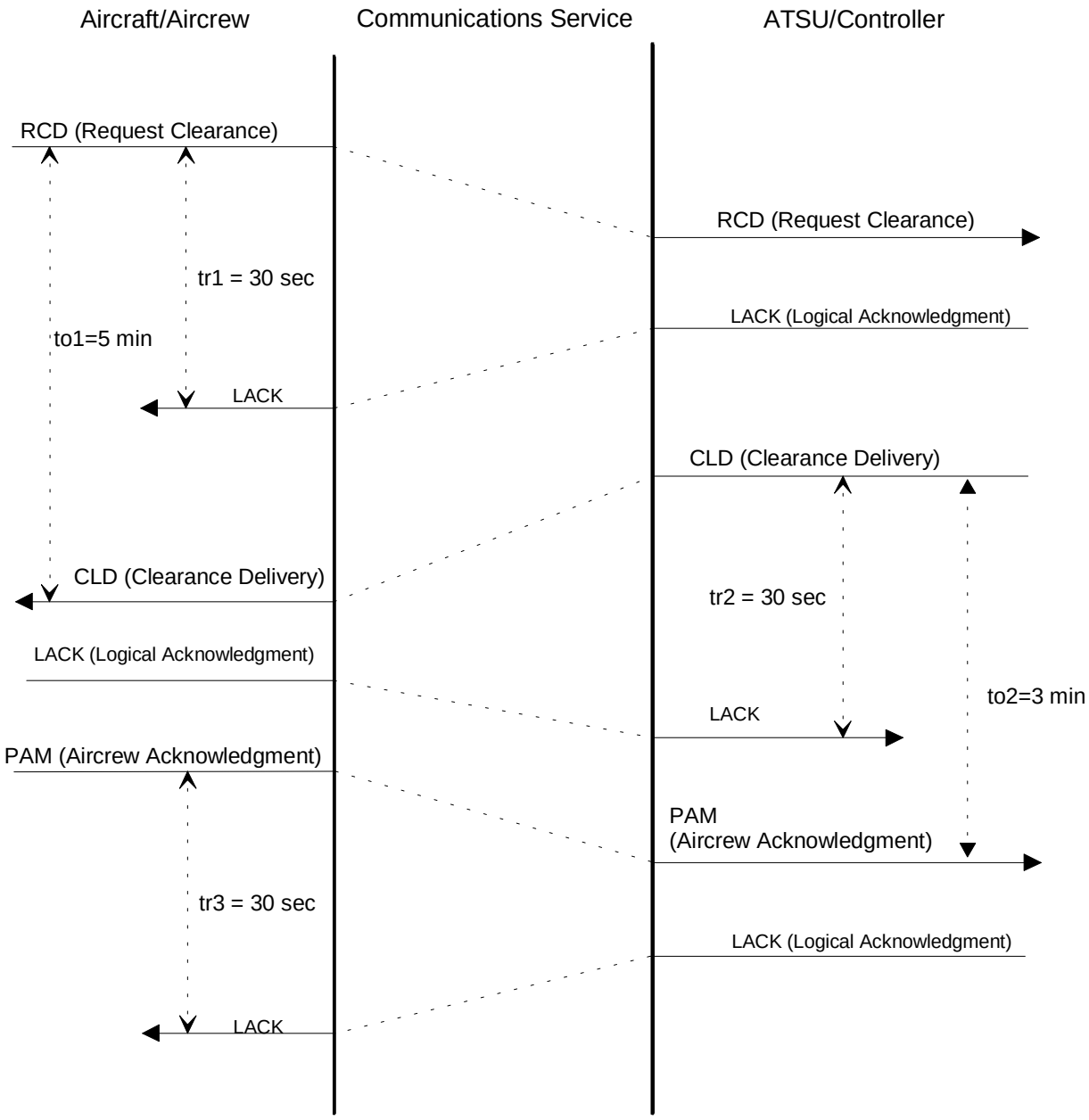
Step	Abnormal Event	Response
1	Incorrect RCD composed by the Aircrew due to: 1. Wrong combination of message elements (see subsection 8 below). 2. RCD already sent and CLD not yet received. 3. CLD awaiting response by Aircrew.	The Aircrew shall be informed of the error. The message shall not be sent.
2	Invalid RCD received at the C-ATSU due to: 1. Wrong combination of message elements (see subsection 8). 2. Previous RCD already received and CLD not yet sent. 3. CLD sent to the aircraft awaiting response by Aircrew. 4. Flight plant not available at the C-ATSU.	The message shall be discarded and an ERROR response message shall be sent to the aircraft. The following message elements shall be used to indicate the cause of the error: 1. “MESSAGE REJECTED : ERROR IN MESSAGE”; 2. “MESSAGE REJECTED : REQUEST BEING PROCESSED” or “MESSAGE REJECTED : REQUEST ALREADY RECEIVED”; 3. “MESSAGE REJECTED : DEPARTURE CLEARANCE PENDING ACKNOWLEDGEMENT”; 4. “MESSAGE REJECTED : FLIGHT PLAN NOT HELD”.
3	Incorrect CLD composed by the Controller due to: 1. Wrong combination of message elements (see subsection 8 below). 2. No previous RCD received from aircraft.	The Controller shall be informed of the error. The message shall not be sent.

4	Invalid CLD received by the aircraft due to: 1. Wrong combination of message elements (see subsection 8 below). 2. CLD received by the aircraft before an Aircrew initiated RCD.	The message shall be discarded and an ERROR response message shall be sent to the C-ATSU. The following message elements shall be used to indicate the cause of the error: 1. “MESSAGE REJECTED : INVALID CLEARANCE”; 2. “MESSAGE REJECTED : SERVICE UNAVAILABLE”.
5	Incorrect PAM composed by the Aircrew due to: 1. Wrong combination of message elements (see subsection 8).	The Aircrew shall be informed of the error. The message shall not be sent.
6	Invalid PAM received at the C-ATSU due to: 1. Wrong combination of message elements (see subsection 8). 2. Another DCL Clearance (reclearance) (CLD) sent before the PAM was received.	The message shall be discarded and an ERROR response message shall be sent to the Aircraft. The following message elements shall be used to indicate the cause of the error: 1. “MESSAGE REJECTED : INVALID ACKNOWLEDGMENT. WILCO/ STBY/UNABLE EXPECTED”; 2. “MESSAGE REJECTED : SUPERSEDED CLEARANCE”.

6. Time Sequence Diagrams

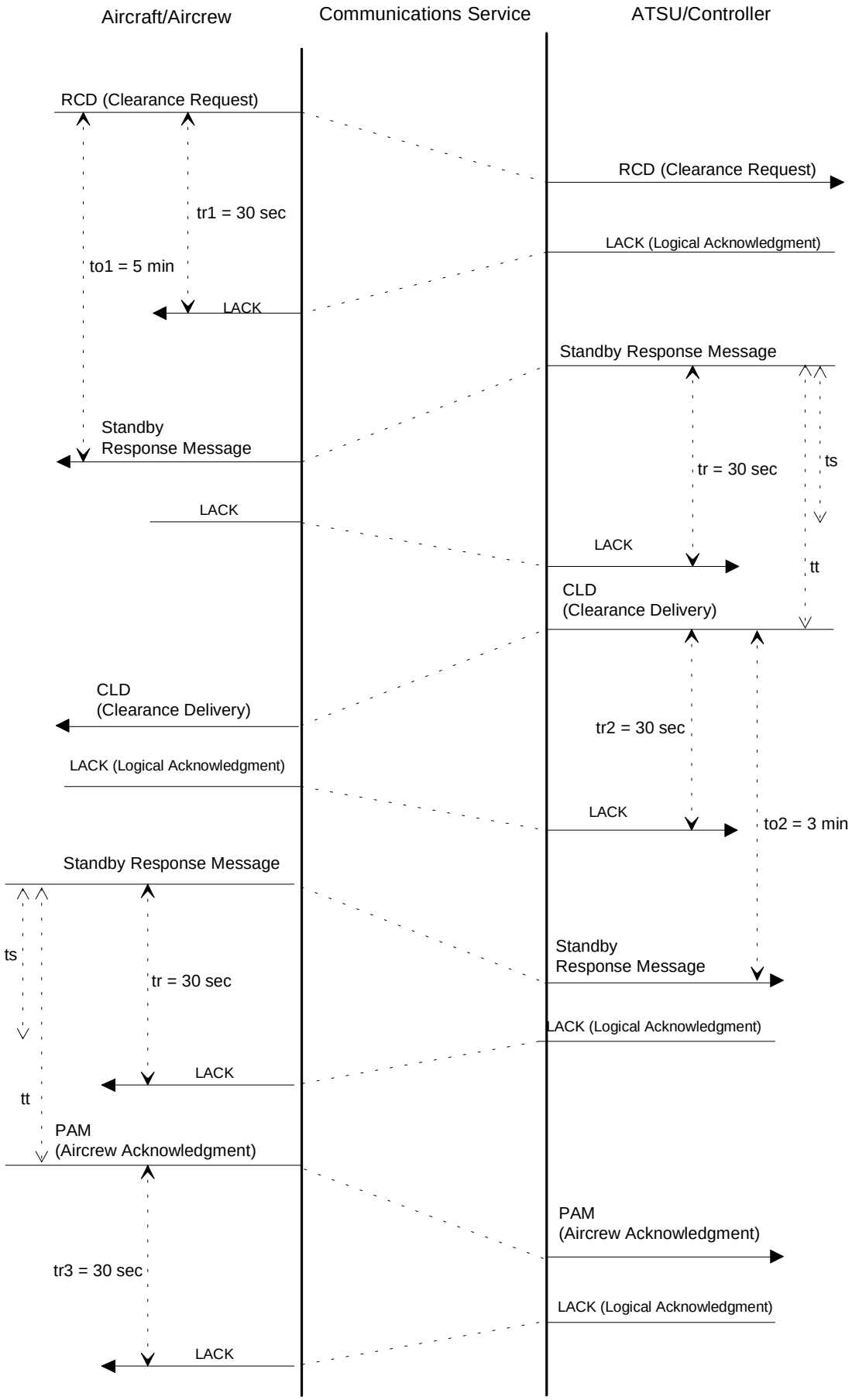
6.1. Normal Exchange

This diagram shows the normal sequence of messages in the DCL service.



<NOTE: The time-out values given in the following table are indicative only and require validation through actual operations.>

6.2. Standby Exchange



NOTE : The values of the Standby timers 'tt' and 'ts' are local implementation issues.

7. Quality Of Service Requirements

Message Category: The DCL Request (RCD), including Logical Response (i.e. loop time), DCL Clearance (CLD), and Aircrew Acknowledgment Message (PAM) are Category 3 messages.

Communications Priority: 3.

Information Urgency:. Urgency attributes are given for each message element in subsection 8.

Information Security:

Data Origin Authentication: Normal

Access Control: M, A

Data Integrity: Maximum

NOTE : The "ICAO Manual of Air Traffic Services (ATS) Data Link Applications" does not contain Security requirements.

8. Information Exchanges

The DCL messages follow the message composition rules described in Section 4 : CPDLC Introduction and Definitions.

The message elements that shall be used to compose DCL messages are given in the tables below. The following element type categories are used in those tables:

M Mandatory;

I/A If Applicable;

O Optional.

These categories are defined in Appendix B : Service Definition Template.

NOTE : Messages with the text "N2" as a message number (Msg Num.) are not supported by the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications". These messages are expected to be implemented as pre-formatted Free text messages.

NOTE : The definitions of the data elements between the square brackets [ ] below are provided in Section 9 : CPDLC Data Glossary.

8.1. DCL Request (RCD)

The following message elements shall be used to compose a RCD:

Element Type	Msg Num.	Message Element	URG	ALRT	RESP
M	25	REQUEST [clearance type] CLEARANCE	N	L	Y
I/A	79	ATIS [atis code]	N	L	N
M	N2	GATE [gate]	N	L	L
M	N2	AIRCRAFT TYPEWAKE [aircraft type] [wake turbulence]	N	L	L
O	98	[free text]	N	N	N

The field [clearance type] must have the value “DEPARTURE”.

NOTE : Information such as avionics indicator, flight id, departure and destination airport do not need to be included in the RCD since they are provided to the C-ATSU in the data link logon process.

NOTE : The “ICAO Manual of Air Traffic Services (ATS) Data Link Applications” does not support the inclusion of the departure gate and the aircraft type and wake in the RCD.

8.2. Request EOBT Change (REC)

The following message elements shall be used to compose a REC:

Element Type	Msg Num.	Message Element	URG	ALRT	RESP
M	N2	REQUEST EOBT CHANGE [time]	U	M	Y

8.3. Revised EOBT (RET)

The following message elements shall be used to compose a RET:

Element Type	Msg Num.	Message Element	URG	ALRT	RESP
M	N2	REVISED EOBT [time]	N	M	W/U

8.4. DCL Clearance (CLD)

The following two message elements shall be used to compose a CLD:

Element Type	Msg Num.	Message Element	URG	ALRT	RESP
M	73	[departure clearance]	N	M	W/U
O	208	[free text]	L	L	N

The field [departure clearance] is defined in Section 9 : CPDLC Data Glossary. The following table provides the “mandatory”, “optional” and “if applicable” elements of the [departure clearance] field.

The following table provides the list of the main elements of the CLD message to be introduced in the [departure clearance] field:

CLD Message Contents	Type		
	M	I/A	O
ICAO Unit Name (C-ATSU)	X		
Clearance Number	X		
Flight ID	X		
Destination Airport	X		
Runway Departure	X		
Route of Flight	X		
SSR Code		X	
Departure Time Interval		X	
Next Frequency And Callsign		X	
ATIS code	X		
Cleared Flight Level	X		
Clearance Limit	X		
Clearance Time of Expiry		X	
Free Text			X

NOTE : The Clearance Limit is an ICAO mandatory element for departure clearances.

NOTE : The display of the CLD elements should follow the order shown in the above Message Contents table.

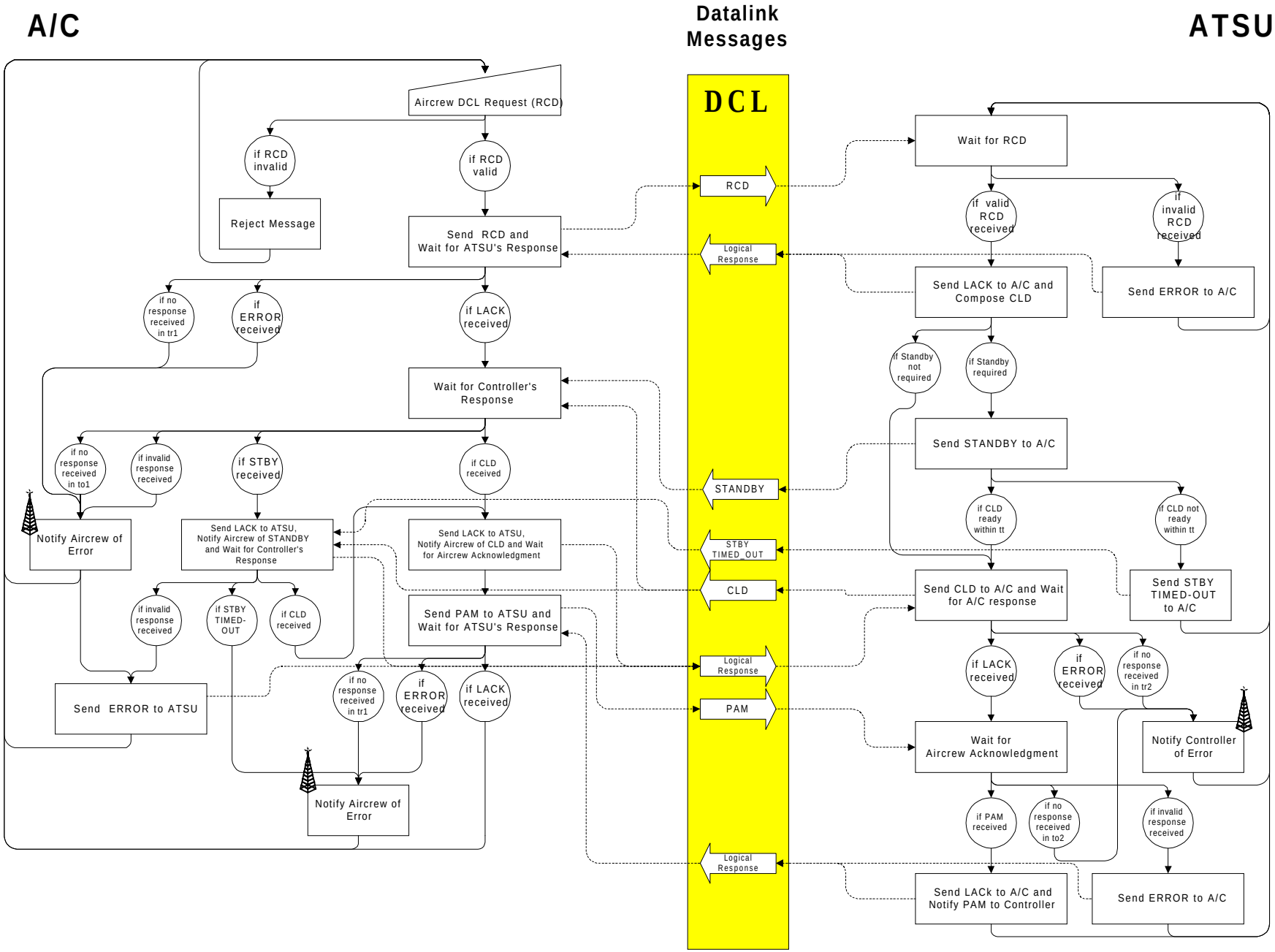
8.5. Aircrew Acknowledgment (PAM)

One of the following message elements shall be used to compose a PAM:

Element Type	Msg Num.	Message Element	URG	ALRT	RESP
O	0	WILCO	N	M	N
O	1	UNABLE	N	M	N
O	2	STANDBY	N	M	N

9. Event Sequence Diagram

The diagrams in this subsection provide an overview of some of the main normal and abnormal sequences of events within the DCL service.


A/C
Datalink Messages
ATSU
DCL
Aircrew DCL Request (RCD)
if RCD invalid
if RCD valid
Reject Message
Send RCD and Wait for ATSU's Response
RCD
Logical Response
Wait for RCD
if valid RCD received
if invalid RCD received
Send LACK to A/C and Compose CLD
Send ERROR to A/C
if no response received in tr1
if ERROR received
if LACK received
Wait for Controller's Response
if Standby not required
if Standby required
Send STANDBY to A/C
if no response received in to1
if invalid response received
if STBY received
if CLD received
STANDBY
if CLD ready within tt
if CLD not ready within tt
Notify Aircrew of Error
Send LACK to ATSU, Notify Aircrew of STANDBY and Wait for Controller's Response
Send LACK to ATSU, Notify Aircrew of CLD and Wait for Aircrew Acknowledgment
STBY TIMED_OUT
CLD
Send CLD to A/C and Wait for A/C response
Send STBY TIMED-OUT to A/C
if invalid response received
if STBY TIMED-OUT
if CLD received
Send PAM to ATSU and Wait for ATSU's Response
Logical Response
PAM
if LACK received
if ERROR received
if no response received in tr2
Send ERROR to ATSU
if no response received in tr1
if ERROR received
if LACK received
Wait for Aircrew Acknowledgment
Notify Controller of Error
Notify Aircrew of Error
if PAM received
if no response received in to2
if invalid response received
Logical Response
Send LACk to A/C and Notify PAM to Controller
Send ERROR to A/C

Section 9 : CPDLC Data Glossary

This section contains the definitions of the data elements between the square brackets [ ] in the CPDLC message elements as they appear in the ICAO Manual of Air Traffic Services Data Link Applications. Definitions are listed in alphabetical order:

Aircraft Identification:	A group of letters, figures or a combination thereof which is identical to or the code equivalent of the aircraft callsign. It is used in Field 7 of the ICAO Model flight plan.
Aircraft Type	Specifies the aircraft type. (IA5 string of 2-4 characters)
Airport:	Four characters that specifies the ICAO four-letter identifier for the airport.
Airway Identifier:	Specifies the particular airway to be used within the route of the aircraft. (IA5 string of 2-5 characters.)
Airway Intercept:	Specifies the airway which will be intercepted and followed in the aircraft route of flight.
Altimeter:	Indicates the aircraft altimeter setting in SI or non-SI units.
Approved Departure Time:	Departure time issued by ATC or ATFM.
ATIS Code:	Specifies the alphanumeric value for the current version of the automatic terminal information service (ATIS) in effect at a given location.
ATW Along Track Waypoint:	Sequence of information used to compute additional way-points to an aircraft's route of flight. The following data composes the *ATW Along Track Waypoint:* a) *Position*, b) *ATW Distance,* c) *Speed* (optional), and d) *ATW Level Sequence* (optional).
ATW Distance Tolerance:	Indicates whether a distance can be plus or minus.
ATW Distance:	Used to specify the distance along a route of flight at which point to add the fix. Composed of *ATW Distance Tolerance* and *Distance*.
ATW Level Sequence:	Sequence of 1 or 2 ATW Levels.

ATW Level Tolerance: 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. Indicates:

a) at,

b) at or above, or

c) at or below.

ATW Level: Contains ATW Level Tolerance and Level.

Clearance Expiry Time: Time after which a given clearance is no longer valid.

Clearance Limit: The point to which an aircraft is granted an air traffic control clearance. Specified as a *Position*.

Clearance Type: Specifies a particular type of clearance. Where specified, the following clearance types are permitted:

a) approach,

b) departure,

c) further,

d) start-up,

e) pushback

f) taxi,

g) take-off,

h) landing,

i) oceanic,

j) en-route, or

k) downstream.

Code (SSR): Specifies the Mode A value for the aircraft.

Date Time Group: Provides date and time as YYMMDD and HHMMSS.

Date Time Track Generated: Date and time of the creation of a track.

Date Time Track Start: Date and time of the track activation.

Date Time Track Stop: Date and time of the track termination.

Date: Gives the date in YYMMDD format using *Year*, *Month*, and *Day* data.

Day:	Day of the month.
Degree Increment:	Specifies the number of degrees (of latitude or longitude) separating reporting points.
Degree Minutes:	Provides minutes of a latitude or longitude degree.
Degree Seconds:	Provides seconds of a latitude or longitude degree.
Degrees:	Indicates the degree value in degrees magnetic or degrees true.
Departure Airport:	Flight plan departure airport.
Departure Clearance:	Sequence of data structures necessary to provide a departure clearance. The sequence of data structures that compose a departure clearance data structure are: a) *Aircraft Identification* b) *Clearance Limit*, c) *Flight Information*, d) *Further Instructions (optional).*
Departure Expected Clearance Time:	Indicates time when a clearance is expected. Associated with flow management program in effect.
Departure Frequency:	Provides departure frequency as a Frequency and ICAO Unit Name.
Departure Minimum Interval:	Specifies the minimum interval of time to depart behind the preceding aircraft.
Departure Runway:	Runway of departure.
Departure Time Controlled:	Specifies the time the aircraft is allowed to depart within a time window.
Departure Time:	Sequence of Approved Departure Time (optional), Departure Time Controlled (optional), Departure Expected Clearance Time (optional) data, Departure Minimum Interval (optional).
Destination Airport:	Flight plan destination airport.

Direction: Indicates the horizontal direction specified in terms of the current direction relative to the aircraft or in terms of the cardinal points of the compass. Values are as indicated:

a) left,

b) right

c) either side,

d) north,

e) south,

f) east,

g) west,

h) north east,

i) north west,

j) south east, or

k) south west.

Distance Offset Direction: Sequence of Distance Offset and Direction data.

Distance Offset: Specifies the offset distance from the aircraft's route in SI or non-SI units.

Distance To Next Point: Indicates the distance to the next way-point in SI or non-SI units.

Distance: Provides the distance in SI or non-SI units.

EFC Time: Specifies the time when a further clearance is expected.

Error Information: Indicates the error conditions as follows:

a) unrecognised message reference number,

b) end service with pending messages,

c) logical acknowledgment not accepted,

d) more than one next data authority element, or

e) insufficient message storage capacity.

Facility Designation: Specifies the ICAO four-letter location indicator or the ICAO eight-letter combined location indicator, three letters designator and an additional letter.

Facility Identification: Provides a facility identification as either a Facility Designation or a Location Name.

Fix Name: Specifies the ICAO identifier for a given fix.

Fix Next Plus One: Specifies the point after the next point in the aircraft's route as a *Position*.

Fix Next: Indicates the next point in the aircraft's route as a *Position*.

Flight Information: Information for a route of flight. Specified as:

a) *Route of Flight*, or

b) *Levels of Flight*, or

c) *Route of Flight* and *Levels of Flight.*

Flight Level: As defined in PANS/RAC (Doc 4444).

Flight Plan Segment: Indicates the type of information used to define a particular point in the aircraft route of flight.

Free Text: Used to convey unstructured information.

Frequency Sat Channel: Specifies the appropriate address for use with a satellite voice system.

Frequency VHF Channel: Specifies the VHF channel to permit the use of a resolution of 8.33 kHz.

Frequency: Specifies the frequency and an indicator of the RF spectrum used for the given frequency. The types of frequency that can be provided include:

a) *Frequency HF*,

b) *Frequency VHF*,

c) *Frequency UHF*,

d) *Frequency Sat Channel*, or

e) *Frequency VHF Channel*.

Further Instructions: Provides additional information in a departure clearance as follows:

a) *Code (SSR)* (optional),

b) *Departure Frequency* (optional),

c) *Clearance Expiry Time* (optional),

d) *Departure Airport* (optional),

e) *Destination Airport* (optional),

f) *Departure Time* (optional),

g) *Departure Runway* (optional)

h) *Revision Number* (optional), or

i) *ATIS Code* (optional).

