INTERNATIONAL CIVIL AVIATION ORGANIZATION
European and North Atlantic Office

ORGANIZACIÓN DE AVIACIÓN CIVIL INTERNACIONAL
Oficina Europa y Atlántico Norte

ORGANISATION DE L'AVIATION CIVILE INTERNATIONALE
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МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ГРАЖДАНСКОЙ АВИАЦИИ
Европейское/Североатлантическое бюро

3 bis villa Emile Bergerat, 92522 Neuilly-sur-Seine Cedex, France

Reference : MTG/OGM/DLSG -07-0157 22 May 2007

Subject : **Development of a strategy for data link harmonization**

Action required :

1. Comments on a) the draft strategy for data link harmonization; and b) the amendments to the ADS-C application, to reach ICAO EUR/NAT Office by **1 July 2007**
2. Note progress of work identifying the issues and resolutions associated with providing data link services to ATN aircraft in a FANS-1/A environment

Sir/Madam,

1. The European Air Navigation Planning Group (EANPG) and the North Atlantic Systems Planning Group (NAT SPG) identified the need for convergence of data link applications between the European (EUR) and North Atlantic (NAT) Regions and mandated the ICAO EUR/NAT Office to establish a joint EUR/NAT Data Link Steering Group (DLSG) which would be tasked to develop a harmonised data link service (EANPG Conclusion 46/21 and NAT SPG Conclusion 40/7 refer). In this respect, I have the honour to inform you that the Data Link Steering Group (DLSG), at its third meeting on 16 March 2007, agreed that a draft strategy for data link harmonization developed by the aeronautical telecommunication network (ATN) Accommodation Drafting Group (ADG) be transmitted to States the Office is accredited, user States and appropriate international organizations for comment.

2. It was recognized that data link was being implemented in different regions, often with only local considerations in mind, which has resulted in different aircraft avionics and different procedures for pilots and air traffic controllers. Given that a considerable portion of aircraft and their air crews operate globally, these differences can have a significant impact on the safety and efficiency of international civil aviation. Aircraft would need to be equipped with a growing number of data link systems and pilots would have to use different data link procedures for the same tasks as they moved from one part of the world to another.

3. In an effort to support data link convergence and migration to a single automatic dependent surveillance — contract (ADS-C) application, the DLSG has developed a draft amendment to the ADS-C technical guidance contained in *Manual of Air Traffic Services Data Link Applications* (Doc 9694). The purpose of this amendment is to also better meet future evolving requirements of automated air traffic management (ATM) systems, taking advantage of aircraft with advanced capabilities. Any comments you may have thereon would be highly appreciated.

Distribution: EUR/NAT Provider States

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Tel.: National 01 46 41 85 85 International +33 1 46 41 85 85
Fax: National 01 46 41 85 00 International +33 1 46 41 85 00
E-mail: icaoeurnat@paris.icao.int
Web: http://www.paris.icao.int

4. In examining the draft strategy for data link harmonization and the draft amendment to Doc 9694 concerning the ADS-C application, the DLSG asked me to draw your specific attention to and invite your comments on any action being taken within your State that might indicate that convergence using the draft strategy for implementation of ADS-C or controller-pilot data link communications (CPDLC) or convergence towards the amended ADS-C application would prove difficult.

5. The DLSG also reviewed progress on the issues related to the accommodation of ATN-equipped aircraft in a FANS-1/A environment and the resolutions that would be necessary to support such accommodation. The DLSG agreed that the work progressed to date should be communicated to the various regional data link implementation and coordinating groups for further consideration. A table covering the various issues and resolutions is attached for your information.

Please accept the assurances of my highest consideration.

Karsten Theil
ICAO Regional Director
Europe and North Atlantic

Enclosures:

A — Draft strategy for data link harmonization (ADS-C and CPDLC)
B — Draft amendment to Doc 9694 related to ADS-C
C — Table identifying the issues and resolutions associated with providing data link services to ATN aircraft in a FANS-1/A environment

Appendix A

Draft data link harmonization strategy

- Any additional ADS-C implementation should either;

    i) utilise without change the existing FANS 1/A DO-258A/ED-100A[1] ADS-C, or

    ii) move to the full implementation of the common technical definition that will be defined based on relevant provisions and guidance material *(Manual of Air Traffic Services Data Link Applications (Doc 9694))* developed by ICAO and its technical bodies

    Partial or divergent ADS-C evolutions should not be pursued, as they will continue to promote divergent paths to the detriment to the broader community.

- Any additional CPDLC implementation should either;

    i) utilise without change the existing FANS 1/A (DO-258A/ED-100A) and ATN (DO-280B/ED-110B[2] CPDLC for ACM/ACL/AMC[3] data link services), or

    ii) move to the full implementation of the internationally agreed common technical definition, based on *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444), and other operational material as appropriate. A common technical definition might be the technical provisions for the CPDLC application (*Manual on detailed technical specifications for the aeronautical telecommunications network (ATN) based on ISO/OSI standards and protocols* (Doc 9880, First edition).

    Partial or divergent CPDLC evolutions that result in excluding messages from aircraft systems should not be pursued, as they will continue to promote divergent paths to the detriment to the broader community.

- Procedural commonalities for implementation of the above packages were considered to be essential. Regional and other implementation groups should harmonise and adopt common procedural guidance packages, rather than each region developing and promulgating unique procedures for common functions.

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[1] *RTCA/EUROCAE Interoperability Requirements for ATS Applications Using ARINC 622 Data Communications (FANS 1/A INTEROP Standard)*

[2] *RTCA/EUROCAE Interoperability Requirements Standard For ATN Baseline 1 (ATN B1 INTEROP Standard)*

[3] Air traffic control communications management/Air traffic control clearances and information/Air traffic control microphone check

APPENDIX B

PROPOSED CHANGES TO ICAO DOC 9694

Table of Contents

Explanation of Terms

Aircraft address. A unique combination of 24 bits available for assignment to an aircraft for the purpose of air-ground communications, navigation and surveillance.

Aircraft identification. A group of letters, figures or a combination thereof which is identical to or the code equivalent of the aircraft call sign. It is used in Field 7 of the ICAO model flight plan.

Air traffic services interfacility data communication (AIDC). A data link application that provides the capability to exchange data between air traffic service units during the notification, coordination and transfer of aircraft between flight information regions.

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

Automatic dependent surveillance (ADS-C) agreement. An ADS-C reporting plan which establishes the conditions of ADS-C data reporting (i.e. data required by the air traffic services unit and frequency of ADS-C reports which have to be agreed to prior to the provision of the ADS-C services).

Note.— The terms of the agreement will be exchanged between the ground system and the aircraft by means of a contract, or a series of contracts.

ADS-C contract. A means by which the terms of an ADS-C agreement will be exchanged between the ground system and the aircraft, specifying under what conditions ADS-C reports would be initiated, and what data would be contained in the reports.

Note.— The term "ADS-C contract" is a generic term meaning variously, ADS-C event contract, ADS-C demand contract, ADS-C periodic contract or an emergency/urgency alert. Ground forwarding of ADS-C reports may be implemented between ground systems.

ATS surveillance system A generic term meaning variously, ADS-B, PSR, SSR or any comparable ground system that enables the identification of aircraft.