Hold At Waypoint Speed High: Specifies the upper value for a holding speed range.

Hold At Waypoint Speed Low: Specifies a holding speed. When used with *Hold At Waypoint Speed High*, specifies the lower value for a holding speed range.

Hold At Waypoint: Sequence of data structures used to define the holding procedure to be used at a particular point. The *Hold At Waypoint* consists of an sequence of the following:

a) *Position*,

b) *Hold At Waypoint Speed Low* (optional),

c) *ATW Level* (optional),

d) *Hold At Waypoint Speed High* (optional),

e) *Direction* (optional),

f) *Degrees* (optional),

g) *EFC Time* (optional), and

h) *Legtype* (optional).

Hold Clearance: Provides a holding clearance to the aircraft. The *Hold Clearance* is provided using:

a) *Position*,

b) *Level*,

c) *Degrees*,

d) *Direction*, and

e) *Legtype* (optional).

Hours: Specifies the hour in 24-hour notation.

ICAO Callsign Suffix: Indicates the ATC function performed by the ICAO facility as follows:

a) center,

b) approach,

c) tower,

d) final,

e) ground control,

f) clearance delivery,

g) departure, or

h) control.

Intercept Course From Selection.	Used to specify the point from which the intercept course originates and an indication of which type of fix is specified. Provided as one of the following: a) *Published Identifier*, b) *Latitude Longitude*, c) *Place Bearing Place Bearing*, or d) *Place Bearing Distance*.
Intercept Course From:	The *Intercept Course From* is used to specify a fix and a bearing from that fix needed to intercept a route using *Intercept Course From Selection* and *Degrees*.
Latitude Degrees:	Degrees of latitude.
Latitude Direction:	Indicates whether north or south latitude is specified.
Latitude Longitude:	Sequence of Latitude and Longitude.
Latitude Reporting Points:	Indicates the latitude on which to base incremental reporting points. Provided as of *Latitude Direction* and *Latitude Degrees*.
Latitude:	Provides latitude as *Latitude Degrees*, *Degree Minutes* (optional), and *Degree Seconds* (optional).
Latlon Reporting Points:	Provides either Latitude Reporting Points or Longitude Reporting Points.
Leg Distance:	Indicates the aircraft leg in SI or non-SI units.
Leg Time:	Specifies aircraft leg in terms of minutes.
Leg Type:	Provides either Leg Distance or Leg Time.
Level Current:	Specifies the current aircraft level.
Level Tolerance:	Choice to indicate at, at or above, or at or below, concerning the related level value.
Level:	Allows level to be omitted, or specified as a single level, or vertical range in one of the following ways: a) *Altitude* in metres or feet, or b) *Flight Level* in metres or feet.

***Levels of Flight**:*	Specified as a choice of: a) *Level,* or b) *Procedure Name*, or c) *Level* and *Procedure Name.*
Location Name:	Specifies the name of the aeronautical station.
Longitude Degrees:	Degrees of longitude.
Longitude Direction:	Indicates whether east or west longitude is specified.
Longitude Reporting Points:	Indicates the longitude on which to base incremental reporting points. Provided as *Longitude Direction* and *Longitude Degrees*.
Longitude:	*Provides longitude as Longitude Degrees, Degree Minutes (optional), and Degree Seconds (optional)*.
Month:	Month of the year.
Navaid:	Specifies a particular navigation aid.
Persons On Board:	Specifies the number of persons on the aircraft.
Place Bearing Distance:	Used to indicate a location based on the degrees and distance from a known point. Provided using *Place Bearing* and *Distance* data.
Place Bearing Place Bearing:	Used to define a point as the intersection formed by two bearings from two known points. Provided as two *Place Bearing*.
Place Bearing:	Sequence of Fix Name, Latitude Longitude (optional), and Degrees.
Point Level Block:	Provides a level range using two *Levels*.
Point Level:	Specifies level related details concerning a given point. Provided using *Flight Level* and *ATW Level Tolerance*.
Position Current:	Specifies the current location of the aircraft as a *Position*.

Position Report: Uses the following data necessary to provide an aircraft position report as follows:

a) *Position Current*,

b) *Time At Position Current*,

c) *Level*,

d) *Fix Next* (optional),

e) *Time ETA At Fix Next* (optional),

f) *Fix Next Plus One* (optional),

g) *Time ETA destination* (optional),

h) *Remaining Fuel* (optional),

i) *Temperature* (optional),

j) *Winds* (optional),,

k) *Turbulence* (optional),

l) *Icing* (optional),

m) *Speed* (optional),

n) *Speed Ground* (optional),

o) *Vertical Change* (optional),

p) *Track Angle* (optional),

q) *True Heading* (optional),

r) *Distance* (optional),

s) *Supplementary Information* (optional),

t) *Reported Waypoint Position* (optional),

u) *Reported Waypoint Time* (optional), and

v) *Reported Waypoint Level* (optional).

Position: Information used to specify a location. Position can be specified as:

a) *Fix Name*,

b) *Navaid*,

c) *Airport*,

d) *Latitude Longitude*, or

e) *Place Bearing Distance*.

Procedure Approach: Specifies a procedure as an approach procedure.

Procedure Arrival: Specifies a procedure as an arrival procedure.

Procedure Departure: Specifies a procedure as a departure procedure.

Procedure Name:	Used to uniquely identify the standard arrival, approach or departure procedure using the following: a) *Procedure Type*, b) *Procedure*, and c) *Procedure Transition* (optional).
Procedure Transition:	Specifies the name of the procedure transition.
Procedure Type:	Specifies the type of procedure as arrival, approach, or departure.
Procedure:	Specifies the name of the procedure.
Published Identifier:	Used to provide the location of the specified fix. Provided using *Fix Name* and *Latitude Longitude*.
Remaining Fuel:	Specifies the amount of fuel remaining on the aircraft using *Time* data.
Reported Waypoint Level:	The level of the waypoint for which the report is being made.
Reported Waypoint Position:	The position of the waypoint for which the report is being made.
Reported Waypoint Time:	The time of the waypoint for which the report is being made.
Reporting Points:	Used to indicate reporting points along a route of flight based on a specific Latitude and/or Longitude increment expressed in degrees.
Revision Number:	Specifies the revision number of the departure clearance. Used to differentiate different revisions of the departure clearance for a given aircraft flight.

Route Clearance: Data necessary to provide a route clearance. Provided using the following data:

a) *Aircraft Identification* (optional),

b) *Departure Airport* (optional),

c) *Destination* Airport (optional),

d) *Gate* (optional),

e) *Runway Departure* (optional),

f) *Procedure Departure* (optional),

g) *Runway Arrival* (optional),

h) *Procedure Approach* (optional),

i) *Procedure Arrival* (optional),

j) *Airway Intercept* (optional),

k) *Route Information Sequence* (optional), and

l) *Route Information Additional* (optional).

Route Information Additional: Additional data used to further specify a route clearance. Provided using the following:

a) *ATW Along Track Waypoint Sequence* (optional),

b) *Reporting Points* (optional),

c) *Intercept Course From Sequence* (optional),

d) *Hold At Waypoint Sequence* (optional),

e) *Waypoint Speed Level Sequence* (optional), and

f) *RTA Required Time Arrival Sequence* (optional).

Route Information: Indicate the method used to define the aircraft route of flight. The actual aircraft route of flight will probably consist of multiple *Route Information* sequences as follows:

a) *Published Identifier* (optional)

b) *Latitude Longitude* (optional),

c) *Place Bearing Place Bearing* (optional),

d) *Place Bearing Distance* (optional),

e) *Airway Identifier* (optional), and

f) *Track Detail* (optional).

Route Of Flight: Specifies route of flight using Route Information

RTA Required Time Arrival: Sequence used to associate an estimated time of arrival with a specific point along a route of flight. The *RTA Required Time Arrival* consists of:

a) *Position*,

b) *RTA Time*, and

c) *RTA Tolerance* (optional).

RTA Time:	Used to specify the required time of arrival for an aircraft at a specific point.
RTA Tolerance:	Specifies the possible tolerance expressed in minutes in the RTA time.
Runway Arrival:	Specifies the arrival runway.
Runway Configuration:	Used to specifically identify one runway in a group of parallel runways. Can be specified as left, right, or center.
Runway Departure:	Specifies the departure runway.
Runway Direction:	Specifies the direction of the runway.
Runway:	Specifies a runway using Runway Direction and Runway Configuration.
RVR:	Runway Visual Range as distance.
Speed Ground:	Ground speed expressed in either SI or non-SI units.
Speed Indicated:	Indicated aircraft speed expressed in either SI or non-SI units.
Speed Mach:	Aircraft speed specified as a Mach value.
Speed True:	Aircraft true speed expressed in either SI or non-SI units.
Speed Type:	Indicates what type of speed is to be provided: a) Indicated, b) True, c) Ground, d) Mach, e) Approach, f) Cruise, g) Minimum, h) Maximum, or i) Not specified.

Speed:	Provides the aircraft speed as one of the following: a) *Speed Indicated*, b) *Speed True*, c) *Speed Ground*, or d) *Speed Mach*.
Temperature:	Temperature specified in degrees Celsius.
Time At Position Current:	Specifies the time that the current location of the aircraft was indicated.
Time ETA At Fix Next:	Specifies the time an aircraft is expecting to cross the next point in the route.
Time ETA Destination:	Specifies the time an aircraft is expecting to land at the destination airport.
Time HHMMSS:	Provides time as HHMMSS.
Time Minutes:	Specifies time in minutes of an hour.
Time Seconds:	Specifies time in seconds of a minute.
Time Tolerance:	Provides a time tolerance as: at, at or before, or at or after.
Time:	Sequence of *Hours* and *Time Minutes*.
To From Position:	Used to indicate a “to” or “from” relative to a specified position.
To From:	Specifies to or from.
Track Angle:	Specifies the aircraft ground track in degrees.
Track Detail:	Associates a sequence of fixes with a particular track name. Specified using *Track Name* and *Latitude Longitude.*
Track Name:	Specifies the name of an identified group of points which make up a section of a route.

Traffic Type:	Indicates what type of traffic is present. Permitted types: a) opposite direction, b) same direction, c) converging, or d) crossing.
True Heading:	Specifies the aircraft true heading in degrees.
True Track Angle:	Specifies true track angle to the next way-point using degrees.
Turbulence:	Specifies the severity of turbulence. Can be one of the following: “light”, “moderate”, or “severe”.
Unit Name Frequency:	Sequence of Unit Name and Frequency.
Unit Name Of Departure Frequency:	Specifies the location name for the departure frequency.
Unit Name:	Sequence of Facility Identification and ICAO Callsign Suffix (if required).
Vertical Change:	Sequence of Vertical Direction and Vertical Rate.
Vertical Direction:	Specifies whether the rate of vertical change is in the upward or downward direction.
Vertical Rate:	Specifies the vertical rate of change in SI or non-SI units.
Wake Turbulence	Specifies the aircraft wake turbulence that can be : heavy, medium or light.
Waypoint Speed Level:	Used to associate levels and speeds with particular points in a route clearance. It is composed using the following: a) *Position*, b) *Speed* (optional), and c) *ATW Level Sequence* (optional).
Wind Direction:	Specifies the direction of the wind using *Degree Value.*
Wind Speed:	Provides wind speed in SI or non-SI units.
Winds:	Provides wind using *Wind Direction* and *Wind Speed*.

Year: Provides year as last two digits of a year.

The following provides the required range and resolution for the data elements introduced in the above definitions:

VARIABLES	PARAMETERS	Unit	Range/Size	Resolution
Aircraft Identification		IA5 Character String	2-7 characters	N/A
Airport		IA5 Character String	4 characters	N/A
Airway Identifier		IA5 Character String	1-5 characters	N/A
Altimeter	Altimeter SI	Hecto Pascal	750.0 - 1250.0	0.1
	Altimeter *	Inches Hg	22.00 - 32.00	0.01
Level	Flight Level SI	1 level (10 m)	100 - 2 500	1
	Flight Level non-SI	1 level (100 ft)	30 - 700	1
	Level SI	Metres	-30 to +25 000	1
	Level non-SI	Feet	-600 - +70 000	10
ATIS Code		IA5 Character	1 character	N/A
Bearing		Degrees	1 - 360	1
Code (SSR)		Integer	4 octal digits	N/A
Date	Year	Year of Century	0 - 99	1
	Month	Month Of Year	1 - 12	1
	Day	Day Of Month	1 - 31	1
Degrees	Degrees Magnetic	Degrees	1 - 360	1
	Degrees True	Degrees	1 - 360	1

VARIABLES	PARAMETERS	Unit	Range/Size	Resolution
Departure Minimum Interval		Minutes	0.1 - 15.0	0.1
Distance	Distance SI units	Kilometres	0 - 2000	0.25
	Distance non-SI units	Nautical Miles	0 - 1000	0.1
Distance Offset	Distance Offset SI	Kilometres	1 - 500	1
	Distance Offset non-SI	Nautical Miles	1 - 250	1
Distance to Next Point	Distance To Next Waypoint SI units	Kilometres	1 - 2000	0.1
	Distance To Next Waypoint non-SI units	Nautical Miles	1 - 1000	0.1
Fix Name		IA5 Character String	1-5 characters	N/A
Free Text		IA5 Character String	1 - 200 characters	N/A
Frequency	Frequency HF	kHz	2 850 - 28 000	1
	Frequency VHF	MHz	117.975 - 137.000	0.025
	Frequency UHF	MHz	225.000 - 399.975	0.025
	Frequency VHF Channel	Numerical	117.975 - 137.000	0.005
	Satellite Channel	Digit string	12 digits	N/A
Facility	Facility Designation	IA5 Character String	4-8 characters	N/A
	Location Name	IA5 Character String	3 - 18 characters	N/A
	Navaid	IA5 Character String	1 - 4 characters	N/A
Latitude	Longitude Degrees	Degrees	0 - 90	0.001
	Degree Minutes	Minutes	0 - 59.99	0.01
	Degree Seconds	Seconds	0 - 59	1
Longitude	Longitude Degrees	Degrees	0 - 180	0.001

VARIABLES	PARAMETERS	Unit	Range/Size	Resolution
	Degree Minutes	Minutes	0 - 59.99	0.01
	Longitude Seconds	Seconds	0 - 59	1
Leg Distance	Leg Distance SI units	Kilometres	0-100	1
	Leg Distance non-SI units	Nautical Miles	0-50	1
Leg Time		Minutes	0-10	1
Persons On Board		Integer	1 - 1000	1
Procedure Transition		IA5 Character String	1 - 5 characters	N/A
Revision Number		Integer	1 - 16	1
RTA Tolerance		Minutes	0.1-15.0	0.1
Runway Direction		Integer	1 - 36	1
RVR	RVR SI units	Metres	0-1500	1
	RVR *	Feet	0-6100	1
Speed	Ground Speed SI	Kilometres/Hour	- 100 to + 4000	1
	Ground Speed non-SI	Knots	- 50 to + 2000	1
	Mach	Mach Number	0.5 - 4.0	0.001
	Indicated SI	Kilometres/Hour	0-800	1
	Indicated non-SI	Knots	0-400	1
	Speed True SI	Kilometres/Hour	0-4000	1
	Speed True non-SI	Knots	0-2000	1

* Unit measurement not specified in Annex 5

Temperature	Temperature Celsius	Degrees Celsius	- 100 to + 100	1

VARIABLES	PARAMETERS	Unit	Range/Size	Resolution
Time	Time Hours	Hours of Day	0 - 23	1
	Time Minutes	Minutes of Hour	0 - 59	1
	Time Seconds	Seconds of Minute	0 - 59	1
Track Name		IA5 Character String	1-6 characters	N/A
Version Number	Version number	Integer	0 - 15	N/A
Vertical Rate	Vertical Rate SI	Metres/ Second	± 1 000	1
	Vertical Rate non-SI	Feet/Minute	± 30 000	10
Wind Speed	Wind Speed SI	Kilometres/Hour	0 - 500	1
	Wind Speed non-SI	Knots	0 - 250	1

Section 10 : Automated Downlink of Airborne Parameters (ADAP) Introduction and Definitions

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1. Introduction

The aircraft avionics, e.g. navigation and flight management systems, are capable of making available in real time, data which may be of use to Controllers and ground systems. This includes air speed, heading and vertical rate. These parameters could be downlinked to the appropriate ground system automatically, with beneficial results including reduced Controller workload and enhanced ground system tracking.

Currently, most of the parameters describing the aircraft status are only available onboard and can be used solely by the on-board system. When this information is required by ground systems it can only be extrapolated from static or reference data and the updates may be reported with some delay.

ADAP only involves automated system to system exchanges. Normally, neither the Aircrew nor the Controller are involved in the data-link exchange. The data collection and treatment are automatic.

In relation to the ADS data link application, ADAP allows an alternative means to ADS for the ground system to obtain aircraft parameters without requiring the full ADS functionality.

Its initial use will be in areas where radar is the primary means of surveillance, and where the downlinked parameters will augment that derived from radar data processing, primarily for Controller access.

ADAP can be supported by the ATN or by sub-network specific services.

One of the potential ADAP services is described in this document:

1. the Controller Access Parameters (CAP) service, which relates to the parameters that are downlinked to be displayed to a Controller in order to enhance Controller awareness;

Additional ADAP services will be introduced in future editions of this document.

In order to have a pragmatic approach and to justify the collection of any particular parameter, this document highlights the ADAP services with the presentation of a subset of ground functions described in operational scenarios. The ground functions are selected, a priori, on the criteria of their technical maturity and of their early implementation. Other scenarios using other functions and possibly other parameters should be added when becoming mature.

The list of parameters for downlink selected in this document may have to be expanded in the future in the light of new developments.

2. General Operational Context

ADAP is relevant to all flight phases and airspace.

The downlinked parameters will be used by several different ground functions; they will contribute to the improvement of the ground system, especially in the domains of:

a) Controller access to aircraft parameters,

b) surveillance,

c) conflict detection,

d) medium term planning, for the benefit of Air Traffic Management.

2.1. Controller Access to Aircraft Parameters

Air Traffic Controllers monitor the traffic and, for that purpose, use the situation display augmented by the surveillance system. In high or medium density traffic areas, this system relies on a high redundancy SSR coverage and multiple radar tracking. The situation display gives an accurate view of aircraft current position, of ground related aircraft status (track, ground speed) and of its short term evolution given by extrapolation techniques.

ADAP will provide the Controller with parameters measured on board (e.g. magnetic heading, indicated air speed).

ADAP will extend the domain of common reference for Aircrew and Controller.

2.2. Enhanced Surveillance

One of ADAP's purposes is to enhance surveillance performed on the ground.

ADAP will improve the horizontal tracking allowing early detection of turns by the availability of parameters such as roll angle and heading.

ADAP will improve vertical tracking by the availability of vertical speed.

ADAP will improve the tracking initiation phase by the availability of heading and ground speed.

2.3. Conflict Detection

The conflict detection functions Short Term Conflict Alert (STCA) and Minimum Safe Altitude Warning (MSAW) will also benefit from ADAP, particularly the improvements of the ground tracking.

The direct use of ADAP into those functions should allow better anticipation by giving means to improve the short term trajectory prediction.

ADAP should also help in minimising the false alarm rate.

2.4. Medium Term Planning

Medium term planning actions on air traffic (addressing a time horizon ranging from 5 to 30 minutes), rely on the prediction of aircraft flight path. Trajectory prediction utilises flight plan information, and current aircraft status as reported by the surveillance system.

ADAP will allow the ground system to have a better knowledge of the aircraft status, especially in the monitoring of flight path changes, and thus will allow for improvement in the precision of the trajectory prediction.

ADAP will provide the ground system with the trajectory computed on board by the avionics. This use of ADAP will not be addressed in the first stages.

3. General Expected Benefits

The information provided to Controllers and to the ground functions through the ADAP services will improve the capacity and the safety of the air traffic control system. The improvement is mainly coming from the **reduction of the uncertainty on the expected behaviour of the aircraft**.

The ADAP services will improve the Controller awareness of the aircraft behaviour. It allows the Controller to have a better and more efficient anticipation and a more reliable medium term prevision. Probably, the most efficient way of providing the information to the Controller is to have it easily available on request or to display it on pre-defined events for short periods.

The ADAP services will reduce the R/T congestion. Many Controller/Aircrew dialogues consist in requests from the Controller on the values of parameters which cannot be elaborated by ground based surveillance (e.g. heading or airspeed). The CAP service will provide this information in a more rapid and more reliable way to the Controller which will result in a reduction of his mental workload.

Section 11 : Controller Access Parameters (CAP) Service

Service No.	Name	Abb.	Cat	References	Version No.
O-7	Controller Access Parameters	CAP	AM		2.0 16/5/97

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1. Scope and Objective

This data link service aims at enhancing the ATC surveillance functions and the availability of aircraft parameters to the Controller by extracting data from the airborne system.

The service is foreseen to be primarily used in continental airspace, both in en-route and terminal areas.

2. Expected Benefits, Anticipated Constraints, and Associated Human Factors

2.1. Expected Benefits

- ⇨ direct provision of up-to-date aircraft parameters to the Controller,
- ⇨ reduction of both Controller and Aircrew workload,
- ⇨ reduction of voice channel occupancy,
- ⇨ reduction of the risk of error,
- ⇨ extension of the domain of common reference for Aircrew and Controller,
- ⇨ improvement of the capacity of pre-regulation (e.g. sequencing) in terminal sectors,
- ⇨ reduction of the Controller workload by reducing uncertainty concerning expected behaviour of the aircraft,
- ⇨ improvement of safety by provision of a more precise prediction of vertical aircraft behaviour (i.e. securisation of FL clearance and improvement of the monitoring of FL clearances execution),
- ⇨ improvement of capacity and efficiency by allowing for more anticipation in planning of traffic,
- ⇨ improvement of safety in high density traffic areas.

2.2. Anticipated Constraints

- ⇨ Downlinked selected aircraft parameters such as auto flight system panel settings and FMS target values should not be used in integrated co-operative ATM applications and in safety critical systems without establishing their absolute validity and their relevance to the intended flight profile of the aircraft prior to their transmissions.
- ⇨ The implementation of ATM application and of safety critical systems using downlinked selected aircraft parameters should not result in the requirement to fly aircraft coupled to the autoflight system or specific modes at all time. Therefore the use of selected aircraft parameters should only be considered as a means to provide non essential enhancements to the normal operation of the above applications and systems.
- ⇨ transmission delay.
- ⇨ possible legal implications of the use by the Controller of Data link derived information.
- ⇨ possible disparity in Air Operators operational use of the Mode Control Panel (MCP) selected Flight Level.
- ⇨ review of all autoflight systems logic relevant to the CAP selected parameters shall be performed.

2.3. Associated Human Factors

- ⇨ An appropriate Human Machine Interface should allow the Controller to efficiently bring into display required downlinked parameters.

⇨ Impact on cockpit Aircrew procedures with regard to Aircrew selected values.

3. Service Operational Context

Air Traffic Controllers in a radar based operational environment must monitor the traffic and, for that purpose, use the situation display generated by the surveillance system. In high or medium density traffic areas, the surveillance system is based on a redundant SSR coverage and radar tracking. The situation display gives an accurate view of aircraft current position, of ground related aircraft status (track, ground speed) and of its short term evolution given by extrapolation techniques.

The operational limitations of the situation display are:

- the absence of information relative to the air related status of the aircraft, like heading and air speed.
- some inertia in the display of aircraft evolution (e.g. detection of turn), this inertia being operationally and technically justified by the concern of avoiding unsteadiness in the display.

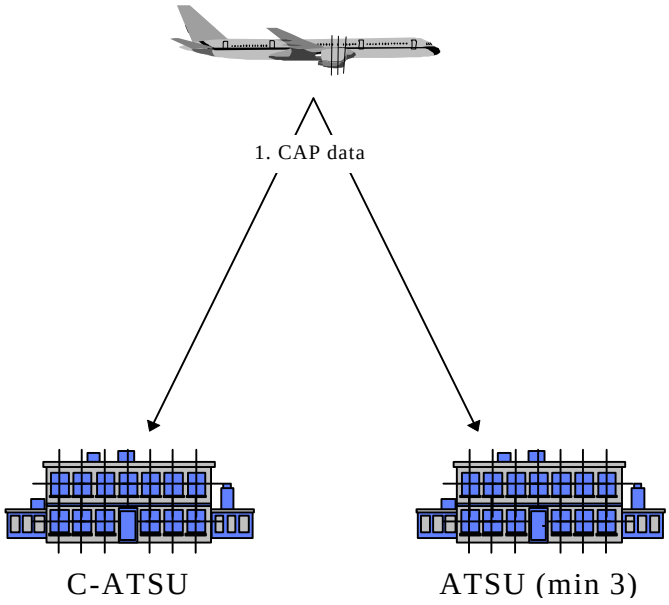
Those limitations induce workload in two domains :

- it contributes to the congestion of the R/T : in order to elaborate pertinent control instructions, the Controller very often needs to obtain from the Aircrew, information such as ‘indicated heading’ and ‘indicated air speed’.
- it significantly contributes to Controller workload, forcing him/her to closely check that instructions are correctly executed by the aircraft. For a single manoeuvre this monitoring activity may last several minutes (from the detection of the start of manoeuvre until the confirmation that the manoeuvre ends as expected) and is very demanding in terms of Controller's cognitive resources, especially when safety is concerned. In periods of heavy traffic, when the Controller has to monitor more than one conflict, the risk exists of misunderstandings in the Aircrew/Controller communications that could lead to difficult situations.