Note.— A comparable ground-based system is one that has been demonstrated, by comparative assessment or other methodology, to have a level of safety and performance equal to or better than monopulse SSR..

Automatic dependent surveillance-broadcast (ADS-B). ADS-B is a surveillance application transmitting parameters, such as position, track and ground speed, via a broadcast mode data link, at specified intervals, for utilization by any air and/or ground users requiring it. ADS-B is a data link application.

Availability. The ability of a system to perform its required function at the initiation of the intended operation. It is quantified as the proportion of the time the system is available to the time the system is planned to be available.

Baseline information: Required information upon which to measure certain type of ADS-C events (altitude change event, air speed change event, ground speed change event, heading change event and track angle change event).

Continuity. The probability of a system to perform its required function without unscheduled interruptions during the intended period of operations.

Controller-pilot data link communications (CPDLC). A data link application that provides a means of communication between controller and pilot, using data link for ATC communications.

Data link application. A data link application is the implementation of data link technology to achieve specific air traffic management (ATM) operational functionalities. For example, in this context the current functionalities are DLIC, ADS, CPDLC, DFIS, AIDC, and ADS-B.

Data link flight information services (DFIS). A data link application that allows the exchange of pertinent flight data between air and ground users.

Data link initiation capability (DLIC). A data link application that provides the ability to exchange addresses, names and version numbers necessary to initiate data link applications.

Data link service. A data link service is a set of ATM-related transactions, both system supported and manual, within a data link application, which have a clearly defined operational goal. Each data link application service is a description of its recommended use from an operational point of view.

End-to-end transfer delay. The period elapsed from the time at which the originating user initiates the triggering event until the time the transmitted information has been received by the intended recipient.

Integrity. The probability of one or more undetected errors in a completed communication transaction..

Note.— Integrity relates to the trust which can be placed in the correctness of the information provided.

Operational requirement (OR). A statement of the operational attributes required of a system for the effective and/or efficient provision of air traffic services to users.

Note.— Explanations of other terms are provided in the Glossary and in the Data Glossaries for data link applications.

Glossary

ACARS	Aircraft communications addressing and reporting system
ACAS	Airborne collision avoidance system
ADS-C	Automatic dependent surveillance - contract
ADS-B	Automatic dependent surveillance-broadcast
AIDC	ATS interfacility data communication
AIP	Aeronautical information publication
ALRT	Alert
AMSS	Aeronautical mobile satellite service
ASM	Airspace management
ATC	Air traffic control
ATFM	Air traffic flow management
ATIS	Automatic terminal information service
ATM	Air traffic management
ATN	Aeronautical telecommunications network
ATS	Air traffic service(s)
ATSU	Air traffic services unit
C-ATSU	Controlling ATS unit
CDA	Current data authority
CNS	Communications, navigation and surveillance
CPDLC	Controller-pilot data link communications
D-ATSU	Downstream ATS unit
DC	Departure clearance
DDA	Downstream data authority
DFIS	Data link flight information services
DLIC	Data link initiation capability
DSC	Downstream clearance
ETA	Estimated time of arrival
ETD	Estimated time of departure
FANS	Special Committee for the Monitoring and
(Phase II)	Co-ordination of Development and Transition Planning for the Future Air Navigation System (Phase II)
FASID	Facilities and Services Implementation Document
FDPS	Flight data processing system
FIR	Flight information region
FIS	Flight information service
FMS	Flight management system
FOM	Figure of merit
GNSS	Global navigation satellite system
GPWS	Ground proximity warning system
HF	High frequency
IAS	Indicated air speed
ID	Identification
IFR	Instrument flight rules
LACK	Logical acknowledgement
LOA	Letter of agreement
METAR	Aviation routine weather report
Mode S	Mode select
MOU	Memorandum of understanding
MSG	Message
NDA	Next data authority
NIM	Navigational integrity monitoring
NM	Nautical miles
NOTAM	Notice to airmen
OCM	Oceanic clearance message
OR	Operational requirement
OSI	Open systems interconnection

PANS-RAC	*Procedures for Air Navigation Services — Rules of the Air and Air Traffic Services* (Doc 4444)
PIREP	Pilot report *Note.— Not specified in other ICAO documents.*
QOS	Quality of service
R-ATSU	Receiving ATS unit
RESP	Response
RGCSP	Review of the General Concept of Separation Panel
RNP	Required navigation performance
RVR	Runway visual range
SARPs	Standards and Recommended Practices
SID	Standard instrument departure
SSR	Secondary surveillance radar
STCA	Short-term conflict alert
TAF	Aerodrome forecast
T-ATSU	Transferring ATS unit
TWS	Terminal weather service
URG	Urgency
UTC	Coordinated universal time
VFR	Visual flight rules
VHF	Very high frequency
VMC	Visual meteorological conditions
WILCO	Will comply
WMO	World Meteorological Organization

PART III

AUTOMATIC DEPENDENT SURVEILLANCE - CONTRACT

Chapter 1
APPLICATION OVERVIEW

INTRODUCTION

1.1 This part of the manual contains guidance material for the automatic dependent surveillance - contract (ADS-C) application. ADS-C is the means by which the terms of an ADS-C agreement will be exchanged between the ground system and the aircraft, via a data link, specifying under what conditions ADS-C reports would be initiated, and what data would be contained in the reports. ADS-C will allow controllers to obtain position data and other information from ADS-C-equipped aircraft in a timely manner in accordance with their requirements, and will allow the aircraft to be tracked in airspace where an ATS surveillance service is not available.

1.2 The primary objective of the ADS-C application is to provide automated aircraft position and intent data for ATC. The ADS-C application may also be useful in air traffic flow management (ATFM) and airspace management (ASM).

1.3 ATM benefits from the use of the ADS-C application may include separation minima reduction, and more efficient use of airspace.

1.4 Although the application of ADS-C does not specifically encompass ATC communications, automation or procedures, all of these elements must be tailored to support the ADS-C application and to make meaningful use of the data. Therefore, it is critical to consider the ATC automation and communications systems as the foundation upon which an ADS-C based ATC system is built. The implementation of ADS-C into air traffic systems will be an evolving process. There will be a gradual transition from procedurally oriented strategic air traffic control towards a more tactical control environment.

1.5 The ADS-C application and associated communications will have to be supported by advanced airborne and ground facilities and data link communications with proven end-to-end integrity, reliability and availability.

1.6 ADS-C is one of the applications supported by the ATN.

1.7 Figure III-1-1 depicts a general overview of several components of an ADS-C system.

USE OF ADS-C IN ATS

1.8 The implementation of ADS-C, through reliable data link communications and accurate aircraft navigation systems, will provide enhanced air traffic management in oceanic airspace and other areas where air traffic control services are currently provided. The implementation of ADS-C will also

provide benefits in en-route continental, terminal areas and on the airport surface. The automatic transmission of the aircraft position through ADS-C will replace pilot position reports by voice and/or CPDLC. The content and frequency of reporting will be determined by the controlling ATC unit. In procedural airspace, the effective use of ADS-C in air traffic services will facilitate the reduction of separation minima, enhance flight safety and better accommodate user-preferred profiles.

Use of ADS-C outside the coverage of an ATS surveillance system

1.9 In oceanic and other areas which are beyond surveillance coverage, ADS-C reports will be used by ATS to improve position determination, resulting in improvements in safety, efficient utilization of airspace and improved controller efficiency. This is expected to increase airspace capacity and allow more economical routing and spacing of aircraft.

1.10 The introduction of ADS-C in airspace where an ATS surveillance system is not in use will better enable controllers to identify potential losses of separation or non-conformance with the flight plan and to take the appropriate action.

Transition airspace

1.11 In transition airspace where other means of surveillance become available, provisions are required to integrate ADS-C and other surveillance information. Further information is provided in the appendix to this chapter.

Within radar and/or ADS-B coverage

1.12 ADS-C will be beneficial in areas where it may serve as a supplement to, or as a back-up for radar and/or ADS-B. Further information is provided in the appendix to this chapter.

ADS-C related aeronautical information

1.13 Adequate information on the operating practices having a direct effect on the operations of air traffic services should be published in aeronautical information publications. This shall include a brief description concerning the area of responsibility, requirements and conditions under which the ADS-C service is available, equipment limitations, ADS-C failure procedures if required, and the initial address(es) for each ATC Unit.

FUNCTIONAL DESCRIPTION

1.14 Information received byADS-C can assist ATC in performing the following functions:

1) *Safety Alerts*. The ground system processes ADS-C information and generates appropriate safety relatedalerts and warnings.

2) *Position monitoring*. The ground system processes the incoming ADS-C information and displays it to the controller for air traffic situation monitoring.

3) *Conformance monitoring*. The position and projected profile reported byADS-C is compared to the expected aircraft position, which is based on the current flight plan. Along track, lateral and vertical deviations which exceed a pre-defined tolerance limit will permit an out-of-conformance alert to be issued to the controller.

4) *Flight plan update*. ADS-C reports that contain longitudinal variations which exceed a pre-defined tolerance limit will be used to adjust expected arrival times at subsequent fixes.

5) *Intent validation*. The intent data (eg extended projected profile) contained in ADS-C reports can be compared by the ground system with the current clearance, and discrepancies alerted to the controller.

6) *Conflict detection*. The ADS-C data can be used by the ground system automation to identify violation of separation minima.

7) *Conflict prediction*. The ADS-C position data can be used by the ground system automation to identify potential violations of separation minima.

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

9) *Meteorological forecasts*. ADS-C reports containing wind and temperature data may be used to update meteorological forecasts and hence expected arrival times at waypoints.

10) *Flight management*. ADS-C reports may assist automation in generating optimum conflict-free clearances to support possible fuel-saving techniques, such as cruise climbs requested by the operators.

ADS-C
agreements

1.15 The ATC unit controlling the aircraft should establish the composition and requirements for the transmission of ADS-C reports through an ADS-C agreement with the aircraft. This ADS-C agreement will be fulfilled by one or more contracts.

1.16 Where possible an ADS-C agreement should be established between an aircraft and the ground system prior to the entry into airspace where ADS-C is in use. An ADS-C agreement may also remain in effect for a period of time after an aircraft has exited this airspace.

1.17 Termination of an ADS-C agreement should be achieved automatically by the ground system.

Appendix to Chapter 1

INTEGRATION OF ADS-C AND SSR DATA

1. APPLICATION OVERVIEW

1.1 The safe operation of aircraft in close proximity requires an increase in the availability of accurate positional data, in order to apply reduced separation standards and increase the airspace capacity. This material concerning the integration of ADS-C and SSR data offers guidance to achieve a single calculation of aircraft position, by processing both ADS-C and radar data (data fusion). Consequently, an enhancement of tracking algorithms may be necessary, in order to take advantage of all available surveillance sources as well as process new parameters related to aircraft motion.

1.2 The primary objective of integrating ADS-C-and radar data is to take advantage of ADS-C functionality, both within areas covered by radar surveillance as well as transition areas between radar and ADS-C only coverage. Complete radar coverage in ADS-C-SSR airspace is not required, although outer horizontal limits should normally be coincident. In addition an ADS-C transition buffer zone is advisable. In areas where duplicate radar coverage is currently mandatory the integration of ADS-C data might lead to a mitigation of that requirement, as well as that for the provision of single radar coverage in areas where the installation of radar systems is not feasible or economically justifiable.

1.3 The integration of ADS-C and SSR data in areas already having multiple radar coverage will provide the system with the capability of making track quality as uniform as possible within radar-covered airspace, thus overcoming residual radar shortcomings. The integration of ADS-C and SSR data will result in the augmentation of surveillance performance in existing radar environments, as well as beyond radar coverage. –This integration will also result in a more reliable data availability for conflict detection and the conformance-monitoring function, thus reducing the probability of false alarms of this function. This will be essentially due to kinematic data measured on board and the availability of aircraft intent data.

1.4 Since the ADS-C technique relies upon the capability of an ATC Unit to set up a contract with the aircraft to send reports with appropriate content and periodicity, the contract management function will play a key role in defining the most appropriate periodicity and content to optimize the data integration. The strategy to define the best contract for this function should take into account constraints on airspace and traffic scenario, as well as aircraft flight plan and communication infrastructure performances.

2. SCOPE AND BENEFITS

2.1 The integration of ADS-C and SSR data can provide the following improvements to the surveillance function:

a) automatic acquisition of certain airborne data containing parameters, such as true track, speed, etc., which will improve the ground-tracking of aircraft;

b) availability of surveillance data when radar limitations occur. These limitations are:

1) mechanical rotation of the radar antenna, and

2) garbling, fruit and splitting;

c) coding of the altitude data in 25-foot increments and the availability of the vertical rate, as provided by ground vector or air vector, which will improve the ability of ATC to monitor and make high-quality predictions of aircraft trajectories in the vertical plane, thus improving the short-term conflict alert (STCA) function to significantly reduce the number of false alarms;

d) automatic acquisition of aircraft call-signs by ATC system, thus overcoming current problems connected with SSR code-call sign correlation and with radar identification and transfer procedures;

e) acquisition of surveillance data, when satellite data link is used to support the ADS-C function, also when radar shortcomings such as line-of-sight propagation limitations (e.g. shadowing by orography, earth curvature, low-level flight) become apparent;

f) minimization of the number of SSRs required to supply mono-radar coverage, since ADS-C fills in the small areas not covered by them (“gap filler”);

g) increase of the level of availability using ADS-C as one more level of redundancy;

h) availability of a means for a cross-check of ADS-C with navigation data or radar integrity navigational integrity monitoring (NIM);

i) possibility of adapting the degree of surveillance redundancy for each aircraft according to instantaneous ATC needs, thus providing redundancy in a very cost-effective manner.

2.2 In general the improvements in a) to i) above are applicable to integration between ADS-C and Mode A/C conventional and monopulse SSR. In addition the improvements in e) to i) are applicable also to integrated systems using SSR Mode-S.

3. PERFORMANCE CONSIDERATIONS

When considering the integration of ADS-C and SSR data, the following should be taken into account:

a) performance requirements for ADS-C, including avail-ability and integrity;

b) accuracy of both radar and ADS-C position reports;

c) use of ADS-C data, for example, as part of a data fusion and not just as back-up;

d) trajectory prediction requirements;

e) development of a common surveillance processing system, where both the ADS-C and radar tracks may be amalgamated to generate a single system track; and

f) synchronization of both radar and ADS-C update rates.