4. Overview of Operating Methods with and without Data Link

Step	Operating Method without Data Link	Operating Method with Data Link
1	The Controller makes a request, if time available, to the Aircrew through voice communications whenever he needs additional information related to aircraft state (i.e. heading and speed for separation and/or sequencing).	The required parameters are automatically downlinked without Controller or Aircrew involvement.
2	The Aircrew provides the requested information through voice communications.	The ground system automatically makes the downlinked parameters available for display to the Controller.
3	The Controller acknowledges the transmitted information or requests its re-transmission, and records the information if appropriate.	No Controller response to the transmitted data is necessary in the CAP service.

4.1. Information Exchange Diagram



5. Detailed Service Operating Method with Data Link

5.1. Use of instantaneous indicated heading, air speed and vertical rate

5.1.1. Description of the role of CAP

Indicated heading and indicated air speed/mach number are the two instantaneous parameters which are very often required by the Controller. For those parameters, the CAP service should be used as follows:

- For all aircraft under the responsibility of the ATSU, the CAP service collects periodically or on event the value of indicated heading and indicated air speed. The most recent value is stored in the ground system with the other data relative to the flight. If, for any reason the values are not refreshed as required, they are declared invalid. When the aircraft is turning, the heading may be replaced by a "turn" indication. When the aircraft is accelerating, the speed may be replaced by an "acc" indication.
- The Controller's HMI should indicate aircraft about which valid CAP data is available. When needed, the Controller can display in the track label the indicated heading or the indicated air speed. The Controller could then use them as references to vector one aircraft, or two aircraft on parallel headings, or to control aircraft speed.
- The CAP data could be automatically displayed (if available) for the aircraft involved in an alert by the STCA (Short Term Conflict Alert).

NOTE : The HMI functions described above are just examples of what could be achieved with the CAP service. The definition of the most appropriate HMI is a local implementation issue.

5.1.2. Deployment Analysis

Since the provision of instantaneous indicated heading, air speed and vertical rate through the CAP service does not have a radical impact on the Controller working methods, the benefits introduced by the service are expected to be realised even with a small proportion of CAP equipped aircraft simultaneously in the same sector. As this proportion increases, the benefits will also increase.

Therefore Controllers will easily get familiar with the use of CAP downlinks and it is desirable that the rate of equipped aircraft rapidly grows to a significant proportion.

5.2. Use of selected (or target) Flight Level

5.2.1. Description of the role of CAP

The review of incidents (near misses or STCA recordings) show a significant number of cases where overshooting the cleared flight level (FL) has occurred.

In order to assist improving safety, the CAP service should provide the Controller with the Aircrew selected Flight Level (FL) as input in the Mode Control Panel (MCP) or equivalent. It is not the intention that the Controller monitors Aircrew settings which depend on Aircrews' procedures.

The CAP service should operate as follows:

- The selected FL is only valid, when the aircraft is effectively flown in an Automatic Flight Mode. When this is not the case, the selected FL is expected to be set to 'invalid' by the avionics.
- When the Controller delivers a FL clearance to the Aircrew and enters this clearance into the ground system, the ground system should monitor changes of the selected FL from that aircraft obtained through the CAP service. When a valid selected FL is obtained from CAP for the aircraft, it should be compared to the cleared FL and an alert should be produced **only if** :

1. the selected FL is higher than the cleared FL when the aircraft is climbing, or
2. the selected FL is lower than the cleared FL when the aircraft is descending.

The objective of this logic is to provide only pertinent alarms. The alarm content should be : the concerned aircraft identification, the cleared FL and the selected FL.

NOTE : It is expected that Aircrew procedures will be standardised when the CAP service is in use.

NOTE : The use of selected FL is justified for the improvement of safety; the use of other selected parameters, such as heading and speed does not have the same potential impact. Thus it is not envisaged to use other selected values in the scenario to enhance Controller awareness.

5.2.2. Deployment Analysis

Downlinking of selected flight levels will probably not be possible with all aircraft in the short term. Moreover, the selected value will not always be valid for the reasons stated above.

Therefore the above described function must be considered as a supplementary **safety function; it shall not be a control tool** replacing the Controller in his/her monitoring task. This aspect must be carefully addressed in the definition of Controller working methods and corresponding HMIs.

Provided this is the case, the benefit, in terms of safety, should be realised as soon as some aircraft are equipped. Naturally, maximum benefits will be obtained when a significant number of aircraft is equipped, especially in high density traffic areas.

5.3. Service Availability

The CAP service shall be available in all phases of flight between take-off and landing. The required set of parameters to downlink and the periodicity of the data collection may change during flight.

5.4. Service Description

5.4.1. Normal Mode

The CAP shall be available as long as a data link communications are available with an ATSU.

The parameters provided to the Controller by the CAP service shall be automatically downlinked without Controller or Aircrew involvement.

The information downlinked via the CAP service shall be made available to the Controller on request or on specific events. The selection of the preferred display method is a local implementation issue.

The aircraft shall be capable of downlinking CAP parameters to multiple ATSUs simultaneously (with a minimum of four).

5.4.1.1. Sequence of services

Not applicable.

5.4.1.2. Additional guidelines

Not applicable.

5.4.2. Abnormal Mode

Abnormal Event	Response
Expiration of the period time without reception of a periodic downlink.	The Controller shall be informed of the non availability of the downlinked data when this data is requested. The last received value may be provided to the Controller with a clear indication that this may be invalid data.
Reception of a CAP message which can not be correlated with the aircraft it originates from.	The CAP message should be discarded.
Airborne CAP detects unavailability or discrepancies between the various sources of a parameter.	The downlinking of the parameter shall be interrupted and the Controller shall be informed of the non availability of the downlinked data when this data is requested. The last received value may be provided to the Controller with a clear indication that this may be invalid data.

6. Time Sequence Diagram

Not applicable.

7. Quality of Service

Message Category: Not applicable.

The CAP service does not require specific messages to downlink the parameters, but the maximum time elapsed between the measurement of the parameter and its delivery to the Controller working position shall be 8 seconds 99.996% of the time.

Communications Priority: 4.

Information Urgency:. Normal.

Information Security:

Data Origin Authentication: Normal

Access Control: M, A

Data Integrity: Maximum

8. Information Exchanges

The following table lists the required Range and Resolution of the parameters to be presented to the Controller.

The Re-send Threshold column list the maximum difference allowed between the actual value of the parameter and the last value provided to the Controller.

The Re-send Threshold provides an indication of the operational significance of the value changes of a parameter. When the value change of a parameter is smaller than its Re-send Threshold it is not required to notify the change to the Controller since this change is not of operational significance.

NOTE : The Re-send Threshold requirements can be met with on event, periodical or with a combined downlink approach, according to the rate of change of the parameter to be downlinked.

Parameter	Unit	Range	Resolution	Re-send threshold	Source/ Dest.
Indicated Air Speed (IAS)	Km/h Knot	-106 to 4046 57 to 2183	9 km/h 5 knots	18 km/h 10 knots	aircraft system/ ground system & ATCO
Speed mach	Mach number	0.5 to 4.0	0.005	0.01 of Mach.	aircraft system/ ground system & ATCO
Indicated Magnetic Heading	Degrees	1 to 360	1 degree	5 degrees	aircraft system/ ground system & ATCO
Selected FL	ft	-1000 to 1000000	100 ft	100 ft	aircraft system/ ground system & ATCO
Vertical Rate	ft/mn m/s	-32840 to 32840 -167 to 167	25 ft/mn 0.13 m/s	5%	aircraft system/ ground system & ATCO
Wind vector, airborne wind reading (except for approach phase) composed of:					aircraft system/ ground system & ATCO
Wind Direction	degrees	1 to 360	1 degree	5 degrees	
Wind Speed	knots Km/h	0 to 300 0 to 580	1 knot 2 km/h	10 knots 20 km/h	

Note: The downlinked parameter will be either IAS or Mach speed depending on the mode the aircraft is flying.

9. Event Sequence Diagram

Not applicable.

Section 12 : Data Link Operational Terminal Information Service (D-OTIS)

Service No.	Name	Abb.	Cat	References	Version No.
O-10	Data Link Operational Terminal Information Service	D-OTIS	F	"ICAO Manual of Air Traffic Services (ATS) Data Link Applications"	2.0 16/5/97

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1. Scope and Objective

The D-OTIS service provides automated assistance in requesting and delivering compiled meteorological and operational flight information derived from ATIS, METAR and NOTAMs / SNOWTAMs, specifically relevant to the departure, approach and landing flight phases.

2. Expected Benefits, Anticipated Constraints, and Associated Human Factors

2.1. Expected Benefits

- ⇨ Improved flight safety during flight by providing Aircrew with data otherwise unavailable or difficult to access, for rapid operational exploitation.
- ⇨ Improved flight safety and flight economy by helping Aircrew to take appropriate decisions concerning the conduct of the flight, especially when facing the need to divert en route on an airfield for which no information is currently available on board.
- ⇨ Reduced Aircrew workload: OTIS information doesn't need to be copied by the flight crew if the message is printed on a cockpit printer or is recallable on a data link display. Also, the Aircrew does not have to divert attention from ATS operations to receive voice relay of NOTAM reports from the airline operators;
- ⇨ Reduced air traffic Controller workload: data link implementation will reduce need for Controller response to Aircrew voice requests for status and updates of weather conditions at specific aerodromes;
- ⇨ Reduced ambiguity in the transmitted information: data link implementation eliminates potential misinterpretation resulting from poor voice transmission quality and transcription errors during hand-copy of voice transmissions;
- ⇨ Potential increased accessibility to operational information: Aircrew will be able to request OTIS information from any specified site available within the accessible data base;
- ⇨ The "Update Contract" functionality (that allows Aircrew to request subsequent updates to the requested information) will provide Aircrew with the latest information of concern at all moments.
- ⇨ Integration of meteorological information (i.e. ATIS/METAR) and relevant information on serviceability of radio aids and runway availability and condition (OFIS/NOTAM).
- ⇨ Potential increased accessibility to METAR information: Aircrew will be able to request METAR information from any specified site available within the accessible data base;
- ⇨ Potential reduction in congestion on voice channels: data link implementation will reduce voice requests and responses for relay of METAR reports.
- ⇨ Fast access to METAR reports for selected aerodromes (e.g. no need to listen to METAR reports for other aerodromes in the VOLMET broadcast).

2.2. Expected Constraints

- ⇨ Ground systems must maintain the pertinent data bases with accurate and up to date data.
- ⇨ Ground systems must support the processing of NOTAM information to allow suitable compilation for OFIS where implemented.

2.3. Associated Human Factors

- ⇨ Disruption of crew activities shall be prevented by appropriate avionics display and sound devices.

⇨ Consideration must be given to the method and content of the D- OTIS message display (using text and/or symbology), to ensure that it is uncomplicated, unambiguous, and easily understood by the Aircrew.

3. Service Operational Context

The D-OTIS service encompasses three different sub-services, namely ATIS, METAR and OFIS.

Automatic Terminal Information Service (ATIS)

ATIS is currently a voice broadcast service intended to relieve frequency congestion and air traffic Controller workload by providing pertinent information to aircraft operations in the terminal area through a local broadcast. This broadcast eliminates the need for a Controller to transmit the information to each aircraft individually. This is normally accomplished through the use of a voice recording of the information which is continuously repeated over a published VHF frequency in the vicinity of the aerodrome.

The information broadcast usually lasts less than one minute and includes weather conditions, operating procedures, runways and approaches in use, and various other information which may affect the departure, approach and landing phases of flight.

The recorded ATIS message is updated upon the issuance of a new weather observation, or when conditions or procedures affecting various components of the ATIS message change substantially.

Individual ATIS messages are identified by a designator from the ICAO alphabet, Alpha through Zulu, on a cyclical basis.

In many countries, it is an operational requirement that Aircrew obtain ATIS information prior to contacting the associated ATS facility, and confirm having obtained the current ATIS by repeating the ATIS designator to the Controller on first contact.

Meteorological Aerodrome Report (METAR)

Reports of meteorological conditions at aerodromes are officially recorded and communicated each hour, on the hour, as specified in applicable ICAO/WMO publications (and supplemented by member states as necessary). Intermediate (special) observations are also recorded and communicated when the meteorological conditions change sufficiently to effect aviation operations as defined by specific meteorological threshold criteria.

These meteorological aerodrome reports are encoded in the METAR code format and are made available to all Controlling ATS Units (ATSU), and to all other aviation weather users (private and government) via local and international telecommunications networks.

Individual METAR reports are identified by the specific aerodrome ICAO designation and the appropriate date and zulu time.

METAR reports are received by the Aircrew by requesting and receiving voice transmissions from air traffic Controllers (or flight service specialists where available). At some aerodromes, continuous VHF voice broadcasts of automated weather observations are available (VOLMET). Also, most airline operators provide access to METAR reports through their flight dispatch support either through voice communications and/or ACARS data link service.

Operational Flight Information Service (OFIS)

OFIS is not currently available in the form described below. OFIS information will be derived from the current NOTAM/SNOWTAM information.

OFIS information are originated and issued promptly whenever information of direct operational significance to the approach and landing phases.

Currently NOTAM information is available to the Aircrew on the ground prior to departure. This information usually includes a list of all the active NOTAMs for the departure, destination, alternate and some en route airfields as well as the FIR NOTAMs relevant to the flight. The updates are not normally available in the in-flight phase. It is sometimes partly available

through R/T by the airline ground operations, ATC cannot normally provide NOTAM information to Aircrew during flight. Besides, NOTAM information is sometime so numerous and exhaustive that it becomes difficult to exploit for a rapid decision in flight.

When preparing for approach and landing, the Aircrew needs essentially to correlate the current meteorological and operational status of the airfield with both aircraft and Aircrew operational limitations and landing minima. The degradation of approach navaids and/or airport infrastructure, mentioned in NOTAM, may result in the application of approach minima higher than the published minima available to the Aircrew on the approach plates. The same process applies to landing performance compared to both runway surface conditions and available runway length.

When facing the need to divert en route on an airfield for which no information is currently available on board, it is difficult for the Aircrew to fully assess the situation and to take appropriate decisions concerning the conduct of the flight.

D-OTIS

The Data Link Operational Terminal Information Service (D-OTIS) is intended to provide maximum flexibility both at the implementation stage and at the operation and maintenance stage. By combining meteorological and operational data in the same message, it will allow Aircrew direct access to all the relevant parameters affecting the most critical phases of flight (i.e. departure, approach and landing).

Meteorological data are contained in the ATIS and METAR reports. Where both are available, ATIS shall be the default message for uplink. METAR reports will be sent as a replacement of ATIS, resulting from unavailability of the latter. Three versions of ATIS may exist for request, namely departure, arrival or combined.

Note: The combined ATIS contains both arrival and departure information.

Essential operational data for Aircrew decision making and subsequent aircraft performance are partially contained in the ATIS report, hence its precedence over METAR. Other essential data, such as higher approach minima, available runway length and navaids serviceability status are usually issued in the NOTAM/SNOWTAM form.

The OFIS (Operational Flight Information Service) element of the D-OTIS service is intended to gather and select just the relevant data (i.e. approach minima, reduced runway length and navaids operating status) from all issued NOTAMs. Where available, the OFIS, including SNOWTAMs will be attached to all ATIS and METAR requests and/or broadcasts.

The Aircrew shall be able to specify in the D-OTIS Request:

- the ATSU from which the information is requested;
- the type of information requested. The following table lists the possible types of requests and the information delivered in response.

D-OTIS Request	D-OTIS Information to be delivered
Departure OTIS	Departure ATIS and OFIS reports. If the ATIS is not available it shall be replaced by a METAR report.
Arrival OTIS	Arrival ATIS and OFIS reports. If the ATIS is not available it shall be replaced by a METAR report.
Combined OTIS	Combined ATIS and OFIS reports. If the ATIS is not available it shall be replaced by a METAR report.

Departure ATIS	Departure ATIS. If the ATIS is not available it shall be replaced by a METAR report.
Arrival ATIS	Arrival ATIS. If the ATIS is not available it shall be replaced by a METAR report.
Combined ATIS	Combined ATIS. If the ATIS is not available it shall be replaced by a METAR report.
METAR	METAR report.
OFIS	OFIS report.

4. Overview of Operating Methods with and without Data Link

Two different operating methods can be envisaged for the D-OTIS service:

1. The OTIS information is provided as a continuous data broadcast service, or
2. The OTIS information is provided to the Aircrew on request.

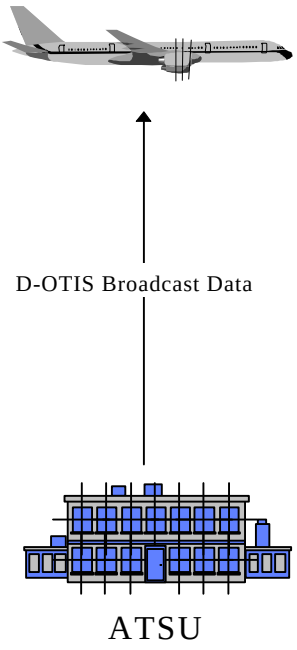
The two operating methods are described below.

The availability of the broadcast and/or request OTIS service for an airport shall be indicated in the relevant AIP's and in the published instrument arrival, approach and departure procedures used on board.

4.1. Broadcast D-OTIS

Step	Operating Method without Data Link	Operating Method with Data Link
1	Aircrew obtains the relevant METAR and NOTAMs on the ground prior to departure and the updates are not normally available in the in-flight phase. If available, the Aircrew selects the published VHF frequency for a particular ATIS broadcast..	Aircrew performs a D-OTIS Request (ORQ), including an “Update Contract” when required.
2	For ATIS, the Aircrew listens to the recorded message until all pertinent information is understood. The Aircrew writes down the information received.	The avionics data link system collects all requested data elements from the broadcast information and composes a D-OTIS Delivery Message (OTD) that is delivered to the Aircrew.
3	Updates can only be obtained by subsequently monitoring the ATIS broadcasts, or by notification from ATC.	a) The avionics data link system shall continuously monitor the broadcast information in order to notify the Aircrew of subsequent updates to the OTIS information when an “Update Contract” has been requested. b) Contract termination can be requested by the Aircrew at any moment by triggering a D- OTIS Termination Request (OTT).

4.1.1. Information Exchange Diagram

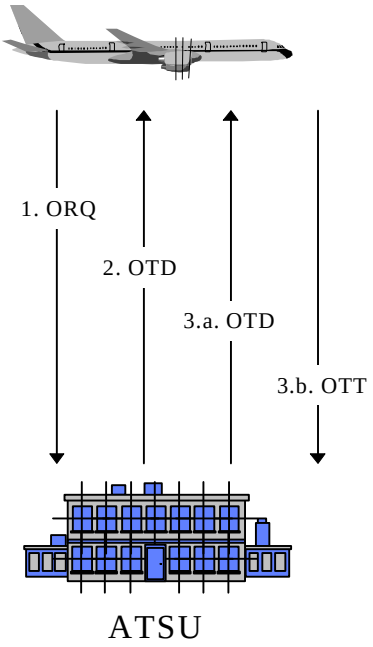


NOTE: The broadcast operating method is not supported in the “ICAO Manual of Air Traffic Services (ATS) Data Link Applications”.

4.2. On-Request D-OTIS

Step	Operating Method without Data Link	Operating Method with Data Link
1	Aircrew obtains the relevant METAR and NOTAMs on the ground prior to departure and the updates are not normally available in the in-flight phase. If available, the Aircrew selects the published VHF frequency for a particular ATIS broadcast..	Aircrew transmits a D-OTIS Request (ORQ) to the appropriate ATSU, including an “Update Contract” when required.
2	For ATIS, the Aircrew listens to the recorded message until all pertinent information is understood. The Aircrew writes down the information received.	The ATSU composes and delivers a D-OTIS Delivery Message (OTD) to the aircraft. The D-OTIS Delivery Message (OTD) is delivered to the Aircrew.
3	Updates can only be obtained by subsequently monitoring the ATIS broadcasts, or by notification from ATC.	a) The ATSU shall transmit subsequent updates of the OTIS information to the aircraft when an “Update Contract” has been requested. b) Contract termination can be requested by the Aircrew at any moment by transmitting a D- OTIS Termination Request (OTT) to the ATSU.

4.2.1. Information Exchange Diagram



5. Detailed Service Operating Method with Data Link

5.1. Service Availability

This Service shall be available during all flight phases, either as a broadcast or as a specific request and delivery message, depending on availability, and for the broadcast version, on the actual position of the aircraft (within or out of range).

5.2. Service Description

5.2.1. Normal Mode

The normal sequence of events is:

Step	Operation
1	The Aircrew shall compose a D-OTIS Request (ORQ). The ORQ shall be transmitted to the appropriate ATSU when the D-OTIS service is provided on request. Otherwise, for broadcast D-OTIS, the avionics shall accept the request and monitor the broadcast data in order to collect the requested information. The Aircrew shall be able to specify in the ORQ: • the ATSU from which the information is requested; • the type of information requested (i.e. Departure OTIS, Arrival OTIS, Combined OTIS, Departure ATIS, Arrival ATIS, Combined ATIS, METAR or OFIS); • the request mode (demand or update contract mode); • the duration of the update contract when updates are requested. *NOTE : The term "Update Contract" refers to the capability for an aircraft to automatically receive updates to a previously received OTIS information.* Aircrew shall have the capability to request multiple D-OTIS update contracts.
2	For on request D-OTIS : If the D-OTIS Request (ORQ) is valid, the ATSU shall transmit a D-OTIS Delivery (OTD) message to the aircraft. Otherwise, a Response ("Unable" or a "Standby") message shall be transmitted to the aircraft and notified to the Aircrew. An "Unable" response message indicates that the requested OTIS data is not available, or that the D-OTIS Request (ORQ) is not valid. The reason of the error shall be contained in the "Unable" response message. *Note: When both broadcast and on request modes of operation are supported, the avionics may automatically use broadcast mode of operation after failure of the on request mode. The Aircrew shall be informed of the mode selected by the avionics.* A "Stand-by" response message indicates that the requested OTIS information is available and being processed for delivery before the expiration of the operational response time [to = 1 minute] or before expiration of the standby time contained in the "Standby" message. After the "Standby" response, the ATSU shall transmit a second message containing either a D-OTIS Delivery (OTD) or an "Unable" response within the operational response time [to] or as stated in the Standby Response message. The Aircrew shall be notified of the received: a) D-OTIS Delivery (OTD), b) "Standby" response, and/or

	c) "Unable" response. If the "Update Contract" was not requested, the service shall end on notification of the OTD or the "Unable" response to the Aircrew. For broadcast D-OTIS : If the D-OTIS Request (ORQ) is valid and the broadcast information is available, the Aircrew shall be informed that the D-OTIS Delivery (OTD) message is being composed. Otherwise, the Aircrew shall be informed of the error in the ORQ or the non-availability of the broadcast information, as described in the Abnormal Mode section below. *Note: When both broadcast and on request modes of operation are supported, the avionics may automatically use the on request mode of operation after failure of the broadcast mode. The Aircrew shall be informed of the mode selected by the avionics.* The Aircrew shall be notified of the D-OTIS Delivery (OTD) message once composed. If the "Update Contract" was not requested, the service shall end on notification of the OTD or the non-availability of the broadcast information to the Aircrew. The OTD message will contain the requested information according to the rules specified in subsection 3. The ODT message will indicate when one or more of the requested message components are unavailable.
3	If an "Update Contract" has been requested, the Aircrew shall receive the latest D-OTIS information (if available) and any subsequent updates to the D-OTIS information until termination of the contract. Since ATIS, METAR and OFIS information may change independently, the subsequent update messages may contain only the updated information with the indication that the other parts of the message have not been modified. For on request D-OTIS the "Update Contract" shall be terminated upon: 1. Manual transmission of a D-OTIS Termination (OTT) message by the ATSU or by the Aircrew; 2. ATSU termination of the contract, after [1 hour] of service, as specified in the D-OTIS Request (ORQ) or on landing detection. This termination shall be notified to the aircraft via a D-OTIS Termination (OTT) message. *Note: For a departure D-OTIS, when the flight status is "airborne" the update contract may be automatically changed to an arrival D-OTIS contract, in case the aircraft needs to return to the departure airport. Automatic termination should then not occur before prior warning/notification is sent to the Aircrew. The warning could come around 15 minutes after take off.* For broadcast D-OTIS the "Update Contract" shall be terminated upon: 1. Manual composition of a D-OTIS Termination (OTT) by the Aircrew. 2. Expiration of the contract duration specified in the D-OTIS Request (ORQ). This termination shall be notified to the Aircrew. 3. Detection of out of range conditions. This termination shall be notified to the Aircrew.

5.2.1.1. Sequence of Services

This Service may be invoked independently of any other Service.

5.2.1.2. Additional Guidelines

The Aircrew should be able to specify the default D-OTIS mode of operation (i.e. broadcast or on request). The default mode shall always be automatically selected when it is available.