4. ADDITIONAL OPERATIONAL CONSIDERATIONS

4.1 In addition to position information, the ADS-C-SSR integration process could benefit from aircraft reporting further information, such as:

a) ground vector: containing track, ground speed and vertical rate; and

b) ADS-C event reports: including lateral deviation, altitude, speed and FOM change.

4.2 The use of this other data could substantially reduce the need for ADS-C periodic position reports.

5. ADS-C CONTRACT CONSIDERATIONS

5.1 The following criteria may have to be taken into account when defining an optimal ADS-C contract strategy:

a) flight plans and related airspace information;

b) radar coverage maps;

c) communication network capabilities;

d) aircraft capabilities;

e) accuracy requirements;

f) tracking needs; and

g) amount of the route of flight, including constraints, cleared by ATS and loaded into the FMC.

5.2 It may be necessary to define different types of contract for each phase of operations namely:

a) en-route navigation;

b) terminal area operations; and

c) ground movements.

6. EN-ROUTE OPERATIONS

6.1 For this phase of operation the main ADS-C contract could be a periodic contract (basic or basic plus ground vector or air vector, depending on aircraft capability) with a low reporting rate, because when the aircraft are flying straight and level, ground processing systems are able to achieve accurate position estimates with low rate reporting.

6.2 Use of ADS-C periodic reports containing basic information and ground vector, when available, may allow a reduction in the data rate and an improvement in tracking.

6.3 In addition, event contracts with the aircraft could allow the detection of the start of a manoeuvre. Such event contracts could indicate a change in one or more of the following parameters:

a) lateral deviation;

b) altitude;

c) vertical rate;

d) ground speed;

e) FOM;

f) heading;

g) times over metering fixes; and

h) Ability to meet vertical, lateral, and speed constraints along the route of flight.

6.4 4 Use of event reporting could minimize the number of required periodic reports.

7. TERMINAL AREA OPERATIONS

7.1 For this phase of operation the main ADS-C contract is a periodic contract (basic plus additional data, depending on aircraft capability) with a high reporting rate, since this may be necessary to satisfy the required tracking accuracy.

7.2 Use of ADS-C periodic reports with additional data (ground vector), when available, may help to minimize the reporting frequency of the required data.

7.3 It is unlikely that in this phase of operations, event reports would be necessary, since the high periodic rate would already provide a good track reconstruction capability.

8. GROUND MOVEMENT OPERATIONS

When the aircraft are moving on the airport surface, the ADS-C contract could be a periodic contract with a very high reporting rate to ensure that the required tracking accuracy is met.

9. TRANSITION

During transition phases and while ADS-C separations equivalent to radar separations are not yet achievable, ADS-C information could be employed as an assistance and back-up to an ATC surveillance service. If it is used as back-up, appropriate large separations may need to be taken into account.

Chapter 2
GENERAL REQUIREMENTS

PERFORMANCE REQUIREMENTS

2.1 Systems developed to support ADS-C will be capable of meeting the communication performance appropriate for the phase of operation.

MESSAGE HANDLING

2.2 In addition to the general performance requirements in Part I, the ADS-C application requires:

a) that messages are generated and sent in a time-ordered sequence; and

b) that messages are delivered in the order that they are sent.

2.3 When ADS-C messages are queued by the ground system and displayed for controller review, they will be handled in the following order:

a) emergency and/or urgency alert ADS-C reports;

b) event or demand ADS-C reports; and then

c) periodic ADS-C reports.

2.4 If more than one message is queued in a), b), or c) in 2.3 above, each will be handled in the order received.

QUALITY OF SERVICE

2.5 The ground system must have the ability to specify the required QOS based on a user-preferred combination of message delay, cost, and permissible error rate.

TIME REQUIREMENTS

2.6 Wherever time is used in the ADS-C application, it will be accurate to within 1 second of UTC.

2.6.1 Message time stamping

2.6.1.1 All messages will be time stamped. The time stamp will consist of the date (YYMMDD) and time (HHMMSS) and will be accurate to within 1 second of UTC.

2.6.1.2 The time stamp will indicate the time that the message is released by the controller, by the pilot, or by an automated system on behalf of the controller or pilot, for onward transmission.

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Note 1.- On the occasions when the pilot or controller make a manual input which triggers sending a message (rarely when ADS-C is in use) , the time stamp will be the time at which he/she authorises the transmission of the message (eg by pressing an "ENTER" key or by activation of a message release function in an interactive display).

Note 2.- For messages generated by a system without human intervention, the time stamp will be the time when the ADS-C application releases the completed message to the communications system.

Note 3 – This time stamp is separate from and in addition to the time in a basic ADS-C report.

Secretariat Note - will be covered by amended material in Appendix A chapter 3 which, itself will be amended to reflect the contents of the Manual on RCP

ADS-C OPERATIONAL TIMERS

2.7 In order to meet the more stringent of the performance requirements in Part I, the aircraft system should be capable of responding to a request for information within 0.5 second.

2.8 If the aircraft cannot respond with a reply message containing the requested information within 0.5 second, it sends a positive acknowledgement of receipt of the request, and must send the information within 30 seconds.

SOURCE OF ADS-C DATA

2.9 ADS-C navigational data must be supplied by the on-board navigational equipment actually navigating the aircraft.

2.10 Information, other than predicted data, contained within an ADS-C report should be no less recent than 2 seconds or ten per cent of the periodic contract rate, if applicable, whichever is the shorter. *The report time must be consistent with the data (eg position information) contained in the report*
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ADS-C REPORT AVAILABILITY

2.11 ADS-C reports will be made available to facilities other than the controlling ATC unit on the basis of ICAO provisions or mutual agreement.

ADS-C CONTRACT REQUIREMENTS

2.12 The avionics will be capable of supporting ADS-C contracts with at least four ATS ground systems simultaneously.

2.13 The avionics will be capable of supporting one demand, one event and one periodic contract with each ground system simultaneously.

2.14 If a ground system requests a contract with an aircraft, and the aircraft cannot support any additional contracts, the aircraft will reply with the ICAO facility designators of the ground systems with which it currently has contracts.

2.15 Procedures will be established to ensure that only appropriate ATC ground systems initiate ADS-C contracts with a given aircraft.

2.16 In the event of an unexpected termination of the ADS-C application, both the avionics and the ground system will be notified of the failure. The resumption of the ADS-C application is incumbent on the ground system.

2.17 An existing contract will remain in place until any new contract of the same type is accepted by both the avionics and the ground system, or until the contract type is terminated.

2.18 If latitude, longitude, level, time , or FOM become unavailable or are invalid, then ADS-C reports must continue to be sent with the FOM parameter set to zero. If subsequently, the information becomes valid or available, the FOM will reflect the accuracy of the information.

2.19 Should information contained in an optional requested block become unavailable or invalid, then the block will not be provided as part of the ADS-C report. If subsequently, the information becomes valid or available it must be included in the ADS-C report.

Chapter 3
ADS-C FUNCTIONAL CAPABILITIES

BACKGROUND

3.1 The ADS-C application is designed to give automatic reports from an aircraft to a ground system. The aircraft provides the information to the ground system in four ways:

a) on demand;

b) when triggered by an event;

c) on a periodic basis; and

d) in an emergency and/or urgency condition.

3.2 The system will be capable of distinguishing each of the four ways listed above.

OPERATING METHOD

3.3 The ADS-C application comprises the following functions:

a) establishment and operation of a demand contract;

b) establishment and operation of an event contract;

c) establishment and operation of a periodic contract;

d) cancellation of contract(s);

e) establishment and operation of emergency and/or urgency alert.

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ESTABLISHMENT AND OPERATION OF A DEMAND CONTRACT

3.4 The demand contract provides the capability for a ground system to request a single ADS-C report from an aircraft and specify which optional ADS-C data is required (if any) in addition to the basic ADS-C report.

3.5 Any number of demand contracts may be sequentially established with an aircraft.

3.6 If the avionics can comply with the demand contract request, it sends the requested report.

3.7 If there are errors in the contract request, or if the avionics cannot comply with the request, it sends a negative acknowledgement indicating the contract number and the reason for rejection.

3.8 If the avionics can partially comply with the contract request, it first sends a non-compliance notification indicating those parts of the contract it cannot comply with and the contract number. Then, it sends a second message which includes;

a) the basic ADS-C report; and

b) the information requested which can be supplied

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3.9 If the extended projected profile data block is to be requested as part of the contract request, then either a time interval or the number of points to be provided is to be included in the contract request.

ESTABLISHMENT AND OPERATION OF AN EVENT CONTRACT

3.10 The event contract allows the ground system to request the avionics to send ADS-C reports when the specified events occur, principally for the purpose of conformance monitoring by ATC.

3.11 The event contract states the event types that are to trigger reports and also any required threshold values delimiting the event types.

3.12 An ADS-C event report consists of a basic ADS-C report and any additional information required by the triggering event.

3.13 Only one event contract may exist between a ground system and an aircraft at any one time, but this may contain multiple event types.

3.14 Each time an event contract is established it replaces any event contract already in place (contract number is updated).

3.15 If the avionics can comply with the event contract request, it sends an ADS-C report with basic information, any additional required information if required by the event type, and a positive acknowledgement. Should the contracted event occur, the required ADS-C report(s) is/are sent.

3.16 If there are errors in the event contract request, or if the avionics cannot comply with the request, it sends a negative acknowledgement to the ground system indicating the contract number and the reason for its inability to accept the contract.

3.17 If the avionics can partially comply with the request, it sends a non-compliance notification indicating the contract number and those parts of the contract with which it cannot comply. Event reports are subsequently sent only for those events with which the aircraft can comply.

3.18 Should an event for lateral deviation change, vertical deviation change, level range deviation, or vertical rate change occur, a report is sent once every minute while the limit(s) specified in the contract are exceeded. These reports will cease when the event parameters return within the specified

thresholds. However, they will resume as soon as the event parameters are exceeded again. For all other events, a single report is sent every time the event occurs.

3.19 If more than one of the events described below occurs at the same time, the avionics sends separate ADS-C event reports for each event.

Event types

3.20 The following ADS-C event types have been defined:

a) vertical rate change;

b) waypoint change;

c) lateral deviation change;

d) level change;

e) level range deviation;

f) airspeed change;

g) ground speed change;

h) heading change;

i) extended projected profile change;

j) FOM (Figure of Merit) field change;

k) track angle change; and

l) vertical deviation change

Vertical rate change

3.21 The vertical rate change event can be triggered in two ways. For positive vertical rate, the event is triggered when the aircraft's rate of climb is greater than the vertical rate threshold, i.e. its rate of climb is greater than expected. For negative vertical rate, the event is triggered when the aircraft's rate of descent is greater than the vertical rate threshold, i.e. its rate of descent is greater than expected.

3.22 The ADS-C vertical rate event report is sent once every minute whenever the aircraft's rate of climb/descent exceeds the value of the vertical rate change threshold.

3.23 The avionics will cease sending ADS-C vertical rate event reports when the aircraft's rate of climb/descent is less than or equal to the value of vertical rate change threshold.

3.24 An ADS-C report sent as a result of the occurrence of a vertical rate change event will contain the basic ADS-C information and ground vector information.

3.25 Figure III-3-1 illustrates a vertical rate change event.

Waypoint change

3.26 Waypoint change event is triggered by a change in the next waypoint. This change is normally due to routine waypoint sequencing. However, it will also be triggered by a change in a waypoint which is not part of the ATC clearance but is entered by the pilot for operational reasons.

3.27 The ADS-C report resulting from a waypoint change event is sent once each time the event occurs.

3.28 An ADS-C report sent as a result of the occurrence of a waypoint change event contains the basic ADS-C information and the projected profile information.

3.29 Figure III-3-2 illustrates the waypoint change event.

Lateral deviation change

3.30 The lateral deviation change event is triggered when the absolute value of the lateral distance between the aircraft's actual position and the aircraft's expected position on the active flight plan becomes greater than the specified left or right lateral deviation threshold.

3.31 The ADS-C lateral deviation change report is sent once every minute while the aircraft's lateral deviation is greater than the value of the left or right lateral deviation threshold.

3.32 The avionics will cease sending ADS-C lateral deviation change reports when the lateral deviation of the aircraft is less than or equal to the value of the left or right lateral deviation change threshold.

3.33 The active flight plan referenced in 3.30 above is either the cleared route contained in the aircraft's navigation system, or the route as modified by the cleared lateral offset, as specified in the contract request.

Note: Use of the cleared route (without the lateral offset) with different left and right deviation thresholdwill allow for proper monitoring of an airplane deviating from the cleared route or on a weather deviation. Use of the offset route would be appropriate for monitoring an aircraft cleared on a parallel offset.

3.34 An ADS-C report sent as a result of the occurrence of a lateral deviation change event contains basic ADS-C information and ground vector information.

3.35 Figure III-3-3 illustrates the lateral deviation change event.

Level change

3.36 The level change event report is triggered when the aircraft's level differs negatively or positively from its value in the previous ADS-C report by an amount exceeding the level change threshold specified in the event contract request. If there has been no previous report, a basic ADS-C report is sent.

3.37 The ADS-C report resulting from a level change event is sent once each time the event occurs.

3.38 An ADS-C report sent as a result of the occurrence of a level change event contains basic ADS-C information and ground vector information.

3.39 Figure III-3-4 illustrates a level change event.

Level range deviation

3.40 The level range deviation is triggered when the aircraft's level is higher than the level ceiling or lower than the level floor.

3.41 The ADS-C level range deviation event report is sent once every minute when the aircraft's level is greater than the value of the level ceiling or less than the value of the level floor.

3.42 The avionics will cease sending ADS-C level range deviation reports when its level is less than or equal to the value of level ceiling and greater than or equal to the value of the level floor.

3.43 An ADS-C report sent as a result of the occurrence of a level range deviation event report contains basic ADS-C information and ground vector information.

3.44 Figure III-3-5 illustrates a level range deviation event.

Airspeed change

3.45 The airspeed change event is triggered when the aircraft's airspeed differs negatively or positively from its value at the time of the previous ADS-C report containing an air vector by an amount exceeding the airspeed change threshold specified in the event contract request. If there has been no previous report containing an air vector, a report is sent.