When both broadcast and on request modes of operation are supported the contents of broadcast and on request reports shall be identical and updated simultaneously

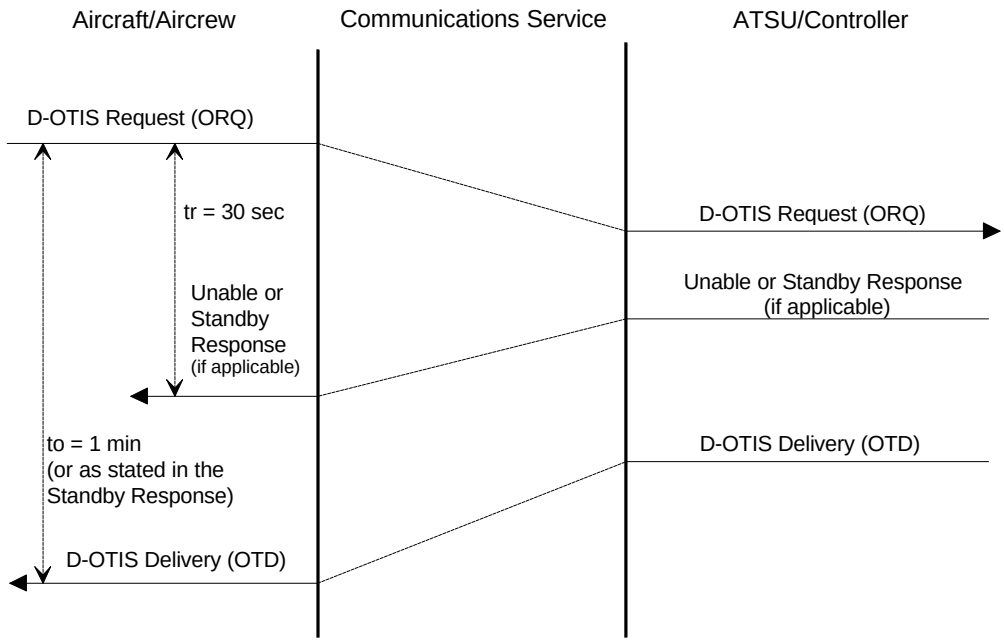
5.2.2. Abnormal Mode

Step	Abnormal Event	Response
1	Incorrect ORQ composed by the Aircrew due to: 1. ORQ already requested for that Airport pending reception of the OTD.	Aircrew informed of the error. Message not sent.
1	Aircrew request of a broadcast D-OTIS when broadcast information is not available.	Aircrew informed of the error.
2	Reception of an ORQ at the ATSU containing a time stamp that indicates that no response can reach the originator before the established technical response time-out.	The received message shall be discarded.
2	Invalid ORQ received by an ATSU due to: 1. unknown OTIS indicator; 2. the ORQ can not be processed further for whatever reason.	The message shall be discarded and an "Unable" response message shall be sent to the aircraft indicating the cause of the error.
2	Reception of an ORQ at the ATSU requesting an update contract that is not supported by the ATSU.	The ATSU shall transmit a OTD to the aircraft (possibly after an "Standby" response) containing: • the requested information, • the indication that the update contract is not supported.
2	Expiration of the technical response time-out [tr = 30 seconds] without reception of a response to the ORQ.	The Aircrew shall be notified. This error shall not preclude the Aircrew from re-sending the D-OTIS Request (ORQ) via data link.
2	Expiration of the operational response time-out [to = 1 minute, or as stated in the "Standby" Response], without reception of the OTD or an "Unable" response.	The Aircrew shall be notified. This error shall not preclude the Aircrew from re-sending the D-OTIS Request (ORQ) via data link.
2	Expiration of the operational response time-out [to = 1 minute], without successful completion of the composition of a broadcast D-OTIS.	The Aircrew shall be notified. This error shall not preclude the Aircrew from re-composing the broadcast D-OTIS Request (ORQ).
2	Doubt or ambiguity concerning the OTD.	The Aircrew shall refer to the voice ATIS broadcast or establish voice contact with the C-ATSU Controller, as appropriate.
3	Unexpected discontinuation of D-OTIS updates during a contract.	The Aircrew shall be notified when possible via a D-OTIS Termination (OTT) message.

6. Time Sequence Diagram

This diagram shows the normal sequence of messages in the on request D-OTIS service.

<NOTE: The time-out values given in the following table and text are indicative only and require validation through actual operations.>



For the broadcast D-OTIS service, the maximum time allowed from the composition of the ORQ to the notification of the OTD to the Aircrew shall be [to = 1 minute].

7. Quality Of Service Requirements

Message Category: The D-OTIS messages are Category 4 messages.

Communications Priority: 7.

Information Urgency: Normal.

Information Security:

Data Origin Authentication: Normal

Access Control: M, A

Data Integrity: Maximum

8. Information Exchanges

8.1. D-OTIS Request (ORQ)

Message contents complies with ICAO Annex 15. The meteorological terminology shall comply with the current ICAO abbreviations and codes (Doc 8400/4)

Message	Message Contents	M	I/A	O	Example Ops Msg Contents	Event/ Trigger	Source/ Dest.	Alert	Response	Op. Reply
D-OTIS Request (ORQ)	Message Type	X			ORQ	Flight crew input	Aircraft/ATSU	**N**	Unable or Standby if necessary	D-OFIS Delivery Message (NOI)
	MessageIdent	X			00456					
	ICAOUnitName (ATSU)	X			EGRB					
	FlightID	X			DLH340					
	AirportID	X			EGLL					
	Type-of-Request (valid entries are Departure OTIS, Arrival OTIS, Combined OTIS, Departure ATIS, Arrival ATIS, Combined ATIS, METAR, OFIS)		X		Arrival OTIS					
	Contract required		X		Yes					
	Contract duration		X		30					
					MESSAGE IN FULL					
					ORQ 00456 EGRB DLH340 REQUEST ARRIVAL OTIS FOR EGLL UPDATES FOR 30 MINUTES					

8.2. D-OTIS Delivery Message (OTD)

The sending a D-OTIS request, the Aircrew can request a full D-OTIS report containing: ATIS (arrival, departure or combined, following availability and request) and OFIS information for the requested aerodrome. Only when ATIS should not be available, METAR shall be sent instead, together with the OFIS. Individual ATIS, METAR and OFIS request can be requested by the Aircrew, following their needs and/or preferences.

Message	Message Contents	M	I/A	O	Example Ops Msg Contents	Event/ Trigger	Source/ Dest.	Alert	Response	Op. Reply
D-OTIS Delivery (OTD-ATIS)	MessageType	X			OTD-ATIS	Receipt of a valid D-ATIS Request (ATR) or, in the case of an update contract, a new ATIS version.	ATSU/aircraft	**V**	N	None
	FlightID	X			DLH340					
	AirportID	X			LFBO					
	Arrival/DepartureIndicator	X			A					
	Contract type	X			C					
	ATIScode	X			P					
	ATISIssueTime	X			1400Z					
	ApproachType+	X			ILS					
	RunwaysInUse	X			15R					
	RunwaySurfaceConditions	X			WET					
	BrakingAction		X		MEDIUM					
	HoldingDelay+		X							
	TransitionLevel+		X		35					
	OtherOperationalInfo		X		BirdActivity					
	SurfaceWind▫	X			20010KT					
	Visibility▫	X			0800					
	RVR▫		X							
	PresentWeather+▫	X			+SNSH					
	CloudSkyCoverGroup▫	X			BKN025					
	AirTemperature▫	X			M04					
	DewPointTemperature▫	X			MO5					
	AltimeterSetting	X			1002					
	Significant Met Phenomena		X		Turbulence					
	(e.g. warnings, temperature inversions)									
	TrendTypeLandingForecast+▫		X							
	SpecificATISInstructions		X							
	Freetext			X						
	Status of Arresting System		X							
	▫ *relevant guidance material is given in ICAO Annex 3*				MESSAGE IN FULL					
	• *not applicable to arrival ATIS*				**OTD -ATIS DLH340 LFBO A UPDATES CONTRACT ATIS P 1400Z**					
	+ not applicable to departure ATIS				**ILS 15R WET MEDIUM TRL 35 BIRD ACTIVITY GLIDE PATH ILS 15R U/S 20010KT 0800 +SNSH BKN025 M04/M05 Q1002 TURBULENCE**					

The message contents shall be defined and agreed on an international basis and comply with existing standards when available.

Message	Message Contents	M	I/A	O	Example Ops Msg Contents	Event/ Trigger	Source/ Dest.	Alert	Response	Op. Reply
D-OTIS Delivery Message (OTD-OFIS)	Message type	X			OTD-OFIS		ATSU/aircraft			
	Date and Time of Issue	X						**V**	N	None
	Originator's Indicator	X								
	OFIS Numbering (N/R/C+number/year)	X			A0923/96 OFISN					
	AirportID	X			EDDH					
	Date/Time of Report	X			031405Z					
	Airport Availability Report	X								
	RunwayAvailibilty Report	X			RWY15/33 CLOSED					
	Validity Period	X			1800					
	Degraded Runway Designator	X			RWY23					
	Validity Period	X								
	Infrasctructure Report	X			ILS CAT1 ONLY ALS U/S WIP					
	Revised Minima	X			A 246FT 1000M B 256FT 1000M C 266FT 1000M D 276FT 1000M					
	Reduced Runway Length	X			LDA2300M					
	Reduced Runway Width		X							
	Runway Surface Condition	X			WET					
	Braking Action	X			MEDIUM					
	Freetext			X	Good luck					
					MESSAGE IN FULL **OTD-OFIS A0923/96 OFISN** **EDDH 031405Z** **RWY 15/33 CLOSED 1800** **RWY 23 ILS CAT1 ONLY ALS U/S WIP** A 246FT 1000M; B 256FT 1000M C 266FT 1000M; D 276FT 1000M **LDA 2300M** WET / MEDIUM **GOOD LUCK**					

Message	Message Contents	M	I/A	O	Example Ops Msg Contents	Event/ Trigger	Source/ Dest.	Alert	Response	Op. Reply
D-OTIS Delivery Message, (OTD-SNOWTAM Attachment)	Message type	X			OTD		ATSU/aircraft			
	SNOWTAM Numbering	X			SWLS0149			**V**	N	None
	AirportID	X			LSZH					
	Date/TimeofObservation (8-figure group)	X			09120620					
	RunwayDesignators	X			02					
	Cleared Runway Length		X							
	Cleared Runway Width		X							
	Deposits over Total Runway Length (1-9)	X			4					
	Mean Depth (mm) for each Third of Rwy	X			XX					
	Friction Measurements on each Third of Rwy and Measuring Device	X			3-RFT					
	Critical Snowbanks		X							
	Runway Lights Obscuration		X							
	Further Clearance		X							
	Time of Completion		X							
	Taxiway	X			4					
	Taxiway Snowbanks		X							
	Apron Conditions		X		4					
	Time of Next Observation	X			09120920					
	Plain Language Remarks (Freetext)		X		MESSAGE IN FULL **OTD SWLS0149 LSZH 09120620 RWY 02 DRY SNOW DEPTH NOT MEASURABLE MEDIUM FRICTION RWY FRICTION TESTER TAXIWAY DRY SNOW NEXT OBSERVATION PLANNED FOR 0920**					

Message	Message Contents	M	I/A	O	Example Ops Msg Contents	Event/ Trigger	Source/ Dest.	Alert	Response	Op. Reply
D-OTIS Delivery Message (OTD-METAR)	Message type	X			OTD-METAR	Receipt of a valid D-METAR Request (MTR) or, in the case of an update contract, a new METAR version.	ATSU/aircraft	**V**	N	None
	AirportID	X			EBBR					
	Time of Observation	X			1630Z					
	Departure or arrival indicator		X		A					
	WindDirectionSpeedWindVariations	X			240/15-20					
	Visibility	X			2000					
	RVR		X		RWY25/1000M					
	Present Weather	X			FG DZ					
	Cloud Sky and Cover	X			SCT 030M OVC 060M					
	Air Temperature/DewPoint Temperature	X			17/16					
	PressureValues	X			QNH 1018					
	Supplementary Information		X		WIND SHEAR IN CLIMB-OUT					
	(e.g. warnings, temperature inversions)									
	Trend type landing Forecast		X							
	Freetext		X							
	METAR Report Type	X								
					MESSAGE IN FULL					
					OTD-METAR EBBR 1630Z A 240/15-25 2000 RWY25/ 1000M FG DZ SCT 030 OVC 060 17/16 Q1018 WIND SHEAR IN CLIMB-OUT					

8.3. D-OTIS Termination Message (OTT)

Message	Message Contents	M	I/A	O	Example Ops Msg Contents	Event/ Trigger	Source/ Dest.	Alert	Response	Op. Reply
D-OTIS Termination (OTT)	MessageType MessageIdent FlightID ICAOUnitName (ATSU) AirportID ContractTerminate Freetext	O O O O X O	 O		OTT 00071 DLH340 LFBO LFBO T MESSAGE IN FULL **OTT 00071 DLH340 LFBO LFBO ARRIVAL OTIS UPDATES NO LONGER BEING DELIVERED**	Aircraft or ATSU termination	Aircraft/ ATSU or ATSU/Aircraft	**Pilot: V** **ATSU: none**	N	None

8.4. D-OFIS Message Contents Proposed Codification

The contents and format of message elements shall be defined and agreed on an international basis and comply with existing standards when available.

Validity Period (4 characters) (Time of the end of validity of the NOTAM)

Airport Availability Report (only in case of airport closure) (e.g. Airport= AIRPORT CLOSED)

Runway Availability Report (only in case of runway closure) (Runway = RWY QFU Designator(s) = as stated in NOTAM)

Degraded Runway Report: (only in case of degradation advised by NOTAM)

Degraded Runway Designator (Runway = RWY QFU Designator(s) = as stated in NOTAM)

Infrastructure Report (NAVAIDS degradation , Infrastructure degradation and reasons as stated in NOTAM with regards to the designated runway)

Revised Minima (Lowest Revised Minima as published in NOTAM for all aircraft categories)

Reduced Runway Length (Landing Distance Available as published in NOTAM = LDA , in feet =FT, in meters= M)

Reduced Runway Width (Runway Width Available as published in NOTAM = RWA, in feet =FT, in meters= M)

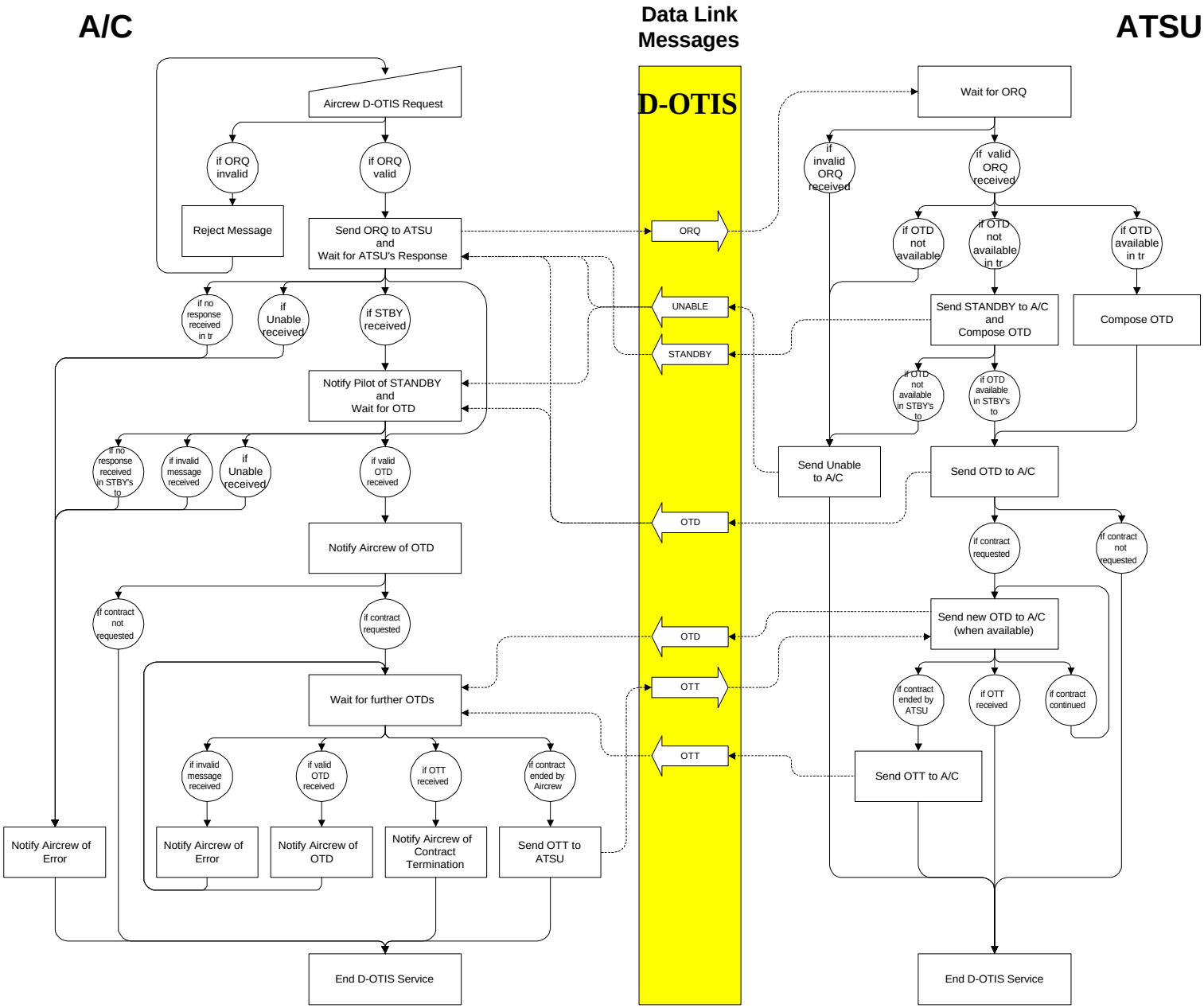
Runway Surface Condition (only in Wet = WET or Contamined = CONTA)

Braking Action (Braking Action= BA, only if MEDIUM or POOR)

If available, the full SNOWTAM report as defined above shall be attached automatically to the D-OTIS OTD.

9. Event Sequence Diagram

The diagram in this chapter provides an overview of the main normal and abnormal sequences of events within the D-RVR service for the on request operating mode.


A/C
Data Link Messages
ATSU
D-OTIS
Aircrew D-OTIS Request
if ORQ invalid
if ORQ valid
Reject Message
Send ORQ to ATSU and Wait for ATSU's Response
if no response received in tr
if Unable received
if STBY received
Notify Pilot of STANDBY and Wait for OTD
if no response received in STBY's to
if invalid message received
if Unable received
if valid OTD received
Notify Aircrew of OTD
if contract not requested
if contract requested
Wait for further OTDs
if invalid message received
if valid OTD received
if OTT received
if contract ended by Aircrew
Notify Aircrew of Error
Notify Aircrew of Error
Notify Aircrew of OTD
Notify Aircrew of Contract Termination
Send OTT to ATSU
End D-OTIS Service
ORQ
UNABLE
STANDBY
OTD
OTD
OTT
OTT
Wait for ORQ
if invalid ORQ received
if valid ORQ received
if OTD not available
if OTD not available in tr
if OTD available in tr
Send STANDBY to A/C and Compose OTD
Compose OTD
if OTD not available in STBY's to
if OTD available in STBY's to
Send Unable to A/C
Send OTD to A/C
if contract requested
if contract not requested
Send new OTD to A/C (when available)
if contract ended by ATSU
if OTT received
if contract continued
Send OTT to A/C
End D-OTIS Service

Section 13 : Data Link Runway Visual Range (D-RVR)

Service No.	Name	Abb.	Cat	References	Version No.
O-9	Data Link Runway Visual Range	D-RVR	F	"ICAO Manual of Air Traffic Services (ATS) Data Link Applications"	2.0 16/5/97

Table of Contents

1. Scope and Objective

The D-RVR service provides automated assistance in requesting and delivering the Instantaneous RVR.

2. Expected Benefits, Anticipated Constraints, and Associated Human Factors

2.1. Expected Benefits

- ⇨ Reduced air traffic Controller workload: data link implementation will reduce need for Controller response to pilot voice requests for instantaneous RVR;
- ⇨ Reduced ambiguity in the transmitted information: data link implementation eliminates potential misinterpretation resulting from poor voice transmission quality;
- ⇨ Potential increased accessibility to RVR information: Aircrew will be able to request RVR information from any specified site available within the accessible data base;
- ⇨ The "Update Contract" functionality (that allows Aircrew to request subsequent updates to the requested information) will provide Aircrew with the latest information of concern at all moments.
- ⇨ Potential reduction in congestion on voice channels: data link implementation will reduce voice requests and responses for relay of RVR reports.
- ⇨ Fast access to RVR reports for selected aerodromes (e.g. no need to listen to RVR reports for other aerodromes in the VOLMET broadcast).
- ⇨ Improved flight safety during flight phase by providing Aircrew with data otherwise unavailable.
- ⇨ Improved flight economy by helping Aircrew to take appropriate decisions concerning the conduct of the flight.

2.2. Expected Constraints

- ⇨ Ground systems must maintain RVR data bases with accurate and up to date data.

2.3. Associated Human Factors

- ⇨ Disruption of Aircrew activities shall be prevented by appropriate avionics display and sound devices.
- ⇨ Consideration must be given to the method and content of the D-RVR message display (using text and/or symbology), to ensure that it is uncomplicated, unambiguous, and easily understood by the Aircrew.

3. Service Operational Context

Currently Aircrew are provided with RVR information by the Controller based on a read out of RVR sensors, or on a broadcast frequency. Pilots are normally prohibited to commence an instrument approach procedure if the RVR is below the published minima. In case of a CAT III final approach, pilots must execute a missed approach procedure if the RVR descends below minima; crew need not abandon approach for CAT I and II, however depending on procedures and circumstances it is likely that approach may have to be abandoned.

Data link will enable the provision of accurate and instantaneous RVR readouts to Aircrew under one of the most critical flight conditions thus contributing to a improve flight safety and economy.

4. Overview of Operating Methods with and without Data Link

Two different operating methods can be envisaged for the D-RVR service:

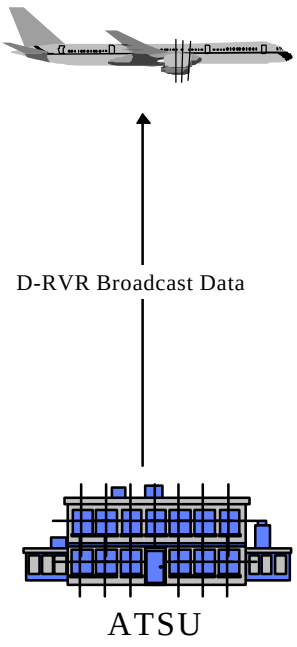
1. The RVR information is provided as a continuous data broadcast service, or
2. The RVR information is provided to the Aircrew on request.

The two operating methods are described below.

4.1. Broadcast D-RVR

Step	Operating Method without Data Link	Operating Method with Data Link
1	Aircrew selects the published VHF frequency for a particular IRVR broadcast or requests it via voice communications from the C-ATSU Controller.	Aircrew performs a D-RVR Request (RTR), including an "Update Contract" when required.
2	The Aircrew listens to the broadcast message until all pertinent information is understood or receives it from the C-ATSU Controller.	The avionics data link system collects the requested data elements from the broadcast data and composes a D-RVR Delivery Message (RTI) that is provided to the Aircrew.
3	Updates can only be obtained by subsequently monitoring the IRVR broadcasts, or by notification from ATC.	a) The avionics data link system shall continuously monitor the broadcast information in order to notify the Aircrew of subsequent updates to the RVR information when an "Update Contract" has been requested. b) Contract termination can be requested by the Aircrew at any moment by triggering a D-RVR Termination (RTT).

4.1.1. Information Exchange Diagram

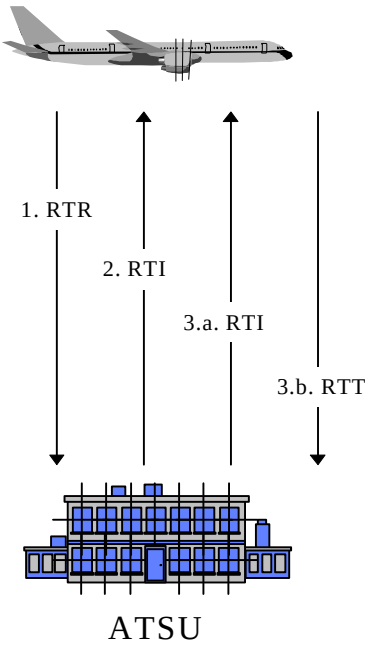


NOTE: The broadcast operating method is not supported in the "ICAO Manual of Air Traffic Services (ATS) Data Link Applications".

4.2. On-Request D-RVR

Step	Operating Method without Data Link	Operating Method with Data Link
1	Aircrew selects the published VHF frequency for a particular IRVR broadcast or requests it via voice communications from the C-ATSU Controller.	Aircrew transmits via Data link a D-RVR Request (RTR), including an "Update Contract" when required.
2	The Aircrew listens to the broadcast message until all pertinent information is understood or receives it from the C-ATSU Controller.	The ATSU transmits via Data link a D-RVR Delivery Message (RTI) to the aircraft. The RTI shall be displayed/printed onboard and the Aircrew read it.
3	Updates can only be obtained by subsequently monitoring the IRVR broadcasts, or by notification from ATC.	a) Subsequent updates to the RVR information shall be sent to the aircraft, if an "Update Contract" has been requested. b) Contract termination can be requested by the Aircrew at any moment by sending a D-RVR Termination Message (RTT).

4.3. Information Exchange Diagram



5. Detailed Service Operating Method with Data Link

5.1. Service Availability

This Service shall be available during all flight phases.

5.2. Service Description

5.2.1. Normal Mode

The normal sequence of events is:

Step	Operation
1	The Aircrew shall compose a D-RVR Request (RTR). The RTR shall be transmitted to the appropriate ATSU when the D-RVR service is provided on request. Otherwise, for broadcast D-RVR, the avionics shall accept the request and monitor the broadcast data in order to collect the requested information. The Aircrew shall be able to specify in the RTR: • the Airport from which the information is requested, and • the request mode (demand or update contract mode). • the duration of the update contract when updates are requested. *NOTE : The term "Update Contract" refers to the capability for an aircraft to automatically receive updates to a previously received RVR.* An aircraft with a D-RVR contract shall not be precluded from sending a D-RVR Request (RTR) for an Airport not nominated in the current contract. Aircrew shall have the capability to request D-RVR information for more than one Airport, including multiple update contracts.
2	For on request D-RVR: If the D-RVR Request (RTR) is valid, the ATSU shall transmit a D-RVR Delivery (RTI) message to the aircraft. Otherwise, a Response ("Unable" or a "Standby") message shall be transmitted to the aircraft and notified to the Aircrew. An "Unable" response message indicates that the requested RVR data is not available, or that the D-RVR Request (RTR) is not valid. The reason of the error shall be contained in the "Unable" response message. A "Stand-by" response message indicates that the requested RVR information is available and being processed for delivery before the expiration of the operational response time [to = 1 minute] or before expiration of the standby time contained in the "Standby" message. After the "Standby" response, the ATSU shall transmit a second message containing either a D-RVR Delivery (RTI) or an "Unable" response within the operational response time [to] or as stated in the Standby Response message. The Aircrew shall be notified of the received: a) D-RVR Delivery (RTI), b) "Standby" response, and/or c) "Unable" response. If an "Update Contract" was not requested, the service shall end on reception of the RTI or the "Unable" response.

	For broadcast D-RVR : If the D-RVR Request (RTR) is valid and the broadcast information is available, the Aircrew shall be informed that the D-RVR Delivery (RTI) message is being composed. Otherwise, the Aircrew shall be informed of the error in the RTR or the non-availability of the broadcast information as described in the Abnormal Mode section below. The Aircrew shall be notified of the D-RVR Delivery (RTI) message once composed. If the "Update Contract" was not requested, the service shall end on notification of the RTI or the non-availability of the broadcast information to the Aircrew. *NOTE: If voice RVR broadcasts are also provided, the contents of voice and data RVR shall be identical and updated simultaneously.*
3	If an "Update Contract" has been requested, the Aircrew shall receive the latest D-RVR information (if available) and any subsequent updates to the D-RVR information until termination of the contract. For on request D-RVR the "Update Contract" shall be terminated upon: 1. Manual transmission of a D-RVR Termination (RTT) message by the ATSU or by the Aircrew; 2. ATSU termination of the contract, after [1 hour] of service, as specified in the D-RVR Request (RTR), on final approach, or on landing detection. This termination shall be notified to the aircraft via a D-RVR Termination (RTT) message. For broadcast D-OTIS the "Update Contract" shall be terminated upon: 1. Manual composition of a D-RVR Termination (RTT) by the Aircrew. 2. Expiration of the contract duration specified in the D-RVR Request (RTR). This termination shall be notified to the Aircrew.

5.2.1.1. Sequence of Services

This Service shall be independent from of any other Service.

5.2.1.2. Additional Guidelines

If both broadcast and on request D-RVR are available, the Aircrew shall be able to select the preferred operating mode.

5.2.2. Abnormal Mode

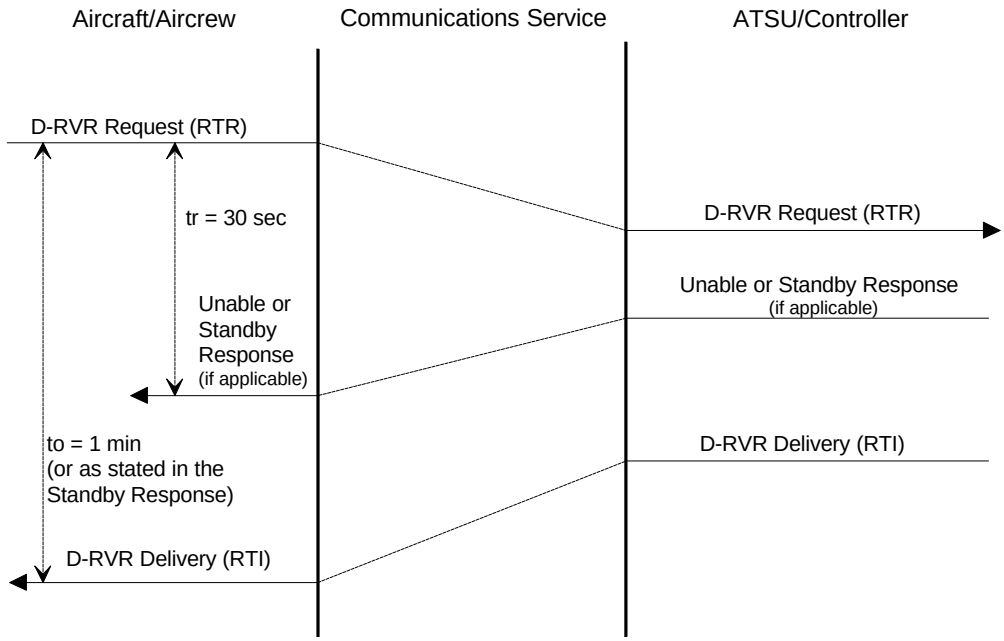
Step	Abnormal Event	Response
1	Incorrect RTR composed by the Aircrew due to: 1. RTR already requested for that Airport pending reception of the RTI.	Aircrew informed of the error. Message not sent.
1	Aircrew request of a broadcast D-RVR when broadcast information is not available.	Aircrew informed of the error.

Step	Abnormal Event	Response
2	Reception of a RTR at the ATSU containing a time stamp that indicates that no response can reach the originator before the established technical response time-out.	The received message shall be discarded.
2	Invalid RTR received by an ATSU due to: 1. unknown Airport location indicator; 2. the RTR can not be processed further for whatever reason.	The message shall be discarded and an "Unable" response message shall be sent to the aircraft indicating the cause of the error.
2	Reception of a RTR at the ATSU requesting an update contract that is not supported by the ATSU.	The ATSU shall transmit a RTI to the aircraft (possibly after an "Standby" response) containing: • the requested information, • the indication that the update contract is not supported.
2	Expiration of the technical response time-out [tr = 30 seconds] without reception of a response to the RTR.	The Aircrew shall be notified. This error shall not preclude the Aircrew from re-sending the D-RVR Request (RTR) via data link.
2	Expiration of the operational response time-out [to = 1 minute, or as stated in the "Standby" Response], without reception of the RTI or an "Unable" response.	The Aircrew shall be notified. This error shall not preclude the Aircrew from re-sending the D-RVR Request (RTR) via data link.
2	Doubt or ambiguity concerning the RTI.	The Aircrew shall establish voice contact with the C-ATSU Controller.
3	Unexpected discontinuation of D-RVR updates during a contract.	The Aircrew shall be notified when possible via a D-RVR Termination (RTT) message.

6. Time Sequence Diagram

This diagram shows the normal sequence of messages in the on request D-RVR service.

<NOTE: The time-out values given in the following table and text are indicative only and require validation through actual operations.>



For the broadcast D-RVR service, the maximum time allowed from the composition of the RTR to the notification of the RTI to the Aircrew shall be [to = 1 minute].

7. Quality Of Service Requirements

Message Category: The D-RVR messages are Category 4 messages.

Communications Priority: 7.

Information Urgency: Normal.

Information Security:

Data Origin Authentication: Normal

Access Control: M, A

Data Integrity: Maximum

8. Information Exchanges

8.1. D-RVR Request (RTR)

Message contents complies with ICAO document 8896 - AN/893/4 (Manual of Aeronautical Meteorological Practice)

Message	Message Contents	M	I/A	O	Example Ops Msg Contents	Event/ Trigger	Source/ Dest.	Alert	Response	Op. Reply
D-RVR Request (RTR)	Message Type MessageIdent ICAOUnitName (ATSU) FlightID AirportID Contract required Contract duration	X X X X X	 X X		RTR 0123 EBWM DLH340 EBBR Yes 30 MESSAGE IN FULL **RTR 0123 EBWM DLH340 REQUEST RVR FOR EBBR UPDATES FOR 30 MN**	Aircrew input	Aircraft/ATSU	**N**	Unable or Standby if necessary	D-RVR Delivery Message (RTI)

8.2. D-RVR Delivery Message (RTI)

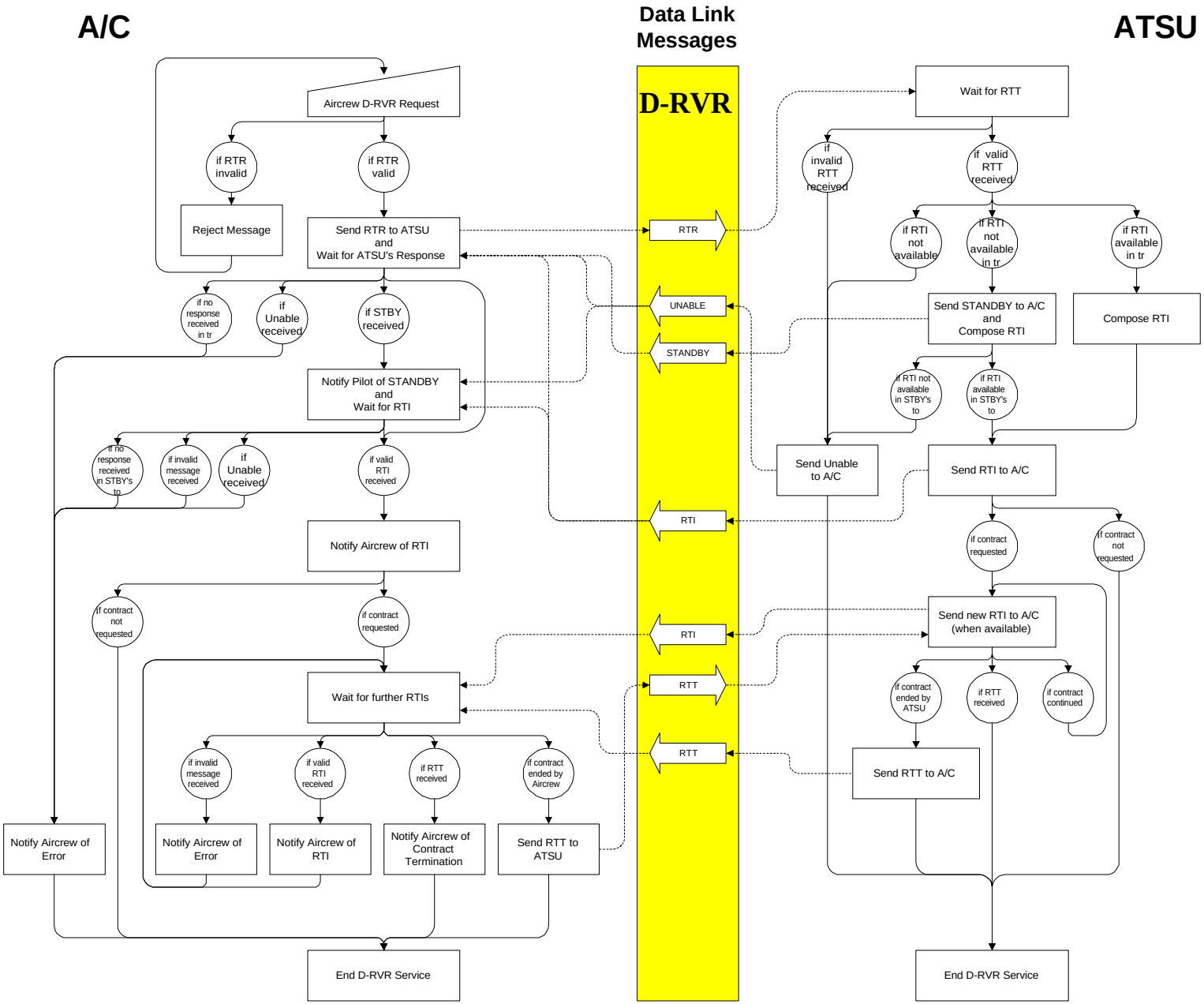
Message	Message Contents	M	I/A	O	Example Ops Msg Contents	Event/ Trigger	Source/ Dest.	Alert	Response	Op. Reply
D-RVR Delivery Message (RTI)	Message type Aerodrome Indicator Time of Issue Runway and RVR Mid point End point Additional Runways RVR Supplementary Information	X X X X	 X X X X		DRM EBBR 1200Z RWY 25R RVR TDZ1000M MID 850M END 700M RWY 25L RVR 1000M MESSAGE IN FULL **DRM EBBR 1200Z RWY 25L RVR TDZ 1000M MID 850M END 700M RWY 25L RVR 1000M**	Receipt of a valid D-RVR Request (RTR) or, in the case of an update contract, a new message version.	ATSU/aircraft	**V**	N	None

8.3. D-RVR Termination Message (RTT)

Message	Message Contents	M	I/A	O	Example Ops Msg Contents	Event/ Trigger	Source/ Dest.	Alert	Response	Op. Reply
D-RVR Termination (RTT)	MessageType MessageIdent FlightID ICAOUnitName (ATSU) AirportID ContractTerminate Freetext	X X X X X X	 X		RTT 00071 DLH340 EBWM EBBR T MESSAGE IN FULL **RTT 00071 DLH340 LFBO LFBO RVR UPDATES NO LONGER BEING DELIVERED**	Aircraft or ATSU termination	Aircraft/ ATSU or ATSU/Aircraft	**Pilot:** **V** **ATSU:** **none**	N	None

9. Event Sequence Diagram

The diagram in this subsection provides an overview of the main normal and abnormal sequences of events within the D-RVR service for the on request operating mode.


A/C
Data Link Messages
ATSU
D-RVR
Aircrew D-RVR Request
if RTR invalid
if RTR valid
Reject Message
Send RTR to ATSU and Wait for ATSU's Response
RTR
Wait for RTT
if invalid RTT received
if valid RTT received
if no response received in tr
if Unable received
if STBY received
UNABLE
STANDBY
if RTI not available
if RTI not available in tr
if RTI available in tr
Send STANDBY to A/C and Compose RTI
Compose RTI
Notify Pilot of STANDBY and Wait for RTI
if RTI not available in STBY's to
if RTI available in STBY's to
if no response received in STBY's to
if invalid message received
if Unable received
if valid RTI received
Send Unable to A/C
Send RTI to A/C
RTI
Notify Aircrew of RTI
if contract requested
if contract not requested
Send new RTI to A/C (when available)
RTI
RTT
Wait for further RTIs
if contract ended by ATSU
if RTT received
if contract continued
RTT
Send RTT to A/C
if invalid message received
if valid RTI received
if RTT received
if contract ended by Aircrew
Notify Aircrew of Error
Notify Aircrew of Error
Notify Aircrew of RTI
Notify Aircrew of Contract Termination
Send RTT to ATSU
End D-RVR Service
End D-RVR Service

Appendix A GLOSSARY AND ABBREVIATIONS

A/G	* Air/Ground
AAGDI / AGADE	Automated Air/Ground Data Interchange, is the means by which airborne avionics and processing systems communicate with ground-based systems.
ACARS	Aircraft Communications, Addressing, and Reporting System.
ACAS	* Airborne Collision Avoidance System (sometimes referred to as TCAS, one of its implemented versions).
ACC	* Area Control Centre
Acknowledgement	** Notification that a given communication has been correctly received and understood.
ACM	ATC Communications Management (Service)
ADAP	Automated Downlink of Airborne Parameters
ADS	* Automatic Dependant Surveillance
ADSP	Automatic Dependant Surveillance Panel (an ICAO group)
AEEC	Airlines Electronic Engineering Committee
AFC	ATC Frequency Change (Service)
AIDC	¬ ATS Interfacility Data Communication
AIP	* Aeronautical Information Publication
Air traffic control clearance	** Authorisation for an aircraft to proceed under conditions specified by an air traffic control unit. *Note 1. - For convenience, the term air traffic control clearance is frequently abbreviated to clearance when used in appropriate contexts* *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.*
AIRCOM	Aircraft Communications
Aircraft call sign	** A group of alphanumeric characters used to identify an aircraft in air-ground communications.
Aircraft identification	** A group of letters, figures, or a combination thereof which is either identical to, or coded equivalent of, the aircraft callsign to be used in air-ground communications, and which is used to identify the aircraft in ground-ground air traffic services communications.
AIS	* Aeronautical Information Services
ALRT	¬ Alert
AMSS	* Aeronautical Mobile Satellite Service
Analog data	** Data in the form of continuously variable physical quantities.
AOC	Airline Operational Communications

APATSI	Airports/Air Traffic Systems Interface
APP	* Approach Control
ARINC	Aeronautical Radio Incorporated
ATC	* Air Traffic Control
ATCO	1) Air Traffic Controller 2) Air Traffic Control Officer
ATIS	** Automatic Terminal Information. The provision of current, routine information to arriving and departing aircraft by means of continuous and repetitive broadcasts throughout the day or a specified portion of the day.
ATM	* Air Traffic Management
ATN	* Aeronautical Telecommunications Network
ATNP	ICAO Aeronautical Telecommunications Panel
ATS	* Air Traffic Services
ATSU	** Air Traffic Services Unit; a generic term meaning variously, air traffic control unit, flight information centre, or air traffic services reporting office. *NOTE In this document, ATSU refers to both human operators (e.g. controllers) and automated systems (e.g. data processing systems) at an ATSU, unless specifically stated otherwise.*
Automatically	An event identified by the system without any manual action by the controller or Aircrew.
AVPAC	Aviation VHF Packet Communications
C-ATSU	The ATS Unit currently responsible for control (i.e. the controlling ATSU).
CAP	Controller Access Parameters (Service)
CDTI	Cockpit Display of Traffic Information
CIC	Clearances and Information Communications (Service).
CLD	DCL Clearance Message (message in the DCL Service).
Clearance function	** The formulation and transmission of a clearance by an air traffic control unit as well as the acknowledgement and acceptance of such clearance by the Aircrew.
CNS	* Communications, Navigation, and Surveillance
COF	‡ Change Of Frequency (a G/G co-ordination message)
COMT	‡ Communications Team
CPDLC	Controller Pilot Data Link Communications, sometimes referred to as Two-Way Pilot Data Link, is the means of communication between controller and Aircrew, using data link in conjunction with or instead of voice, for ATC.
CPDLC link	The technical capability to interchange CPDLC messages established between an Aircraft and an ATSU.
CPDLC messages	The set of air/ground data link messages used by the CPDLC services.

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.
D-FIS	Data Link Flight Information Services
D-GPS	Differential Global Positioning System, a technique for improving the operational performance and utility of GPS.
D-OTIS	Data Link Operational Terminal Information Service
D-RVR	Data Link Runway Visual Range (Service)
Data	** 1) A representation of facts, concepts or instructions in a formalised manner suitable for communication, interpretation or processing by human or automatic means. 2) Any representations such as characters or analogue quantities to which meaning is, or might be, assigned.
Data link	** Terminals together with interconnecting circuits permitting the transmission of data between the terminals.
Data processing	The execution of a systematic sequence of operations performed on data. Synonymous with information processing.
DCL	Departure Clearance (Service)
DDP	Declaration of Design Performance
DED	‡ Directorate of EATCHIP Development
Dialogue Request	A Dialogue Request is the starting point of a dialogue. It conveys a request, an instruction or some specific information to be treated and responded upon by the receiving system or operator. The Dialogue Request can be human or system generated. A Dialogue Request may be followed by one Logical Response and/or one Operational Response.
Digital data	** Data in the form of digits or integral quantities. Contrast with analog data.
DLIC	¬ Data Link Initiation Capability
DMA	Decision Making Aids
DPS	Data Processing System
DSC	Downstream Clearance (Service).
DYNAV	Dynamic Route Availability (Service)
EASIE	‡ Enhanced Air Traffic Management and Mode-S Implementation in Europe
EATCHIP	‡ European Air Traffic Control Harmonisation and Integration Programme
EATMS	‡ European Air Traffic Management System
ECAC	European Civil Aviation Conference
EOBT	* Estimated Off-Block Time

Error	** Any discrepancy between a computed, observed or measured quantity and the true, specified or theoretically correct value or condition. *Note. - An error may be due to a fault or a mistake, but errors also arise from lack of precision which is foreseen or accepted.*
ES	End Service, a message of the ACM service.
ETD	* Estimated Time of Departure
EUR	European (region)
EUROCAE	European Organisation for Civil Aviation Equipment
EWP	EATCHIP Work Programme
FAA	Federal Aviation Administration (USA)
FANS	Future Air Navigation System (ICAO)
FCO	‡ Future Concepts
FCOT	‡ Future Concept Team
FDPS	Flight Data Processing System
FEATS	Future European Air Traffic Management System (ICAO)
FIS	** Flight Information Service. A service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights.
FLIPCY	Flight Plan Consistency (Service)
FMC	Flight Management Computer
FMS	Flight Management System
FOU	Frequency of Use
FPPS	Flight Plan Processing System
G/G	Ground/ground
GPS	Global Positioning System, a technique for deriving location from space-based assets.
HF	* High Frequency (3,000 to 30,000 KHz)
HMI	Human Machine Interface
IAS	* Indicated Air Speed
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
IFALPA	International Federation of Air Line Pilots Associations
IFATCA	International Federation of Air Traffic Controllers' Associations
IFR	* Instrument Flight Rules
ILS	* Instrument Landing System
IMC	* Instrument Meteorological Conditions
LACK	Logical Acknowledgement.

Logical Response	A Logical Response is notified by the receiving system to the originator of an information flow, in order to notify the originator whether the operational content of the received information is acceptable or unacceptable for further processing and/or presentation to the operator. The Logical Response does not replace any required Operational Response. Two types of Logical Response are used in this document: Logical Acknowledgement (LACK): which provides confirmation from a receiving system that the message has been successfully received and is operationally acceptable for further processing and eventual display to the appropriate person. ERROR response : which provides an indication of the rejection of a received message plus the reason for its rejection. <u>Rules of application</u> a) The Logical Response is not required for every message, it has to be specified case by case based on the operational requirements (e.g. All CPDLC messages require a logical response. Not all D-FIS messages require a logical response). b) The Logical Response shall be generated without human intervention. c) The Logical Response is performed by the end system application. d) The Logical Response shall not be used to avoid the need for technical message to ensure the integrity of data transmissions. e) The level of check on the operational contents of received information required for transmission of a Logical Response and the error information to be contained in the Logical Response is defined in the operational requirements. f) The Logical Response shall be generated and transmitted within a loop time as specified for the service concerned. g) The system shall inform the sender if a Logical Response has not been received within the specified loop time.
Logical Response Time-Out	The Logical Response time-out, represented as [**tr**] in the Time Sequence Diagrams, is the maximum end-to-end time allowed from the moment the triggering event is issued from the originator user process and the moment the Logical Response is received by the originator user process. It therefore includes: • the technical data extraction and composition of the data message that requires a Logical Response; • the data transmission and processing; • the logical checks at the destination; • the transmission and receipt of the Logical Response.
Manually	An event resulting from a manual action by the controller or Aircrew
MASPS	Minimum Aviation System Performance Standards

MCP	Mode Control Panel
Message	** A communication sent from one location to another and comprising an integral number of fields.
Message field	** An assigned area of a message containing specified elements of data.
Message format	** The disposition and structure of the message fields which constitute a message.
METAR	Meteorological Aerodrome Report
MLS	* Microwave Landing System
Mode-S	A new form of SSR with data link capability, improved addressing capacity and increased selective target capability.
MOPS	Minimum Operational Performance Specifications
MRT	Monitoring R/T, an ACM service message.
MSAW	Minimum Safe Altitude Warning
MSF	Master Simulation Facility
MSG	Message
NAM	North American (region)
NAT	* North Atlantic (region)
NDA	Next Data Authority, an ACM service message.
NOTAM	Notice to Airmen (* A notice containing information concerning the establishment, condition, or change in any aeronautical facility, service, procedures or hazard, the timely knowledge of which is essential to personnel concerned with flight operations).
OCD	Operational Concept Document for the EATCHIP Phase III System Generation
ODIAC-TF	‡ Operational Development of Initial Air/Ground Data Communications Task Force
ODID	‡ Operational Display and Input Development
ODT	‡ Operational Requirements and Data Processing Team
OFIS	Operational Flight Information Service
OLDI	‡ On-Line Data Interchange
Operational ATC	Used for operations; connected with the operations of ATC.
Operational control	** The exercise of authority over the initiation, continuation, diversion or termination of a flight in the interest of the safety of the aircraft, and the regularity and efficiency of flight.
Operational objective	Statement of goals to be reached to improve ATM or part thereof.
Operational requirement	A stipulated demand to fulfil an operational Air Traffic Control/Management need.