3.46 The ADS-C report resulting from an airspeed change event is sent once each time the event occurs.

3.47 An ADS-C report sent as a result of the occurrence of an airspeed change event contains basic ADS-C information and air vector information.

Ground speed change

3.48 The ground speed change event is triggered when the aircraft's ground speed differs negatively or positively from its value at the time of the previous ADS-C report containing a ground vector by an amount exceeding the ground speed threshold specified in the event contract request. If there has been no such previous report containing a ground vector, a report is sent.

3.49 The ADS-C report resulting from a ground speed change event is sent once each time the event occurs.

3.50 An ADS-C report sent as a result of the occurrence of a ground speed change event contains basic ADS-C information and ground vector information.

Heading change

3.51 The heading change event is triggered when the aircraft's heading differs negatively or positively from its value at the time of the previous ADS-C report containing an air vector by an amount exceeding the heading change threshold specified in the event contract request. If there has been no previous report containing an air vector, an ADS-C report is sent.

3.52 The ADS-C report resulting from a heading change event is sent once each time the event occurs.

3.53 An ADS-C report sent as a result of the occurrence of a heading change event contains basic ADS-C information and air vector information.

3.54 Figure III-3-6 illustrates the heading change event.

Extended projected profile change

3.55 The extended projected profile change event report is triggered by a change to any of the set of future waypoints that are included in the extended projected profile report. The initial response to the change event request will include the extended profile report as a baseline.

3.56 A change to a waypoint in the extended projected profile report will occur whenever:

a) The active waypoint is sequenced

b) An additional waypoint or holding pattern is inserted in the route that would be included in the report

c) A waypoint or holding pattern in the report is deleted

d) The computed location of a waypoint in the report differs from the baseline calculation by more than the tolerance value for latitude or longitude change (TOL1).

e) A lateral offset that affects the report is entered, modified or deleted

f) The predicted altitude of any waypoint in the report differs from the baseline prediction by more than the tolerance value for altitude change (TOL2).

g) The predicted ETA at any waypoint differs by more than the .greater of the tolerance value for time change (TOL3) or the tolerance value for percentage (TOL4) applied to the time to go to the waypoint.

h) The predicted speed or Mach at the waypoint differs by more than the tolerance value for airpeed change (TOL5) or Mach change (TOL6).

i) Time has passed such that a waypoint that was not previously within the time interval specified in the contract is now within that time interval, subject to the 128 point maximum limit of the extended projected profile report.

3.57 The tolerances used to determine the occurrence of an extended projected profile change should be set in the contract request. Suitable default values for these tolerances are:

a) Tolerance Parameter	b) Definition	c) Tolerance Value	d)
e) TOL1	f) The	g) 0.2	h) Extended

			minimum change in latitude or longitude of a waypoint that constitutes an extended projected profile change		minutes		projected profile change - Waypoint change
i)	TOL2	j)	The minimum change in predicted altitude at a waypoint that constitutes an extended projected profile change	k)	500 ft.	l)	Extended projected profile change - Level change
m)	TOL3	n)	The minimum change in predicted ETA at a waypoint that constitutes an extended projected profile change	o)	3 minutes	p)	Extended projected profile change - Time change
q)	TOL4	r)	The minimum change in time to go to a waypoint that constitutes an extended	s)	1%	t)	Extended projected profile change - Time percentage change

			projected profile change				
u)	TOL5	v)	The minimum change in predicted indicated airspeed at a waypoint that constitutes an extended projected profile change	w)	10 knots	x)	Extended projected profile change - Ground speed change
y)	TOL6	z)	The minimum change in predicted Mach number at a waypoint that constitutes an extended projected profile change	aa)	0.10	bb)	Extended projected profile change – Airspeed change

3.58 The ADS-C report resulting from an extended projected profile change event is sent once each time the event occurs. Subsequent events will be determined by comparison against the most recent extended projected profile report

3.59 An ADS-C report sent as a result of the occurrence of an extended projected profile change event contains basic ADS-C information and extended projected profile information with the waypoints covered by either the specified time interval or within the specified number of future waypoints.

Figure of merit (FOM) field change

3.60 The FOM field change event is triggered by change in the navigational accuracy, navigational system redundancy or in the airborne collision avoidance system (ACAS) availability.

3.61 The ADS-C report resulting from a FOM field change event is sent once each time the event occurs.

3.62 An ADS-C report sent as a result of the occurrence of a FOM field change event contains only basic ADS-C information.

Track angle change

3.63 The track angle change event is triggered when the aircraft's track angle differs negatively or positively from its value at the time of the previous ADS-C report containing a ground vector by an amount exceeding the track angle change threshold specified in the event contract request. If there has been no previous report containing a ground vector, an ADS_C report is sent.

3.64 The ADS-C report resulting from a track angle change event is sent once each time the event occurs.

3.65 An ADS-C report sent as a result of the occurrence of a track angle change event contains basic ADS-C information and ground vector information.

3.66 Figure III-3-7 illustrates the track angle change event.

Vertical deviation change

3.67 The vertical deviation change event is triggered when the absolute value of the vertical distance between the aircraft's actual position and the aircraft's expected position on the active flight plan becomes greater than the vertical deviation threshold.

3.68 The ADS-C vertical deviation change report is sent once every minute while the aircraft's vertical deviation is greater than the value of the vertical deviation threshold.

3.69 The avionics will cease sending ADS-C vertical deviation change reports when the vertical deviation of the aircraft is less than or equal to the value of vertical deviation change threshold.

3.70 An ADS-C report sent as a result of the occurrence of a vertical deviation change event contains basic ADS-C information and ground vector information.

3.71 Figure III-3-X illustrates the vertical deviation change event.

ESTABLISHMENT AND OPERATION OF A PERIODIC CONTRACT

3.72 The periodic contract provides the capability for a ground system to request periodic reports from an aircraft. The ground specifies which optional ADS-C data is required (if any) in addition to the basic ADS-C data. It also specifies the rate at which the basic ADS-C information is required and a modulus (multiple of the basic reporting rate) on the basic rate for each (if any) optional data required.

3.73.1 The avionics will be able to meet a maximum reporting rate of 1 report per second and minimum reporting rate of 1 report per 120 minutes simultaneously for each ADS-C connection established with the aircraft.
Note – to coordinate with the former OPLINKP members

3.73.2 The avionics will be able to support reporting periods from 1 through 59 seconds in increments of 1 second and reporting periods from 1 minute through 120 minutes in increments of 1 minute.

3.74 Only one periodic contract may exist between a given ground system and a given aircraft at any one time.

3.75 Each time a periodic contract is established, it replaces any periodic contract already in place (contract number is updated).

3.76.1 If the avionics can comply with the periodic contract request, it sends the requested ADS-C report with a positive acknowledgement. Periodic reports are subsequently sent at the agreed reporting rate.

3.76.2 If the avionics can comply with the periodic contract request but the ADS-C information cannot be sent within 0.5 second, it sends a positive acknowledgement (including the contract number).

3.77 If there are errors in the periodic contract request, or if the avionics cannot comply with the periodic contract request, it sends a negative acknowledgement to the ground system indicating the the contract number and reason for its inability to accept the contract.