Operational Response	The Operational Response is the end result, generally of an operational nature, expected by the originator of a data link transmission. The Operational Response can be human or system generated. The Operational Response indicates to the sender of an operational transmission, such as a request or instruction, the operational action taken as a result of its e.g. request or instruction. Due to its operational content and meaning, an Operational Response is a higher level response in comparison to a Logical Response. An Operational Response may be followed by one Logical Response and/or another Operational Response (e.g. A Clearance Request <dialogue request> is followed by a Clearance <operational response to the request> which is followed by a Pilot Acknowledgement <operational response to the clearance>).
Operational Response Time-Out	The Operational Response time-out, represented as [**to**] in the Time Sequence Diagrams, is the maximum end-to-end time allowed from the moment the triggering event is issued from the originator user process and the moment the operational response (e.g. pilot acknowledgement to a clearance or automatically generated Departure Clearance in response to a Request) is delivered to the originator user process. It therefore includes: • the technical data extraction and composition of the data message which requires an Operational Response; • the data transmission and processing; • the waiting time for the operator's response action, if applicable • the transmission and receipt of an Operational Response.
OPR	‡ ATM Operational Requirements (Domain of EATCHIP)
ORD	Operational Requirements Document
ORQ	D-OTIS Request Message (message in the D-OTIS service)
OTD	D-OTIS Delivery Message (message in the D-OTIS service)
OTT	D-OTIS Termination Message (message in the D-OTIS service)
PAM	Aircrew Acknowledgement Message (support message)
PANS-RAC	Procedures for Air Navigation Services - Rules of the Air and Air Traffic Services *(ICAO Doc 9426-AN/924)*
PHARE	‡ Programme for Harmonised Research in Europe
PPD	Aircrew Preferences Downlink (Service)
QOS	ø Quality of Service
QOS	Quality Of Service
R-ATSU	The ATS unit that will assume control responsibility (i.e. the receiving ATS unit).
R/T	Radiotelephony
RA	Resolution Advisory (TCAS)
RCD	DCL Request Message (message in the DCL Service)

RDPS	Radar Data Processing System
Readback	A method of operational acknowledgement whereby the operational contents of a message are repeated in full, using R/T, to ensure that the message recipient has complete understanding of the message.
REC	Request EOBT Change (message in the DCL Service)
RESP	¬ Response
RET	Revised EOBT (message in the DCL Service)
RTCA	Radio Technical Commission for Aeronautics
RTI	D-RVR Delivery Message (message in the D-RVR service)
RTR	D-RVR Request Message (message in the D-RVR service)
RTT	D-RVR Termination Message (message in the D-RVR service)
RVR	* Runway Visual Range
SARPS	* ICAO Standards And Recommended Practices
SATCOM	* Satellite Communication
Service	An abstract noun which is used to designate functions, or a service rendered. In the context of this document, 'Service' refers to a set of actions, both system supported and manual, which have a clearly defined operational goal and which begin and end on an operational event
SICASP	SSR Improvement and Collision Avoidance Specialist Panel (an ICAO group)
SID	* Standard Instrument Departure
SIGMET	* Information concerning the en-route weather phenomena which may affect the safety of aircraft operations.
SLA	Service Level Agreement
SNOWTAM	* A special series NOTAM notifying the presence or removal of hazardous conditions due to snow, ice, slush or standing water associated with snow, slush and ice on the movement area, by means of a specific format.
Specification	Detailed description of work done or to be done by a person or group of persons for a project to be carried out; the act of specifying a detailed item.
SSR	* Secondary Surveillance Radar
Standby Operational Response Time-Out	The Standby Operational Response time-out, represented as [**ts**] in the Time Sequence Diagrams, is the time after which the Standby message originator will receive a local warning of the pending Standby.
Standby Termination Time-Out	The Standby Termination time-out, represented as [**tt**] in the Time Sequence Diagrams, is the maximum end-to-end time allowed from the moment the Standby message is sent and the moment the Operational Response is triggered by the Standby originator.
STAR	* Standard Instrument Arrival

STCA	Short Term Conflict Alert; a ground-based safety net
Sub-system	** Any system which is associated with the air traffic control system as a provider and/or recipient of information relating to the provision of air traffic control service.
SYSCO	‡ System-Supported Coordination
T-ATSU	Transferring Air Traffic Services Unit. $ Air traffic control unit/ air traffic controller in the process of transferring the responsibility for providing air traffic control service to an aircraft to the next air traffic control unit/air traffic controller along the route of flight.
TBD	To Be defined
TCAS	Traffic Alert and Collision-Avoidance System
TCAS	Traffic-alert and Collision-Avoidance System (airborne)
TDMA	Time Division Multiple Access, a multiplexing technique for digital communications.
TMA	* Terminal Control Area
TSD	Time Sequence Diagram
TSD	¬ Time Sequence Diagram, showing the sequence of message exchanges within a data link service.
UAC	* Upper Area Control Centre.
URG	¬ Urgency
VCI	Voice Change Instruction, a message of the ACM service.
VDL	VHF Data Link
VDR	VHF Digital Radio
VHF	* Very High Frequency (30 to 300 MHz)
VMC	* Visual Meteorological Conditions
VMC	* Visual Meteorological Conditions
VOLMET	* Meteorological Information for Aircraft in Flight.
WG	Working Group

* *Taken from ICAO Doc 8400/4, ICAO Abbreviations And Codes.*

** *Taken from ICAO Air Traffic Services Planning Manual.*

¬ *Taken from the Draft ICAO Manual of Air Traffic Services (ATS) Data Link Applications.*

‡ *EUROCONTROL terminology.*

ø *Taken from ICAO 9578-AN/935*

$ *Taken from ICAO PANS-RAC Doc. 4444*

Appendix B: Service Description Template

Services in this document are defined in gradually increasing detail, using the following sub-sections:

Header gives 'keyword' references for the Service. The header will include:

- *Service Number* is the unique number of the Service as it will appear in the Operational Requirements document produced by the ODIAC-TF. Initially, this number will be a one-up number starting with O-1.
- *Name* gives the name of the Service. These should be as concise and unambiguous as possible (e.g. ATC Communications Management).
- *Abbreviation* is the abbreviation used for the Service name (e.g. ACM for ATC Communications Management).
- *Category* indicates what kind of Service it is. Valid entries are:

  'C' indicating CPDLC, further broken down into area of applicability (i.e. G=Ground; W=Tower; A=Approach control/TMA; E=Enroute; O=Oceanic; M=Multiple); valid entries are therefore CG, CW, CA, CE, CO, and CM.

  'A' indicating Automated Air/Ground Data Interchange (AGADE), further broken down into area of applicability as outlined above, leaving valid entries of AG, AW, AA, AE, AO, and AM.

  'F' indicating Flight Information Service.
- *References* lists any documents which provide defining material for the Service. Examples would be ICAO documents with relevant operational procedures; technical documents such as ARINC Specification 623 would not apply as they are a lower level of specification and not defining material for the Operational Requirements in the Service Descriptions.
- *Version Number* is a unique number reflecting the maturity of the Service definition, and the date it was produced. These two items provide traceability through the evolution of the definition; Version Numbers indicate the following:

  0.x indicates a 'Draft' version still being discussed by ODIAC;

  1.x indicates a version agreed by ODIAC but not yet endorsed by the ODT;

  2.x indicates a version endorsed by the ODT;

  3.x indicates a version validated through trials and simulations.

Headers appear in the following format:

Service No.	Name	Abb.	Cat	References	Version No.

1. **Scope and Objective** provides a brief description of what the Service does from an operational perspective.

2. **Expected Benefits, Anticipated Constraints, and Associated Human Factors**

   - Expected *benefits* provides a non-exhaustive list of benefits expected from implementation of the Service uniquely or particularly applicable to the Service being described.
   - *Anticipated constraints* describes the constraints which could result from implementation of the Service uniquely or particularly applicable to the Service being described.

- *Human Factors* provides the human factors aspects considered essential for the safe and coherent operation of the service.

3. **Service Operational Context** describes the environment and constraints of today's non-data link services and some additional constraints applicable to the data link service.

4. **Overview of Operating Methods with and without Data Link** provides a comparison between the way the Controller, Aircrew, and/or support systems perform the Service in today's non-data link environment and the proposed operating method with the data link service.

5. **Information Exchange Diagram** provides a graphical representation of the information flows interchanged via the data link in order to implement the service operating method.

6. **Detailed Service Operating Method with Data Link** includes the following parts:

   - **Service Availability** which describes the periods within which the Service should be available.

     It states rules for starting and stopping the Service, in relation to phases of flight or operational events during a flight, and/or ATC phases. The following is specified :

     Service Initiation Event: The moment in time when the service becomes available for a specific flight.

     Service Termination Event: The moment in time when the service becomes unavailable for a specific flight.

     Service Availability Constraints: The periods within which special availability constraints apply to the service.

   - **Service Description** which describes how the Controller, Aircrew, and/or support system(s) will perform the Service with data link assistance. As this heading describes Controller and Aircrew actions, it will also cover procedures and should identify optional features in addition to the standard features of the Service. It contains the following sub-sections:

     - Normal Mode describes how the Service is normally conducted.
     - Sequence Of Services states what other data link services must precede the data link service, if any.
     - Additional Guidelines provide any additional features for the data link service, to include amplification of the preceding elements and any recommended enhancements that could be achieved through advanced airborne or ground equipment.
     - Abnormal Mode describes what should happen if the Service fails, to include error reporting, exception handling, recovery needs, procedures, and alternative information exchange (including reversion to voice communications). Abnormal modes are correlated with the Normal Mode in the Service Description.

7. **Time Sequence Diagram (TSD)** (also known as Message Sequencing Chart) is a standard method to illustrate the information flows in chronological order for the standard (nominal) execution of a Dialogue within the Service.

   The TSD graphically illustrates the requirements associated to the following types of time-out :

   - Logical Response Time-Out
   - Operational Response Time-Out
   - Standby Termination Time-Out
   - Standby Operational Response Time-Out

   Full definitions of these time-outs is provided in Appendix A: Glossary and Abbreviations.

8. **Quality Of Service Requirements (QOS)**: Only exceptions to the global QOS requirements (when available) need be specified. The following QOS attributes are specified for each service:

   - *Message Category* specifies the Transfer or Logical Response time (as applicable) for each message within the Service Dialogue. These two times are defined as follows:

     Logical Response time: The period elapsed from the moment the triggering event is issued from the originator user process and the moment the Logical Response (i.e. a LACK or ERROR message) is received by the originator user process.

     Transfer time: The period elapsed from the moment the triggering event is issued from the originator user process and the moment the message is received, validated and ready for further treatment at the destination user process.

     Logical Response times are specified for all flows that require a Logical Response. Transfer time is specified for the information flows that do not require a Logical Response.

     Transfer and Logical Response times are assigned to one of the time categories in the following table, based on the operational needs for the service concerned. The first column indicates time values meaning Transfer or Logical Response time is achieved 95% of the time; the second column indicates time values meaning Transfer or Logical Response time is achieved 99.996% of the time.

     NOTE 1: Transaction time, or the time it takes to transmit a message over the communications system(s) is not defined as they are included in the Transfer or Logical Response time.

     NOTE 2: The time values given in the following table are indicative only and need to be validated. The concept of Required Communications Performance (RCP) will form the basis for future QOS requirements when finalised by ICAO.

Message Category	95%	99.996%
1	tbd	tbd
2	[5”]	[15”]
3	[10”]	[20”]
4	[30”]	[60”]

   - *Communication Priority* establishes the priority of messages within this Service in relation to other information flows:

     1. Distress, indicating grave and imminent danger;
     2. Urgent, concerning the safety of the aircraft or persons on-board or within sight;
     3. Flight Safety, comprising movement and control messages and meteorological or other advice of immediate concern to an aircraft in flight or about to depart, or of immediate concern to units involved in the operational control of an aircraft in flight or about to depart;
     4. Routine Surveillance or Navigation (e.g. ADS);
     5. Routine operational messages, comprising aircraft operator and other messages of concern to the aircraft in flight or about to depart;
     6. NOTAM-Class I distribution;
     7. Meteorological messages, comprising forecasts, observations and other messages exchanged between meteorological offices;
     8. Low, indicating any message with a lower priority than the above.

   - *Information Urgency* delineates the relative relationship among messages when placed in a queue for operator access. It relates to the handling of the information by

the receiving system. It dictates the order of display, processing (including deletion, modification, and shelf-life), or other action in accordance with the sequencing of essential, routine and time-expired data. Urgency does not influence communication processing, which is defined by communications priority; it applies to the end user processing application only. Valid entries are:

Distress indicating grave and imminent danger;

Urgent comprising movement and control messages and meteorological or other advice of immediate concern to an aircraft in flight or about to depart, or of immediate concern to units involved in the operational control of an aircraft in flight or about to depart;

Normal comprising routine operational messages such as routine surveillance or navigation, meteorological messages, etc.;

Low indicating any message with a lesser urgency than the above.

- *Information Security* provides any applicable security requirements for the messages, including:
  - *Data Origin Authentication*, indicating how much assurance is required that the data source is as stated. Valid entries are:

    Normal, indicating that the indicated originator must always be authentic;

    Low, indicating that the non-authentic originators are acceptable in some circumstances, but must be identifiable and notified to the responsible operators.
  - *Access Control*, indicating the confidentiality level of the data, or the requirement for the data to be restricted to only authorised recipients. Valid entries can be one or more of the following:

    'C', indicating that the data must be protected against any unauthorised access, to include copying of the data;

    'M', indicating that the data must be protected against any unauthorised and undetected modification of a message;

    'A', indicating protection against unauthorised addition of messages;

    'D', indicating protection against unauthorised deletion of messages.
  - *Data Integrity*, indicating the level of trust that can be placed in the data arriving at the destination in the same form that it left the source. Valid entries are:

    Maximum, indicating that loss or corruption of data is unacceptable;

    Medium, indicating that loss or corruption of data is acceptable in some circumstances, but must be identifiable and notified to the responsible operators.

    Minimum, indicating that loss or corruption of data is acceptable and does not require notification.

9. Information Exchanges provides further operational requirements for each information flow described in the above sections.

For CPDLC services this section contains the valid combinations of CPDLC message elements and all associated message composition rules based on the CPDLC message element set defined in the ICAO Manual of ATS Data Link Applications.

For the ADAP and D-FIS services, this section is set out in a table with the following entries:

- *Message* states the name of the specific information flow within the exchange.
- *Message Contents* provides a list of the data elements in the flow.
- *Data Element Category*: Each data element is categorised within the message as Mandatory, If Applicable, or Optional.

The definitions for the three data element categories, to include system handling requirements, are as follows. “If Applicable” is a subset of the Mandatory category.

Mandatory: Mandatory data falls into two sub-categories:

Always present: Data which in all cases shall be included in the message to achieve the operational objectives of the service.

If Applicable: Data which shall be included in the message in specifically defined circumstances to achieve the operational objectives of the service, as described within the Service Description.

End-systems which will send or receive the message concerned shall be capable of successfully extracting and processing all mandatory data elements.

Optional: Data which provides added value to the service in some situations, although its inclusion in the message is not required to achieve the operational objectives of the service (example : Freetext).

End-systems which will send the message concerned are not required to be capable of handling optional data elements, although this capability is recommended due to the added value the data will bring. End-systems which will receive the message concerned shall be capable of handling the optional data elements, at least to the extent that they can successfully extract and process all mandatory data elements from a message which contains optional data elements.

- *Example Operational Message Contents*, provides an example operational content for each data element names in the Message Contents section.

  - *Event Trigger* briefly describes the operational event that will initiate the message.

  - *Source/Destination* gives the operational source and destination of the message. These can be aircraft or one of several ATSU designators, as defined in the glossary.

  - *Alerting Requirements* describes the need for air crew and controller alerting for the data link service.

    Air crew alerting can be one of four categories:

    A/D: Unique aural and visual indication;

    A: Aural and visual indication;

    V: Secondary field-of-view visual alert or aural and visual indication;

    N: No alerting required.

    Controller alerting can be one of four categories:

    H: High;

    M: Medium;

    L: Low;

    N: None.

- *Logical Response* indicates whether a Logical Response is or is not required (‘Y’ and ‘N’ respectively).

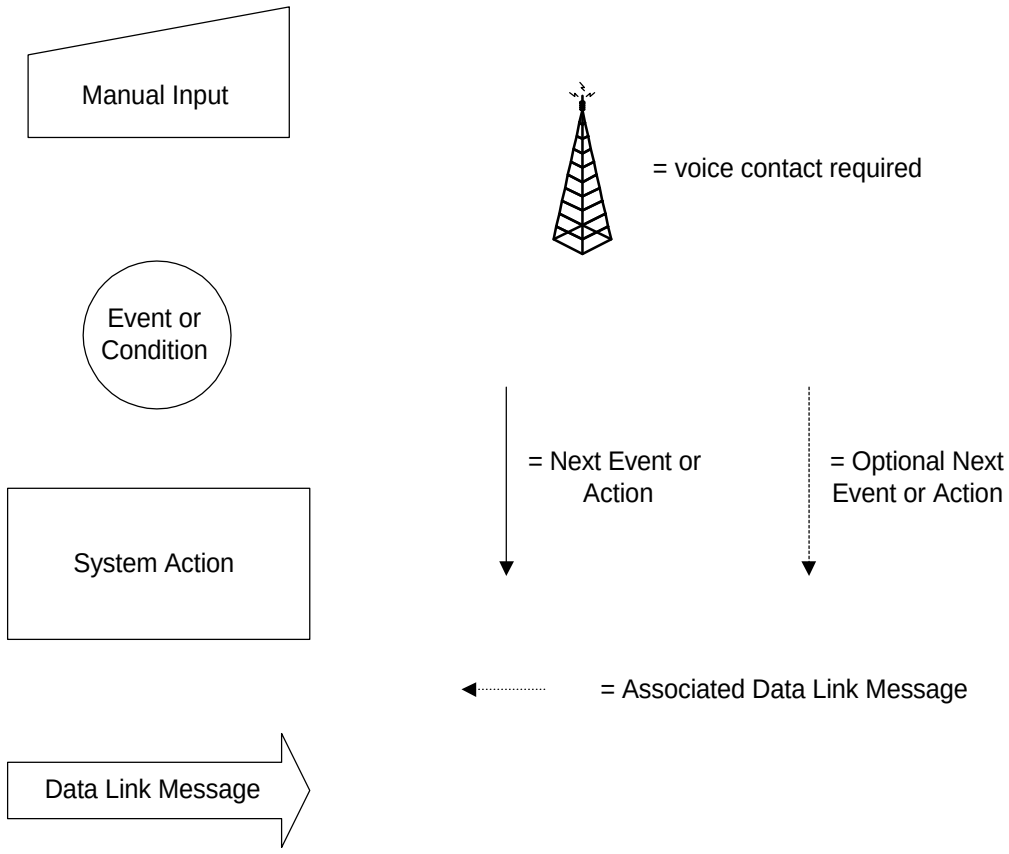
- *Operational Response* provides the name of Operational Response to the information flow.

- An example table is as follows:

Msg	Message Contents	M	I/A	O	Example Op. Msg Contents	Event/ Trigger	Source / Dest.	Alert	Logical Response	Op. Response
								Ctrlr: **Pilot:**		

10. Event Sequence Diagram depicts the main normal and abnormal sequence of events within a service, and including technical issues such as receipt of responses and system processing. Note that this diagram does not contain all events.

The following symbols are used in the Event Sequence Diagrams for describing the logical sequence of events, including technical issues, for each service.



Appendix C: BIBLIOGRAPHY

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- Draft ICAO Manual of Air Traffic Services (ATS) Data Link Applications, Draft Version 0.4, ADSP - September 1996.
- Rules of the Air and Air Navigation Services, Doc 4444-RAC/501, ICAO, Thirteenth Edition 1996.
- Concept of Operations, Mode S in Europe, Version 2.0, EATCHIP, 28 November 1996
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- ECAC Strategy for the 1990s; April 1990.
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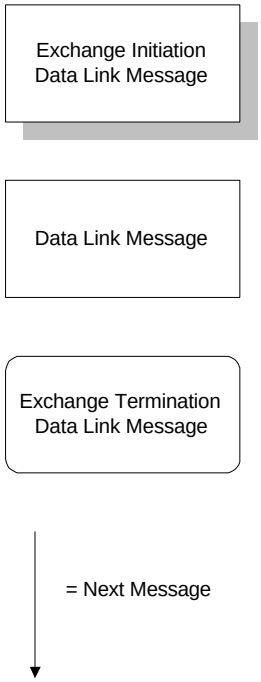
- MOPS for ATC Two-way Data Link Communications; RTCA; DO-219; 6/8/94 (Draft).
- MOPS for airborne ADS equipment, RTCA/DO212; October 1992 (SC170).
- MOPS for Flight Information Service (FIS); RTCA; SC-169 WG3; September 1993.
- MOPS for the mode S airborne data link processor, RTCA/DO-218; August 1993.
- Human Factors Requirements for Data Link; ATA; September 1992.

Appendix D: Message Sequence Matrices

The following diagrams depict the possible logical message flows for the air/ground data communications services defined in this document.
Readers should refer to the appropriate Service Descriptions for details on the message names and other Service aspects reflected in this Appendix.

1. Message Sequence Matrices Symbology

The following symbols are used in the Message Sequence Matrices for describing the logical sequence of messages for each service.



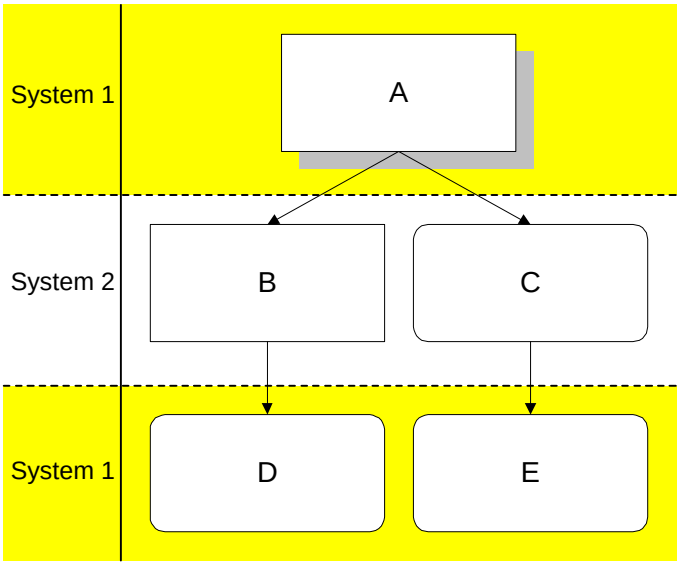
Used to represent the messages that initiate exchanges.

Used to represent messages that can neither initiate nor end an exchange (i.e. responses that require a response)

Used to represent messages that may end exchanges when no additional message is required (i.e. in some cases they may end the exchange but in other cases they might be followed by other messages as stated in the service descriptions).

Arrows indicate all messages that can follow a given message.

Example:



This diagram describes an exchange that can only be initiated on the generation of message "A" by System 1.

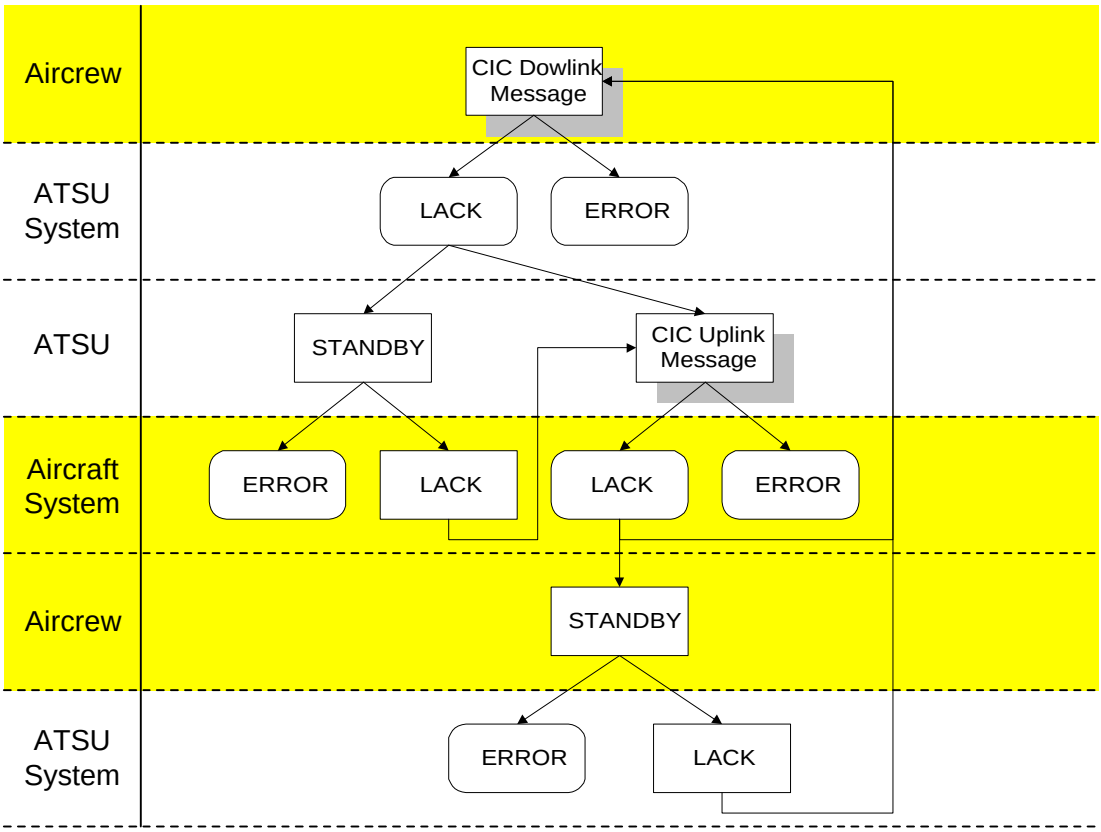
System 2 must continue the exchange by generating message "B" or message "C", but only one of them.

If System 2 generates message "B", System 1 must generate message "D" which will terminate the exchange.

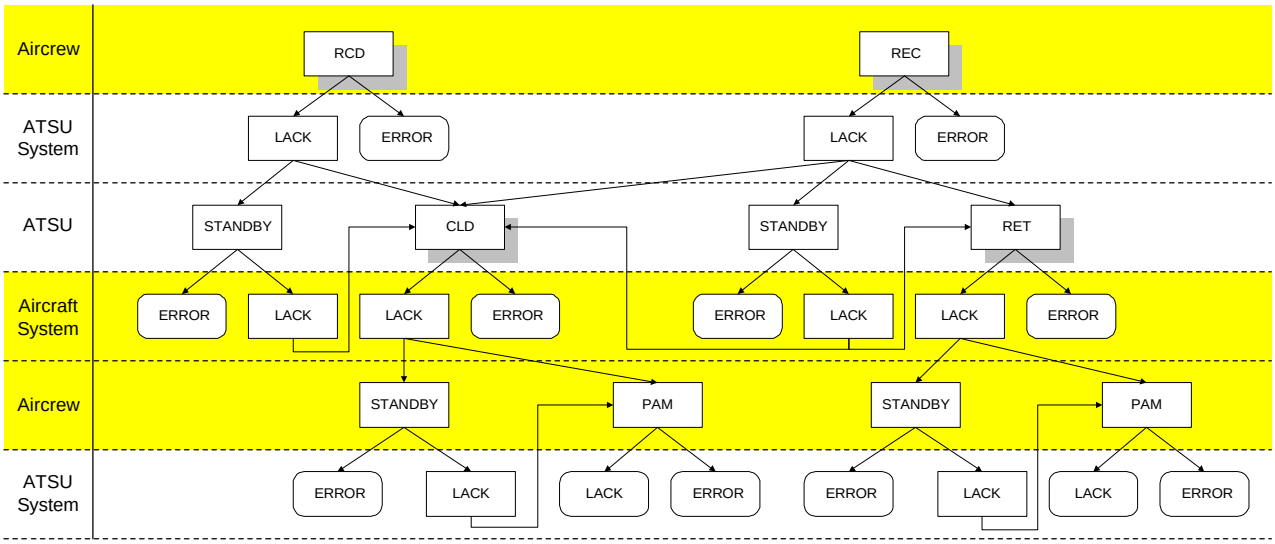
If System 2 generates message "C", this message may end the exchange or "C" may be followed by message "E" generated by System 1 (the contents of "C" will indicate if it "E" is required or not).

Once the exchange is terminated, it can only be initiated again by the generation of message "A" by System 1.

2. CIC Service

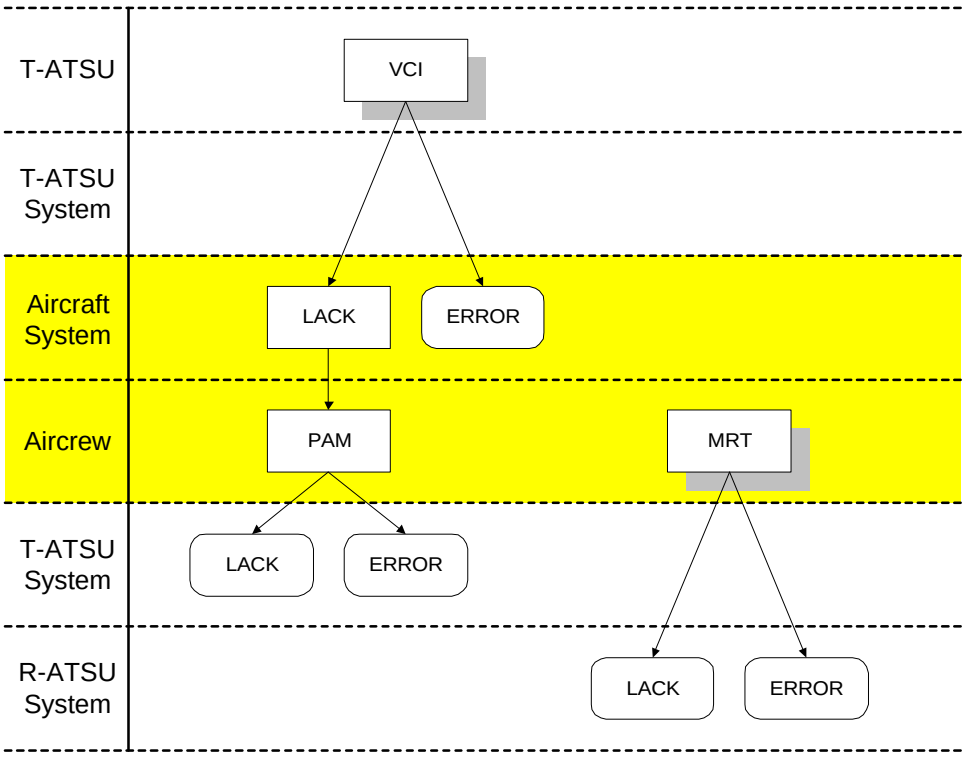


3. DCL Service

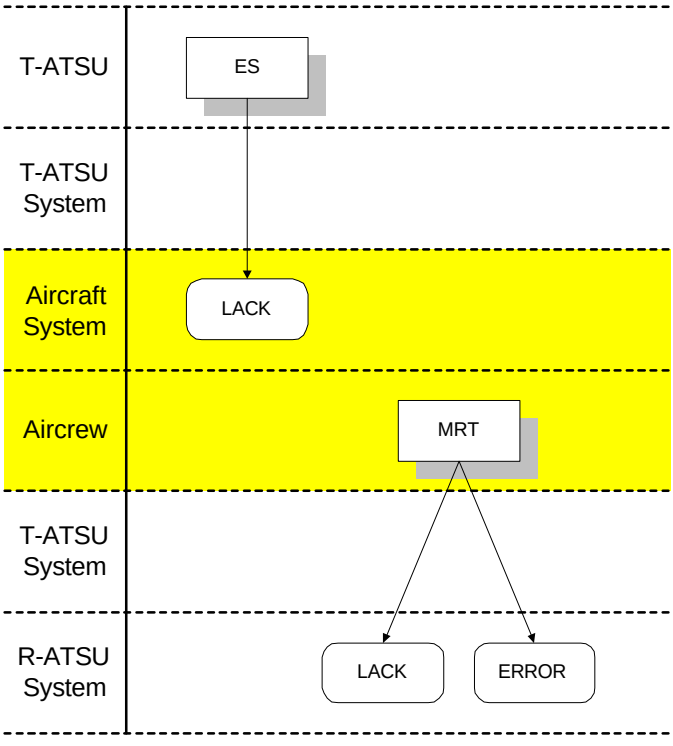


4. ACM Service

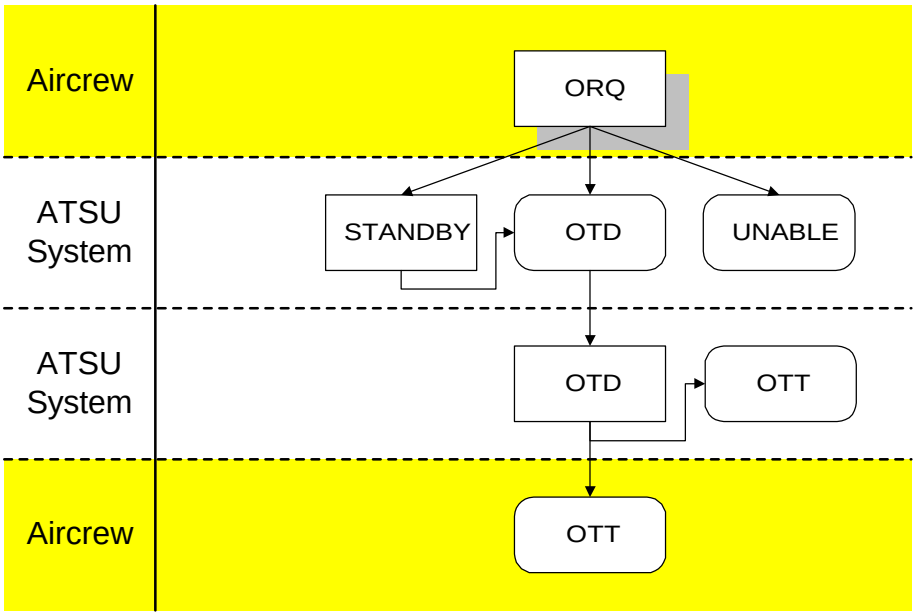
4.1. Communications transfer instructed via data link



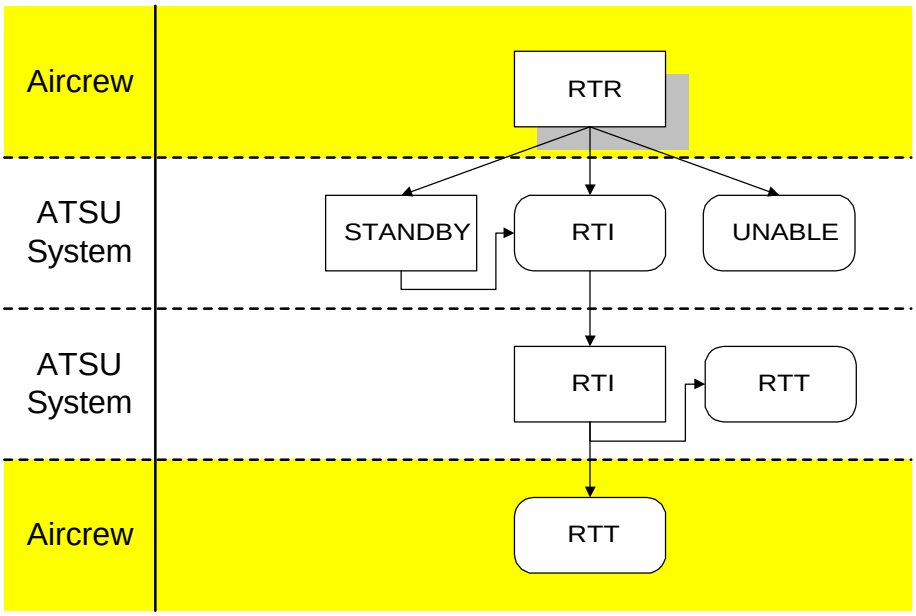
4.2. Communications transfer instructed via voice and data link



5. D-OTIS Service



6. D-RVR Service



Annex 1 : Future ODIAC Work

This Annex contains information material on services that are not part of ODIAC's current mandate but have already been discussed due to their potential for early development. They will be part of ODIAC's future work.
These services still require detailed discussions by ODIAC for final acceptance.

TABLE OF CONTENTS

Annex 1 Section 1 : Flight Plan Consistency (FLIPCY) Service

Service No.	Name	Abb.	Cat	References	Version No.
O-10	Flight Plan Consistency	FLIPCY	AM		0.1 29/5/96

Table of Contents

1. Scope and Objective

Separate management of the flight plan in airborne system and ground system favours flight plan discrepancies:

- Incorrect waypoint insertion in the aircraft navigation system might be source of potential air traffic conflicts.
- Filed flight plan (FPL) messages and associated modification messages (CHG) might be unavailable in ATS units ground systems due to failure of transmission or errors in addressing.
- Filed flight plans with an inappropriate route (e.g. week-end route during the week, direct route obtainable from ATC upon in-flight request only) might be corrected by ATSU ground systems and therefore result in flight plan discrepancies between airborne and ground systems.

In order to ensure against such discrepancies and enable advanced planning in a data link environment, the Flight Plan Consistency (FLIPCY) service will check that the planned flight plan stored in the aircraft navigation systems are consistent to ATC ground systems flight plan.

2. Expected Benefits, Anticipated Constraints, and Associated Human Factors

2.1. Expected benefits

- Safety improvement: conflict detection by anticipation, automated generation and transmission of warning messages to both controller and aircrew;
- Helping aid system for controller;
- Improved ATC planning due to confidence in flight plan informations;
- Reduction in voice communication for pilot and controller;
- Decongestion of voice channels;
- Improvement of the ATC traffic flow.

2.2. Anticipated constraints

Adoption of standards to describe the flight plan routes:

- delimitation of the portion of the route to be checked by the ground flight data processing system (FDPS); route might be delimited according to notions of a number of waypoints and/or a flight duration,
- use of a common referential to describe the route in airborne and ground system; aircraft navigation systems currently computes fictitious waypoints (top of descent, top of climb, deceleration points ...) to be filtered;

Flight plan modifications proposed by the FDPS in case of discrepancy have to be coordinated between adjacent ATS units according to agreements;

2.3. Associated Human Factors

- The FLIPCY service will enhance the confidence of the controller in the ATC data to manage the traffic under his responsibility.
- The service might imply actions from pilot in case of discrepancy and so shall not be performed during critical phases of flight as take off.

3. Service Operational Context

The Flight Plan Consistency service shall be applied for

- the horizontal 2D profile (waypoints and ATS airways),
- the requested flight level (RFL).

Note 1: The RFL value identified in current navigation aid systems could imply misunderstanding in case of intermediate level off or in descent.

Note 2: It could be interested to check other data:

- *type of aircraft and associated wake turbulence category, (it may be supposed that the data type of aircraft will be known through other datalink services),*
- *navigation equipment in working order, which might condition the route to follow (eg RNAV routes, RVSM airspace),*
- *speed.*

The objective of the service being to detect significant discrepancies between airborne and FDPS planned flight plans, FLIPCY service applies to strategic data; so the tactical trajectory changes with updating of the airborne navigation data performed in the ATC clearances service context have to be ignored.

The service is applied on the en route flight plan portion, (SID and STAR excluded). However the service might be performed during SID.

4. Detailed Service Operating Method with Data Link

4.1. Service availability

4.1.1. Service Initiation

The airborne planned flight plan might be downlinked according to 3 different modes :

- systematically and automatically before entering in a new ATS unit's area of responsibility;

  Note 1: delay preceding the entry in the next ATS unit's area has to be relevant with the moment the flight will be operationally taken into account by the receiving centre

  Note 2: the service could be initiated by the ground but may be preferably initiated by the airborne system considering that the service should be performed after the DLIC but before the ACM (too late)

  Note 3: at the flight departure, the FLIPCY service could be performed associated with the pre-departure clearance service.

- in case of modification of the flight plan of the airborne navigation system by the aircrew the flight plan is automatically downlinked, in case of:
  - en-route diversion, with modification of the destination airport,
  - acceptance of a route proposed by ATC through the Dynamic Route Availability (DYNAV) service,
  - insertion of additional waypoint(s) by the aircrew in the airborne navigation system;

  Note: although modifying the airborne flight plan, deletion of waypoint(s) shall not generate the downlinking of airborne flight plan for FLIPCY, excepted if due to the Dynamic Route Availability service, considering first that deletion is mainly performed in tactical situation associated to delivery of "direct to" clearance and secondly that deletion do not involve risk of erroneous data capture.

- on controller's special demand : the controller shall have the possibility to manually request the airborne flight plan for an unexpected check in case of doubt about the progress of a flight.

4.1.2. Service Termination

The service termination occurs when the aircraft leaves the ATS unit's area of responsibility or if starting a STAR procedure.

4.2. Service Description

4.2.1. Normal Mode

1. The aircrafts automatically downlinks the airborne flight plan
2. The FDPS receives, stores, performs the comparison FDPS/airborne flight plans
3. If the airborne flight plan is identical to the FDPS flight plan

    3.1. Then if the FDPS flight plan might be enhanced

        3.1.1. Then the Dynamic Route Availability service is performed

        3.1.2. Else End

    3.2. Else if the airborne flight plan is different but acceptable

        3.2.1. Then

            . the FDPS flight plan is updated

            . If the FDPS flight plan might be enhanced

                3.2.1.1. Then the Dynamic Route Availability service is performed

                3.2.1.2. Else End

        3.2.2. Else

            . the FDPS displays a warning message to the controller with the relevant causes of discrepancy

            . the FDPS uplinks a warning message to be displayed to the aircraw with the relevant cause of discrepancy and a proposal of a correct flight plan

            . End

Note for 3.2.2. discrepancy FDPS/airborne flight plans

- *At this stage, about the correct route associated to the aircrew's warning, the Dynamic Route Availability service is not performed in order to solve first the discrepancy to avoid any risk of confusion; the Dynamic Route Availability is only performed if the airborne flight plan matches with the FDPS one.*
- *The level of the warning messages shall be gradual according to the seriousness of the discrepancy: planned use of route obtainable upon request only, week-end or night route outside schedules, crossing of an active restricted area...*
- *If the FLIPCY service is performed prior to an ATC boundary crossing, the warning addressed to the controller shall be put on standby and then displayed to the receiving controller only from the moment the flight is under the controller's responsibility. Accordingly the warning might be cancelled if meanwhile the aircrew corrects the airborne flight plan; An aircrew's correction due to a FLIPCY warning shall be systematically followed by a second FLIPCY pass for checking.*

- *the aircrew might chose to not react to a FLIPCY warning and await for a pilot/controller voice contact. The controller will have then the possibility to make a FLIPCY check on demand*

4.2.2. Abnormal Mode

In case of doubt or ambiguity, the exchange shall be carried out by voice.

5. Quality of service

Message category: 3

Communication priority: 3 (flight safety)

Information urgency: Urgence

Information security:

- Data Origin Authentication: Normal
- Access Control: M, A, D
- Data Integrity: Maximum

6. Information Exchanges

Warning messages to be displayed to the controller

FLIGHT PLAN CONSISTENCY [flight ident]
CONFLICT
FDPS / [ground FDPS route]
FMS / [airborne route]
WEEK END ROUTE
(or) NIGHT ROUTE
(or) SUBJECT TO INFLIGHT REQUEST
(or) (other sources of discrepancy to be identified)

Warning message to be displayed to the aircrew

FLIGHT PLAN CONSISTENCY [flight ident]
CONFLICT
FMS / [airborne route]
WEEK END ROUTE
(or) NIGHT ROUTE
(or) SUBJECT TO INFLIGHT REQUEST
(or) (other sources of discrepancy to be identified)
PERMISSION TO PROCEED VIA [ground FDPS route]

Annex 1 Section 2 : Dynamic Route Availability (DYNAV) Service

Service No.	Name	Abb.	Cat	References	Version No.
O-11	Dynamic Route Availability	DYNAV	AM		0.1 29/5/96

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1. Scope and Objective

The use of conditional and direct routes are subject to constraints due to military activities and other operational restrictions.

Periods for temporary restrictions are available according to the Flexible Use of Airspace (FUA) rules. During those periods, the aircraft have to avoid the restricted routes or areas.

Considering that availability of conditional and direct routes or the removal of restrictions can be anticipated, the objective of the Dynamic Route Availability (DYNAV) service is to automate the notification of availability of alternative routings.

The ATC Ground Flight Data Processing System (FDPS) shall compute potential route modifications for planned flights to be uplinked and proposed to Aircrew.

2. Expected Benefits, Anticipated Constraints, and Associated Human Factors

2.1. Expected benefits

- Easier use of the airspace by minimized constraints of the current air traffic management due to exclusion of civil air traffic from airspace reserved for defense purpose with financial consequences in terms of operating costs (crew, fuel, maintenance);
- Added flexibility to operators to dynamically adjust the flight routing to respect the arrival punctuality (Hub);
- Provision of an automatic aid system to controller, reduction in controller's workload;
- Reduction in voice channel congestion and R/T workload.

2.2. Anticipated constraints

- The Dynamic Route Availability service is a corollary to Flight Plan Consistency service; Flight plan stored in the airborne navigation system and flight plan stored in the ATC Ground Flight Data Processing System (FDPS) shall be identical.
- Delimitation of the portion of route to perform the service;
- Service shall be inhibited for the segment of route on which the flight is on progress in order to maintain a relevant notice;
- Route improvements might be delivered by an ATC unit not responsible for the control of the flight when the modified route segment becomes effective, especially in the case of countries responsible of several ATS units; So route improvements have to be coordinated between adjacent ATS units according to agreements.

2.3. Associated Human Factors

To be provided.

3. Service Operational Context

Route improvements are initiated by ATC;

Route improvement messages are strategic;

The service is applied for the 2D profile;

The ground FDPS shall have the capability to identify the route improvements to be uplinked either automatically either by the controller;

4. Detailed Service Operating Method with Data Link

4.1. Service availability

4.1.1. Service Initiation

The service might be initiated at any time during the progress of the flight in the ATS unit's area of responsibility.

4.1.2. Service Termination

The service shall be terminated as the flight in progress leaves the ATS unit's area of responsibility or is starting an approach procedure.

4.2. Service Description

4.2.1. Normal Mode

1. The ATC ground FDPS identifies a situation favourable to a route improvement considering on one hand the planned flight plans and in another hand the real time updated periods of restriction for airspace

2. If the computerized route improvement do not require a controller's agreement

2.1. Then

. the route improvement is directly uplinked to be displayed to the aircrew

. end

2.2. Else

. the route improvement is displayed to the controller

. If the controller agrees the proposed route improvement

2.2.1. Then

. the controller uplink the route improvement message to be displayed to the aircrew

. End

2.2.2. Else

. the controller cancels the route proposal

. End

Note:

- *In case of over workload, the controller shall have the capability to temporary inhibit the Dynamic Route Availability service;*
- *If the aircrew accepts the route proposal, the aircrew shall have the capability to automatically update the airborne navigation system to minimize insertion errors; In this case, the updated airborne route shall be downlinked to perform the flight plan consistency to update the ATC ground system;*

4.2.2. Abnormal Mode

In case of doubt or ambiguity, the dialogue shall be carried out by voice.

5. Quality of service

Message category: 4
Communication priority: 4 (navigation)
Information urgency: Normal
Information security:
- Data Origin Authentication: Normal
- Access Control: M, A, D
- Data Integrity: Maximum

6. Information Exchanges

Uplinked route-improvement message:

ROUTING IMPROVEMENT [flight ident.]
DUE TO - WEEK END ROUTE [airway ident.] FLYABLE BY [time]
(or) NIGHT ROUTE [airway ident.] FLYABLE BY [time]
(or) RESTRICTED ROUTE [airway ident.] FLYABLE BY [time]
(or) RESTRICTED AREA [area ident.] FLYABLE BY [time]
PERMISSION TO PROCEED DIRECT FROM [position] TO [position]
(or) VIA [airway ident.]

Annex 1 Section 3 : System Access Parameters (SAP) Service

Service No.	Name	Abb.	Cat	References	Version No.
O-9	System Access Parameters	SAP	AM		0.1 17/7/96

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1. Scope and Objective

This data link service aims at constituting and keeping up-to-date a ground based database of aircraft parameters to be used by several different ground functions.

The service is foreseen to be primarily used in continental airspace, both in en-route and terminal areas.

2. Expected Benefits, Anticipated Constraints, and Associated Human Factors

2.1. Expected Benefits

- ⇨ enhanced trajectory prediction and monitoring,
- ⇨ availability of meteorological nowcast,
- ⇨ enhanced tracking,
- ⇨ enhanced safety nets.

2.2. Anticipated Constraints

- ⇨ transmission delay.

2.3. Associated Human Factors

None

3. Service Operational Context

The SAP service will improve the automated assistance to the controller. A better knowledge of the aircraft intentions allows to have more sophisticated alarm systems, to reduce the false alarm rate, and to provide greater anticipation. In the same way the detection of trajectory changes will be improved. It will reduce the delay between the delivery of a clearance and the feedback by the reported trajectory change on the screen, thus reducing controller's workload induced by the monitoring of instructions.

The SAP service doesn’t deal directly with the use of the parameters in ground functions. The available aircraft parameters will be used by several different ground functions which will be clients of the SAP service. This will contribute to the improvement of the ground system and will benefit to the Air Traffic Management.

4. Service Operating Method

4.1. Enhanced Trajectory Prediction and Monitoring

The ground based trajectory prediction function produces the predicted trajectory for all the flights with a time horizon which allows planning and traffic organization to be performed at different geographical levels and filters (sector level, area level, region level). After the initial prediction, flight path monitoring function detects deviations between the prediction and the actual flight path followed by the aircraft. The deviations are analysed in order to update the prediction.

Those functions use generic aircraft models (aerodynamics and engine models) and can be a lot more precise if actual aircraft data (such as weight, and speeds) are available as input data instead of default values.

The trajectory prediction performed by the ground system is used by all the main functions assisting the controller in his/her task :

- distribution of flight data to the right control unit at the right time,
- automatic coordination between sectors and between centers, based on estimated times at sector boundaries,
- display to controllers : ETO, predicted Top of Climb (ToC), Top of Descent (ToD), etc ...
- medium term (5 to 10 min.ahead) conflict detection (MTCD),
- sequencing and metering tools for arrival to airports.

The more accurate is the predicted trajectory, the more efficient those tools become. What is seeked here is to improve the precision with a look-ahead time of 10 to 30 minutes and especially in climb and descent phases where current ground systems often give poor results.

It is therefore necessary for the ground system to dispose of an accurate function in order to produce and to update as required, the predicted trajectory of all the flights in the area of responsibility. Effectively even though the airborne trajectory may become available via data-link, it will be necessary for the ground to test how ATC constraints will impact on the trajectory, for instance to solve conflicts or sequencing problems.

NOTE : One complementary way to improve the trajectory prediction is to improve the quality of the meteo forecast. This is the purpose of a separate section (see 4.2. Meteorological Nowcast, page 5).

4.1.1. Description of the role of SAP

Before the aircraft takes off or enters the area, the trajectory is predicted on the basis of :

- flight plan[1][SC1],
- default initial conditions derived from the flight plan, and
- default control values (essentially speeds, plus aerodynamic configurations for the approach phases).

When an aircraft enters the surveillance coverage, it is supposed to become visible for the SAP service at about the same moment.

In case of a departure, the first event to collect is the airborne status which allows to re-generate all the ETOs relative to this date.

In all cases, the initial conditions are updated using both SSR surveillance tracking (which provides : identification, position and altitude) and SAP parameters (which

[1] one key item of the flight plan is the **aircraft type**; then, the ICAO definition is not precise enough for accurate trajectory prediction (e.g. difference between B737-200 and B737-400 is not shown); moreover this field is sometimes erroneous due to airlines contingencies.

provides : confirmation and completion of the aircraft type, initial weight, current heading, current speed). The selected values are collected. The selected speed is compared to the one used in the model and a correction is made if necessary. The initial weight coming from SAP replaces the default value used in the first calculation. The aircraft type is updated in the flight plan.

The updated trajectory is generated on the basis of :

- flight plan,
- real initial conditions, and
- updated control values (according to current selections).

It must be noted that the predicted trajectory gives a list of 4D points, each point bearing a lot of information relative to the aircraft state at that point, which are also a result of the trajectory generation (air speed, ground speed, rate of climb/descent, heading, etc ...)

While the aircraft is progressing in the airspace, the flight path monitoring function uses both SSR tracking and SAP to :

- monitor the progress along the flight plan. The event 'change of waypoint to-go' is used to early detect that a waypoint is overflown,
- detect any discrepancy between the prediction and the actual flight path. The instantaneous parameters : speed (CAS/Mach from SAP and GS from SSR), rate of climb/descent from SAP, are used along with 3D position from SSR.
- according to thresholds, trigger a new generation of the trajectory starting from the current position and using corrected input data.