3.78 If the avionics can partially comply with the request, it sends a non-compliance notification indicating the contract number and which parts of the periodic contract cannot be complied with. Periodic reports are subsequently sent containing only the requested information that the avionics can supply.

3.79 If the requested reporting rate cannot be met due to system degradation, then the avionics will send a non-compliance notification including the contract number and, then report at a rate that is supportable by the avionics that is closest to the requested rate. Subsequently, if the avionics can report at the requested rate it will report at that rate.

3.80 If the extended projected profile data block is to be requested as part of the contract request, then either a time interval or the number of points to be provided is to be included in the contract request.

CANCELLATION OF CONTRACT(S) OPERATION

3.81 Cancellation of contracts allows the ground system to cancel a contract or all contracts currently in operation. The ground system specifies which contracts will be cancelled. The avionics acknowledges the cancellation and ceases sending the ADS-C reports for the cancelled contract(s).

ESTABLISHMENT AND OPERATION OF AN EMERGENCY AND/OR URGENCY ALERT

3.82 This function allows the avionics to provide an emergency and/or urgency alert, either on instruction from the pilot or automatically.

3.83 When a periodic or event contract is established, or in response to a demand contract request, the emergency and/or urgency capability provides the capability for the ADS-C reports to indicate to the ground system(s) that the aircraft is in any one or more of the following situations:

a) Emergency;
b) No communications;
c) Unlawful Interference;
d) Minimum fuel;
e) Medical; and/or
f) Reserved.

Note 1.- Other than for Emergency, the above listing does not imply a heirarchical ordering.

Note 2.- No communications means loss of communications capability, both voice and CPDLC, if equipped.

3.84 When an emergency and/or urgency situation is selected by the flight crew, existing or requested ADS-C contracts will react in the following ways:

a) For a Demand contract, the report will contain the requested information plus the emergency and/or urgency condition (from those listed in 3.83 above).

b) For a Periodic contract, the existing periodic contract will remain in force but the relevant emergency and/or urgency condition (from those listed in 3.83 above) shall also be identified in any subsequent periodic report.

c) For an Event contract, any relevant event will generate an event report with the emergency and/or urgency condition indicated. Any subsequent event reports will also contain the requested event information together with the emergency and/or urgency condition .

d) In addition to any existing Periodic or Event contract , when an emergency/urgency alert is initiated in an aircraft, the avionics shall immediately send an additional unsolicited basic ADS report to all ATC ground systems with which a contract is in place. This additional report will contain the emergency and/or urgency condition information.

e) In addition, any changes to the emergency and/or urgency condition will generate a further basic ADS report showing the changed emergency and/or urgency condition.

CANCELLATION OF
EMERGENCY AND/OR URGENCY ALERT

3.85 Only aircraft can cancel the emergency and/or urgency alert. The avionics removes the emergency/urgency condition information from all ADS-C reports and any contracts (periodic, event or demand) currently in force with each ATC ground system continue normally. This will result in an additional ADS basic report as in 3.84 e) above.

SUMMARY TABLE OF

ADS-C FUNCTIONS

3.86 Table III-3-1 summarizes ADS-C functionality described above.

APPENDIX TO CHAPTER 3

3.87 The appendix to this chapter provides guidance on expected ADS-C message exchange rates in specific airspace environments.

Table III-3-1. ADS-C functionality summary

Message	*Purpose*	*Triggering conditions*	*Source/ destination*
Demand contract request	Obtain single ADS-C report on demand, specifying what data are to be reported	Controller/FDPS request	Ground-air
Periodic contract request	Request establishment of routine ADS-C reporting contract; specifying what data are to be reported and at what rate	Airspace proximity; Changing airspace conditions; Application of a reduced separation standard	Ground-air
Event contract request	Request establishment of ADS-C event contract; specifying certain flight conditions under which relevant data will be reported	Airspace proximity, changing airspace conditions	Ground-air
Noncompliance notification	Indicates which data cannot be complied with for a given contract	Contract establishment	Air-ground
ADS-C report (Demand, Periodic or Event)	Provide ADS-C data according to contract request	Contract conditions for initiating a report are met	Air-ground
Cancel contract request	Request cancellation of a specific contract	Air traffic conditions no longer require certain reporting	Ground-air
Cancel all contracts	Request cancellation of all contracts	Air traffic conditions no longer require any ADS-C reports from the avionics	Ground-air
Negative acknowledgement	Indicates that an error has been detected or that the avionics cannot comply with any part of the contract, indicating reason	Contract establishment, cancellation	Air-ground
Acknowledgement	Indicates that avionics can comply with contract, however the avionics is unable to send the initial report within 0.5 second	Contract establishment, cancellation,	Air-ground
Vertical deviation change	Absolute value of the vertical distance between the aircraft`s actual position and the aircraft`s expected position on the active flight plan becomes greater than the vertical deviation threshold	Report once every minute while the aircraft`s vertical deviation is greater than the value of the vertical deviation threshold	Basic ADS-C information, ground vector
Vertical rate change	a) positive vertical rate: aircraft`s rate of climb is	Report once every minute whenever the aircraft`s rate of	Basic ADS-C information,

	greater than the vertical rate threshold b) negative vertical rate: aircraft`s rate of descent is greater than the vertical rate threshold.	climb/descent exceeds threshold	ground vector
Waypoint change	Change in the next waypoint	Report once each time the event occurs	Basic ADS-C information, projected profile
Lateral deviation change	Absolute value of the lateral distance between the aircraft`s actual position and the aircraft`s expected position on the active flight plan becomes greater than the left or right lateral deviation thresholds	Report once every minute while the aircraft`s lateral deviation is greater than the value of the left or right lateral deviation thresholds	Basic ADS-C information, ground vector
Level change	Aircraft`s level differs negatively or positively from its value in the previous ADS-C report, by an amount exceeding the level change threshold specified in the event contract request. If there has been no previous report, a basic ADS-C report is sent.	Report once each time the event occurs.	Basic ADS-C information, ground vector
Level range deviation	a) aircraft`s level is higher than the level ceiling b) aircraft`s level lower than the level floor	Report once every minute when the aircraft`s level is greater than the value of the level ceiling or less than the value of the level floor.	Basic ADS-C information, ground vector
Airspeeed change	Aircraft`s airspeed differs negatively or positivelyfrom its value at the time of the previous ADS-C report containing an air vector, by an amount exceeding the airspeed change threshold specified in the event contract request. If there has been no previous report containing an air vector, a report is sent.	Report once each time the event occurs.	Basic ADS-C information, air vector
Ground speed change	Ground speed differs negatively or positively from its value at the time of the previous ADS-C report containing a ground vector, by an amount exceeding the ground speed threshold specified in the event contract request.	Report once each time the event occurs	Basic ADS-C information, ground vector

	If there has been no such report containing a ground vector, a report is sent.		
Heading change	Aircraft`s heading differs negatively or positively from its value at the time of the previous ADS-C report containing an air vector, by an amount exceeding the heading change threshold specified in the event contract request. If there has been no previous report containing an air vector, a report is sent.	Report once each time the event occurs.	Basic ADS-C information, air vector
Extended projected profile change	Change to any of the set of future waypoints that define the active route of flight. The number of waypoints covered in the contract is either defined by a specified time interval or by a selected number from the time of the request.	Report once each time the event occurs.	Basic ADS-C information, extended projected profile
FOM (Figure of Merit Change)	a) change in the navigational accuracy, b) change navigational system redundancy, c) change in the Airborne Collision Avoidance System (ACAS) availability	Report once each time the event occurs.	Basic ADS-C information,
Track Angle change	Aircraft`s track angle differs negatively or positively from its value at the time of the previous ADS-C report containing a ground vector, by an amount exceeding the track angle threshold specified in the event contract request. If there has been no previous report containing a ground vector, a report is sent.	Report once each time the event occurs.	Basic ADS-C information, ground vector

Appendix to Chapter 3

ADS-C MESSAGE EXCHANGE RATES

Table III-3-A1 details the possible message exchange rate of ADS-C messages for ATS purposes in the environments specified. The rates shown are the expected averages, per flight.