When a deviation is detected which shows that the aircraft is no longer inside its flight plan (e.g. heading deviation), a trajectory prediction is performed using current heading and selected heading if available from SAP. This prediction can be used by conflict detection functions.

4.1.2. Expected benefits

Studies performed on the modelling of aircraft performances (ref : several Eurocontrol reports dated the early 80s) show that the aircraft weight significantly impacts the performances in climb : for example, the distance (respectively the time) to climb to FL 240 may vary for as much as 30 NM (respectively 7 minutes) for a Boeing 737-100 in the range of authorized Take-Off Weights (TOW); (almost 1 NM and 10 seconds per 1% deviation in TOW).

The influence of the CAS is also very important, both in climb and in descent phase. The same studies for the same aircraft type show that the distance (respectively the time) to climb to FL 200 vary of around 1.8 NM (respectively 17 seconds) per 10 kts variation of CAS.

So the position of the ToC and the shape of the trajectory to reach the ToC may significantly vary, as well as the geometry of the potential conflicts during the climb.

In the descent phase, aircraft weight has less impact, the most important parameter remaining the selected speed.

It must be noted that a lot of control incidents are reported during vertical evolutions of aircraft.

Benefits will derive from the improved accuracy of the predicted trajectory performed by the ground system using SAP service. They are summarized below :

- provide the controller with reliable tools for MTCD,
- reduce controller workload by reducing incertitude concerning expected behaviour of the aircraft,
- improve safety by giving a more precise prediction of vertical evolutions,
- improve capacity and efficiency by allowing for more anticipation in traffic planning.

4.1.3. Transition plan

The main benefits are expected from an improved precision in the trajectory prediction function. The achievable precision will not be the same for all the flights as it will depend on a lot of parameters, an important one being the knowledge of some SAP data. Thus it is expected that the ground based trajectory prediction also provides an accuracy indicator to be used by the different tools such as conflict detection.

Benefits can therefore be obtained as soon of some aircraft are equipped and are able to provide the most important parameters. Nevertheless the benefit will be really perceptible when a significant proportion of the fleet (at least 50 %) is able to provide the most important parameters.

4.1.4. List of parameters, characteristics and mode of collection

parameter	unit	collection mode	purpose
aircraft type	string : ICAO type + version nb	once in initial conditions	trajectory prediction
aircraft weight	lbs	once in initial conditions (either Take-Off Weight, either instanneous weight when entering airspace)	trajectory prediction
heading	degree	periodic : every 10 sec in terminal airspace every 30 in en route airspace	trajectory monitoring
CAS (Calibrated Air Speed) or Mach	knots or Mach nb	periodic : every 20 sec in climb/desc every 60 sec in cruise	trajectory monitoring
rate of climb/desc	ft/min	periodic : every 20 sec in climb/descent	trajectory monitoring
selected CAS or Mach	knots or Mach nb	on event when it changes	trajectory prediction
selected heading	degree	on event when it changes	trajectory prediction
selected FL	100 ft	on event when it changes	trajectory prediction
airborne status	boolean	on event when becomes true	trajectory prediction
waypoint to-go	name or geo pos.	on event when it changes	trajectory monitoring

4.2. Meteorological Nowcast

The improvement of meteorological (Met) data for air traffic management purposes was studied by UK meteorological office (UKMO) and Meteo France under the PHARE[2] programme. This study is still going on but has already produced results (Report for Eurocontrol, PHARE Programme Task TM 02 dated December 1994).

4.2.1. Description of nowcast using SAP

The achievement of the 4D control of aircraft will require the introduction of enhanced capabilities to the overall ATM system. The single most important enhanced capability

[2]PHARE : Programme for Harmonization of ATM Research in Eurocontrol

required is the ability to provide accurate 4D trajectory prediction (TP). Key to the ability to produce accurate 4D trajectory prediction tools is the need for accurate knowledge on the Met conditions which the aircraft will encounter. To address this issue the UKMO, joined by Meteo France in 1993 investigated the Met data accuracy required and how this might be achieved using a short term forecasting technique known as “Nowcasting ”.

The Nowcasting technique uses recent observations to update prevision model results in order to improve the short term predictions.

The SAP Nowcast service consists in the use by Met office of specific airborne values to upgrade short term Met forecast. The improved forecast would be delivered to aeronautical community as airlines, ATC services, and to airborne aircraft via a specific data-link service.

4.2.2. Expected benefits

4.2.2.1. Operational requirement

As reported in the above mentionned document :

The operational requirements in terms of the accuracy of Nowcast data have been initially agreed as :

- Wind component :

  5 knots s.d. for ATC purpose (20 mn ahead),

  2.5 knots s.d. for FMS purpose (up to 1 hour ahead),

  5 knots s.d. for FMS purpose (1 - 2 hours ahead).

- Temperature :

  2.5 °C s.d. in climb.

- Anti-Icing :

  250 metre s.d. in prediction of the top and base of anti-icing use in descent.

- Turbulence :

  The prediction of turbulence is required to a high accuracy. (Note : this qualitative statement was the only operational requirement available from either the ground or airborne TP teams at that time).

4.2.2.2. Expected improvement with Nowcast

“UKMO has shown that their global NWP model forecast RMS errors can be significantly reduced... On average over a 16 month period the RMS errors for forecasts up to 2 hours ahead were reduced by about 0.5°C in temperature from 1.6°C to 1.1°C, and by almost 1m/s (2 kts) in wind component..”

and

“UKMO has also shown that their regional NWP model forecast RMS errors can be substantially reduced over the UK using a high density of reports taken from recordings of the majority of aircraft in the British Airways fleet on a particular day. Throughout most of the day the RMS errors of forecasts up to 1 hour ahead were reduced by at least 0.8°C in temperature from 2.0°C to 1.2°C and by at least 1.5 m/s (3 kts) in wind component... ”.

There are substantial benefits in trajectory prediction and aircraft operation in having significant improvement in short term Met forecast.

4.2.3. Transition issues

The improvement will be significant as soon as the density of data is sufficient to feed the Met models. A ratio of about 15% of the aircraft equipped should be sufficient to feed the models over the core area. Maybe in area where the traffic density is lower, like the northern part of Europe, a greater proportion of the fleet should be equipped.

A significant improvement in wind and temperature forecasting can already be obtained with the use of wind and temperature data (cf. 2.3.2.2.). In a second step, the collection of humidity and icing information would allow for better prevision of all meteo phenomena.

4.2.4. List of parameters, characteristics and mode of collection

The observation should be precisely positioned, especially in altitude. There is no high requirement concerning the transmission delay (can reach several minutes)

parameter	unit	collection mode	purpose
Position (4D)	lat, long, alt (ft), time	periodic (every 3 mn or every 3000 ft)	To position the information collected and to timestamp it
Wind vector	direction : degree speed : knots	periodic (every 3 mn or every 3000 ft)	nowcast
SAT (Static Air Temperature)	°C	periodic (every 3 mn or every 3000 ft)	nowcast
Humidity*	%	periodic (every 3 mn or every 3000 ft)	nowcast
Icing condition* (ice detector) or anti-icing	tbd	periodic (every 3 mn or every 1000 ft)	nowcast

*those parameters are not required in a first stage

4.3. Enhanced tracking

Multi-Radar tracking systems have recently made great progress by the use of Multiple Plots / Variable Update (MPVU) techniques. But there is still room for improvement and the use of down linked aircraft parameters looks very promising. A gain in precision for all the kinematic parameters (position, heading, speed, rate of climb or descent, mode of flight) updated by the ground tracking system for each aircraft can be reasonably expected.

Amongst all the parameters available through the mode S specific services, only those which are likely to bring significant improvement should be retained. The use of selected parameters within the ground tracking system should not be foreseen as it could result in a delay in detecting the possible violation of the initial pilot intention or control instruction.

4.3.1. Description of the role of SAP

The use of SAP could enhance both the horizontal tracking and the vertical tracking.

For the horizontal tracking, the use of the roll angle or the heading[3] could help in determining an angular speed needed for predicting in turn. The heading and ground speed could help in initiation phase. Indeed, the use of these parameters as initial values for the filter could speed up the track confirmation process .

For the vertical tracking, the very first advantage of the mode S will be the more accurate mode C information (25 ft quantification). But the use of a down linked altitude rate should be fruitful.

[3] It is to be noticed that "heading" from the ground tracker point of vue corresponds to "track angle" onboard

4.3.2. Expected benefits

The gain in precision which will result from the use of SAP depends on the initial quality of the tracking system.

4.3.3. Transition plan

Benefits can be obtained as soon as some aircraft are equipped and able to provide the relevant parameters. Nevertheless, a global benefit such as the reduction of separation minima can not be expected before the complete upgrade of the fleet.

4.3.4. List of parameters, characteristics and mode of collection

parameter	unit	collection mode	purpose
True track angle (label 313)	deg	periodic (every radar scan)	Horizontal tracking
Roll angle (label 325)	deg	periodic (every radar scan)	Horizontal tracking
Ground Speed (label 312)	kt	periodic (every radar scan)	Horizontal tracking
Altitude rate (label 365)	ft/mn	periodic (every radar scan)	Vertical tracking

4.4. Enhanced Safety Nets (STCA & MSAW)

Another type of operational scenarios using SAP are those related to the safety net functions : Short Term Conflict Alert and Minimum Safe Altitude Warning.

To begin with, the improvements of the ground tracking induced by the use of SAP will benefit to STCA and MSAW. But the direct use of SAP into those functions should allow better anticipation by giving means to improve the short term trajectory prediction. It should also help in minimising the false alarm rate.

4.4.1. Description of the role of SAP

For both functions, the use of the roll angle or the heading could help in determining an angular speed needed for predicting in turn. Furthermore, the use of selected parameters in heading or altitude could appear deciding in the mastering of false alarm rate.

4.4.2. Transition plan

Benefits can be obtained as soon as some aircraft are equipped and able to provide the relevant parameters.

4.4.3. List of parameters, characteristics and mode of collection

parameter	unit	collection mode	purpose
True track angle (label 313)	deg	periodic (every radar scan)	Short term prediction
Roll angle (label 325)	deg	periodic (every radar scan)	Short term prediction
Selected magnetic course (label 100)	deg	tbd	Prevention of false alarm
Selected altitude (label 102)	ft	tbd	Prevention of false alarm

Annex 1 Section 4 : Data Link Significant Meteorological Information (D-SIGMET)

Service No.	Name	Abb.	Cat	References	Version No.
O-11	Data Link Significant Meteorological Information	D-SIGMET	F	"ICAO Manual of Air Traffic Services (ATS) Data Link Applications"	0.2 12/11/96

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1. Scope and Objective

The D-SIGMET service provides automated assistance in requesting and delivering SIGMET information.

2. Expected Benefits, Anticipated Constraints, and Associated Human Factors

2.1. Expected Benefits

- Reduced Aircrew workload: SIGMET information doesn't need to be copied by the Aircrew if the message is printed on a cockpit printer or is recallable on a data link display. Also, the Aircrew does not have to divert attention from ATS operations to receive voice relay of SIGMET reports from ATS units;
- Reduced ambiguity in the transmitted information: data link implementation eliminates potential misinterpretation resulting from poor voice transmission quality and transcription errors during hand-copy of voice transmissions;
- Potential increased accessibility to SIGMET information: Aircrews will be able to request SIGMET information from any specified site available within the accessible data base;
- The "Update Contract" functionality (that allows Aircrews to request subsequent updates to the requested information) will provide Aircrews with the latest information of concern at all moments.
- Improved flight safety during flight phase by providing Aircrew with data otherwise unavailable.
- Improved flight economy by helping Aircrew to take appropriate decisions concerning the conduct of the flight.

2.2. Expected Constraints

- Ground systems must maintain SIGMET data bases with accurate and up to date data.

2.3. Associated Human Factors

- Disruption of Aircrew activities shall be prevented by appropriate avionics display and sound devices.
- Consideration must be given to the method and content of the D-SIGMET message display (using text and/or symbology), to ensure that it is uncomplicated, unambiguous, and easily understood by the Aircrew.

3. Service Operational Context

The purpose of SIGMET information is to advise pilots of the occurrence or expected occurrence of en-route weather phenomena which may affect the safety of aircraft operations.

The preparation and issue of SIGMET reports is the prime responsibility of meteorological watch offices (MWO). The validity period of these reports is normally of 4 hours, 6 hours being the maximum, and they are written in abbreviated plain language, using approved ICAO abbreviations.

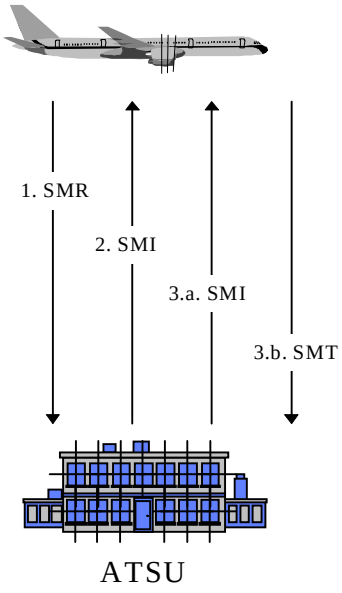
SIGMET information is often based on aircraft reports, but it may also be based on weather satellite data and on ground-based observations, such as weather radar observations, or on forecasts.

SIGMET information messages are distributed on ground initiative to aircraft in flight through associated ATS units

4. Overview of Operating Methods with and without Data Link

Step	Operating Method without Data Link	Operating Method with Data Link
1	Prior to departure, the Aircrew obtains SIGMET reports from ground operations. Once in flight, SIGMET information is received on ground initiative from ATS units.	Aircrew transmits via Datalink a D-SIGMET Request (SMR). Including an "Update Contract", if so wished.
2		The ATSU transmits via Datalink a D-SIGMET Delivery Message (SMI) to the aircraft. The SMI shall be displayed/printed onboard and the Aircrew read it.
3		a) Subsequent updates to the SIGMET info shall be sent to the aircraft, if an "Update Contract" has been requested. b) Contract termination can be requested by the Aircrew at any moment by sending a D-SIGMET Termination Message (SMT).

4.1. Information Exchange Diagram



5. Detailed Service Operating Method with Data Link

5.1. Service Availability

This Service shall be available during all flight phases.

5.2. Service Description

5.2.1. Normal Mode

The normal sequence of events is:

Step	Operation
1	The Aircrew shall transmit a D-SIGMET Request (SMR) to the appropriate ATSU. The Aircrew shall be able to specify in the SMR: • the route for which the SIGMET information is requested, and • the request mode (demand or update contract mode). *NOTE : The term "Update Contract" refers to the capability for an aircraft to automatically receive updates to a previously received SIGMET information. When an aircraft requests an Update Contract, the ATSU will send the latest SIGMET information, and any subsequent updates to that information.* An aircraft with a D-SIGMET contract shall not be precluded from sending a D-SIGMET Request (SMR) for other SIGMET information not covered in the current contract. Aircrew shall have the capability to request multiple D-SIGMET update contracts.
2	If the D-SIGMET Request (SMR) is valid, the ATSU shall transmit a D-SIGMET Delivery (SMI) message to the aircraft. Otherwise, a Response ("Unable" or a "Standby") message shall be transmitted to the aircraft and notified to the Aircrew. An "Unable" response message indicates that the requested SIGMET data is not available, or that the D-SIGMET Request (SMR) is not valid. The reason of the error shall be contained in the "Unable" response message. A "Stand-by" response message indicates that the requested SIGMET information is available and being processed for delivery before the expiration of the operational response time [to = 1 minute] or before expiration of the standby time contained in the "Standby" message. After the "Standby" response, the ATSU shall transmit a second message containing either a D-SIGMET Delivery (SMI) or an "Unable" response within the operational response time [to] or as stated in the Standby Response message. The Aircrew shall be notified of the received: a) D-SIGMET Delivery (SMI) or b) "Standby" response, or c) "Unable" response. If an "Update Contract" was not requested, the service shall end on reception of the SMI or the "Unable" response.

3	If an “Update Contract” has been requested, the Aircrew shall receive the latest D-SIGMET message (if available) and any subsequent updates to the D-SIGMET information set until termination of the contract. The “Update Contract” shall be terminated upon: 1. Manual transmission of a D-SIGMET Termination (SMT) message by the ATSU or by the Aircrew; 2. ATSU termination of the contract, after [1 hour] of service, as specified in the D-SIGMET Request (SMR), on final approach, or on landing detection. This termination shall be notified to the aircraft via a D-SIGMET Termination (SMT) message.

5.2.1.1. Sequence of Services

This Service shall be independent from of any other Service.

5.2.1.2. Additional Guidelines

None.

5.2.2. Abnormal Mode

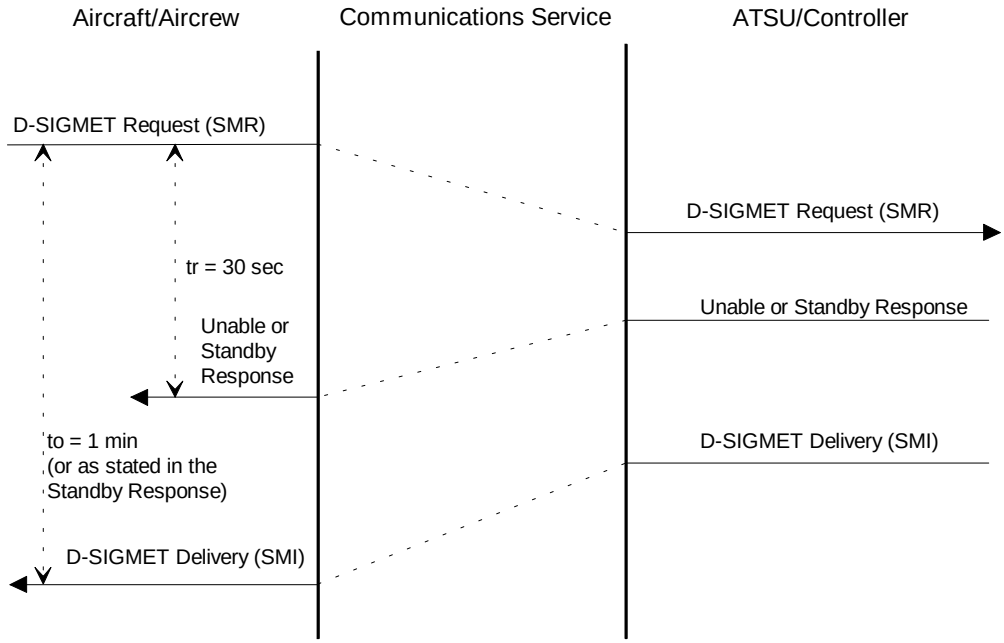
Step	Abnormal Event	Response
1	Incorrect SMR composed by the Aircrew due to: 1. SMR already requested for that route pending reception of the SMI.	Aircrew informed of the error. Message not sent.
2	Reception of a SMR at the ATSU containing a time stamp that indicates that no response can reach the originator before the established technical response time-out.	The received message shall be discarded.
2	Invalid SMR received by an ATSU due to: 1. unknown route requested; 2. the SMR can not be processed further for whatever reason.	The message shall be discarded and an “Unable” response message shall be sent to the aircraft indicating the cause of the error.
2	Reception of a SMR at the ATSU requesting an update contract that is not supported by the ATSU.	The ATSU shall transmit a SMI to the aircraft (possibly after an “Standby” response) containing: • the requested information, • the indication that the update contract is not supported.
2	Expiration of the technical response time-out [tr = 30 seconds] without reception of a response to the SMR.	The Aircrew shall be notified. This error shall not preclude the Aircrew from re-sending the D-SIGMET Request (SMR) via data link.
2	Expiration of the operational response time-out [to = 1 minute, or as stated in the “Standby” Response], without reception of the SMI or an “Unable” response.	The Aircrew shall be notified. This error shall not preclude the Aircrew from re-sending the D-SIGMET Request (SMR) via data link.
2	Doubt or ambiguity concerning the SMI.	To Be Defined

3	Unexpected discontinuation of D-SIGMET updates during a contract.	The Aircrew shall be notified when possible via a D-SIGMET Termination (SMT) message.

6. Time Sequence Diagram

This diagram shows the normal sequence of messages in the D-SIGMET service.

<NOTE: The time-out values given in the following table are indicative only and require validation through actual operations.>



7. Quality Of Service Requirements

Message Category: The D-SIGMET messages are Category 4 messages (ADSP level H).

Communications Priority: 7.

Information Urgency: Normal.

Information Security:

Data Origin Authentication: Normal

Access Control: M,A

Data Integrity: Maximum

8. Information Exchanges

8.1. D-SIGMET Request (SMR)

NOTE: In the information exchanges tables, the following codes are used for the M, I/A and O fields:

B Required and supported by the ADSP Guidance Material, (i.e. required by Both the ADSP and ODIAC)

A Not required but supported by the ADSP Guidance Material, (i.e. required by the ADSP and not by ODIAC)

O Required but not supported by the ADSP Guidance Material. (i.e. required by ODIAC and not by the ADSP)

Message contents complies with ICAO document 8896-AN/893/4 (Manual of Aeronautical Meteorological Practice). The meteorological terminology shall comply with the current ICAO documentation

Message	Message Contents	M	I/A	O	Example Ops Msg Contents	Event/ Trigger	Source/ Dest.	Alert	Response	Op. Reply
D-SIGMET Request (SMR)	Message Type	O			SMR	Aircrew input	Aircraft/ATSU	**N**	Unable or Standby if necessary	D-SIGMET Delivery Message (SMI)
	MessageIdent	O			02678					
	ICAOUnitName (ATSU)	O			LFZZ					
	FlightID	O			DLH340					
	RequestedRouteDescription	O			DIK-REM BSN					
	Contract required		O		Yes					
	Contract duration		O		30					
					MESSAGE IN FULL **SMR 02678 LFZZ DLH340 REQUEST SIGMET FOR DIK REM AND BSN UPDATES FOR 30 MN**					

8.2. D-SIGMET Delivery Message (SMI)

Message	Message Contents	M	I/A	O	Example Ops Msg Contents	Event/ Trigger	Source/ Dest.	Alert	Response	Op. Reply
D-SIGMET Delivery Message (SMI)	Message type	O			SMI	Receipt of a valid D-SIGMET Request (SMR) or, in the case of an update contract, a new message version.	ATSU/aircraft	**V**	N	None
	Location indicator	O			EBBU					
	Sequence number	O			SIGMET 1					
	Date-Time indicating period of Validity	O			VALID 221215/221600					
	Originator location indicator	O			EBWM					
	Applicable FIR	O			BRUSSELS FIR					
	Phenomenon Description	O			SEV TURB					
	Type of Information (OBS/FCST)	O			OBS AT 1210					
	Location and level	O			EBBR FL 220					
	Movement and Speed		O		MOV E 40 KMH					
	Changes in intensity (INTSF/WKN/NC)		O		WKN					
	Additional Information		O							
					MESSAGE IN FULL **SMI EBBU SIGMET 1 VALID 211215/221600 EBBM** **BRUSSELS FIR SEV TURB OBS AT 1210 EBBR FL220 MOV E 40 KMH WKN**					

8.3. D-SIGMET Termination Message (SMT)

Message	Message Contents	M	I/A	O	Example Ops Msg Contents	Event/ Trigger	Source/ Dest.	Alert	Response	Op. Reply
D-SIGMET Termination (SMT)	MessageType	O			SMT	Aircraft or ATSU termination	Aircraft/			None
	MessageIIdent	O			00071		ATSU	**Pilot:**	N	
	FlightID	O			DLH340		or	**V**		
	ICAOUnitName (ATSU)	O			LFBO		ATSU/Aircraft			
	RequestedRouteDescription	O			DIK-REM BSN			**ATSU:**		
	ContractTerminate	O			T			**none**		
	Fretext		O		MESSAGE IN FULL **SMT 00071 DLH340 LFBO SIGMET UPDATES FOR DIK-REM NO LONGER BEING DELIVERED**					

Annex 2 : ATN Implementation Issues

This Annex contains information material on alternative or additional operating methods required to implement the operational requirements respecting the constraints contained in the ICAO Manual of ATS Data Link Applications.

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Annex 2 Section 1 : Automatic Dialogue Closure

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1. Scope and Objective

This section proposes a method to automatically close open dialogues for the CPDLC Services.

2. Rationale

The Operational Requirements for the CPDLC services state:

Abnormal Event	Response
Expiration of an operational time-out (to = 2 min) without reception of the operational response message.	The Aircrew or Controller so notified should revert to voice to complete that dialogue. In case a valid response is received after the operational time-out, an ERROR response message, indicating MESSAGE LATE shall be sent to the originator. Local implementation may permit further processing of the received message, but this processing should in no way obviate the need for Controller/Aircrew notification and voice contact.

In order to be able to respond with a “MESSAGE LATE” indication and be able to process the operational responses received after the expiration of the operational time-out, the “ICAO Manual of ATS Data Link Applications” requires to maintain the exchange open (i.e. to keep the message in a table of open exchanges).

If the exchange was to be closed (i.e. to remove the message from the table of open exchanges) at the expiration of the operational time-out, when the operational response arrives late, it would be impossible to correlate it with any open exchange and the late message would have to be rejected sending an error message with the “unrecognized message reference number” indication to the originator.

Since the maximum number of exchanges simultaneously open is currently set to 64, the possibility of automatically closing open exchanges after a suitable time should be foreseen.

3. Operating Method

A new technical timer “tt” may be introduced to automatically close the open exchange as follows:

Abnormal Event	Response
Expiration of the technical timer (tt = 4 min) without reception of the operational response message.	Local closure shall be provided to the message waiting for response, closing the open exchange. The Aircrew or Controller should not be notified of the “tt” time-out. In case a response is received after the “tt” time-out, an ERROR response message, indicating “unrecognized message reference number” shall be sent to the originator.