Table III-3-A1. Exchange rates expected for ADS-C messages

	Oceanic-continental en-route low density	*Oceanic high density*	*Continental high density*	*Terminal area high density*	*Aerodrome (includes approach, taxi and departure)*
Demand contract	1-3 per FIR/sector	1-2 per FIR/sector	1-2 per FIR/sector	1-2 per FIR/sector	3-6
Periodic contract Request	1-3 per FIR/sector	1-2 per FIR/sector	1-2 per FIR/sector	1-2 per FIR/sector	3
Event contract Request	1-3 per FIR/sector	1-2 per FIR/sector	1 per FIR/sector	1 per FIR/sector	2
Cancel contract Request	2 per FIR	2 per FIR	2 per FIR	2 per FIR	2
ADS-C periodic report (with basic ADS-C)	1 every 15-30 min.	1 every 5-15 min.	1 every 10 s-5min.	1 every 3-10s	1 every 0.5-5 s
Air and/or ground vector in ADS-C periodic report	1-3 per FIR/sector	1 every fourth report	1 every fourth report	1 every fourth report	1 every second report
Meteorological information in ADS-C periodic report	1 per waypoint, or 1 per hour	1 per waypoint, or 1 per hour	1 per waypoint, or 1 per hour	Negligible	Negligible
ADS-C event report with projected profile	1 per waypoint	1 per waypoint	1 per waypoint	1 per waypoint	1 per waypoint
ADS-C demand report with extended projected profile	1 per FIR	1 per FIR	1 per FIR	1 per FIR	1
Other ADS-C messages	Under exceptional conditions	Under exceptional conditions	Under exceptional conditions	Under exceptional conditions	Under exceptional conditions
Instantaneous number of aircraft to be supported per ATSU	300	750	1250	450	250

Chapter 4
ADS-C MESSAGES DESCRIPTION

MESSAGES DESCRIPTION

4.1 *Basic ADS-C information*. Every ADS-C report contains the following information:

a) the 3-D position of the aircraft (latitude, longitude, and level);

b) the time; and

c) an indication of the accuracy of the position data information figure of merit.

d) the contract number identifying which request the report is dedicated to.

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4.2 *Optional ADS-C information*. In addition to the basic information included in each ADS-C report, an ADS-C report may contain any (or all) of the following information:

a) aircraft identification;

b) ground vector;

c) air vector;

d) projected profile;

e) meteorological information;

f) extended projected profile; and.

g) Emergency/urgency status
   - i) Emergency;
   - ii) No communications;
   - iii) Unlawful Interference;
   - iv) Minimum fuel;
   - v) Medical; and/or
   - vi) Reserved.

4.3 The aircraft identification is contained in field 7 of the ICAO model flight plan.

4.4 The ADS-C ground vector is composed of the following information:

a) track;

b) ground speed; and

c) rate of climb or descent.

4.5 The ADS-C air vector is composed of the following information:

a) heading;

b) Mach or IAS; and

c) rate of climb or descent.

4.6 The ADS-C projected profile is composed of the following information:

a) next waypoint lat/long;

b) next waypoint - fix name (mandatory if available)

c) estimated level at next waypoint;

d) estimated time at next waypoint;

e) (next + 1) waypoint lat/long;

f) (next+1) waypoint- fix name (mandatory if available)

g) estimated level at (next + 1) waypoint; and

h) estimated time at (next + 1) waypoint.

4.7 The ADS-C meteorological information is composed of the following:

a) wind direction;

b) wind speed;

c) temperature; and

d) turbulence.

4.8 The ADS-C extended projected profile is composed of the following information:

a) next waypoint lat/long;

b) next waypoint - fix name (mandatory if available)

c) estimated level at next waypoint;

d) estimated time at next waypoint;

e) estimated speed (IAS or mach) at next waypoint;

f) (next + 1) waypoint lat/long;

g) (next+1) waypoint- fix name (mandatory if available)

h) estimated level at (next + 1) waypoint;

i) estimated time at (next + 1) waypoint;

j) estimated speed (IAS or mach) at (next +1) waypoint;

k) (next + 2) waypoint lat/long;

l) (next+2) waypoint- fix name (mandatory if available)

m) estimated level at (next + 2) waypoint;

n) estimated time at (next + 2) waypoint ...

o) estimated speed (IAS or mach) at (next +1) waypoint;

p) ... [repeated for up to (next + 127) waypoints].

q) Current gross mass and

r) Gross mass at top of descent

s) Active RTA's

t) Speed schedule

4.9 The waypoints included in the extended projected profile include both lateral waypoints (i.e. those that define the route of flight, and are usually input to the airplane's flight management system) and vertical waypoints (i.e. those associated with speed or vertical trajectory changes, which are usually determined by the airplane's flight management system).

4.10 The lateral waypoints will include:

a) Fixed waypoints used to define the route of flight (including both en-route waypoints and those contained in terminal area procedures)

b) Computed waypoints (e.g. those that are defined by reaching an altitude or flying on a heading, and are thus not fixed). These are usually contained in terminal area procedures.

c) Wherever a lateral (parallel) offset will be initiated or reached

d) Wherever the return from a lateral (parallel) offset will be initiated or completed

4.11 Lateral waypoints will be included regardless of whether they are ATC-compulsory fixes or not.

4.12 The vertical waypoints will include:

a) Wherever the airplane will initiate a climb or descent maneuver

b) Wherever the airplane will complete a climb or descent maneuver, and level off

c) Wherever a speed change of more than 10 knots IAS or 0.10 Mach is planned to be initiated

4.13 Only one waypoint will be reported for a given location, even if it corresponds to multiple lateral/vertical waypoint definitions.

4.14 Whenever a time interval is specified in the contract, all lateral and vertical waypoints (up to the maximum of 128) that will be passed within that time interval will be included in the report.

4.15 Whenever a number of waypoints is specified in the contract, then all lateral and vertical waypoints up to that number will be included in the report.

4.16 A *positive acknowledgement* indicates acceptance of a requested contract. When not sent as part of an ADS-C report, it contains only the contract number. and the contract type.

4.17 A *negative acknowledgement* indicates rejection of the requested contract and contains the contract number and information on the cause for rejection.

4.18 A *non-compliance notification* contains an indication on which part of a requested contract cannot be complied with and the contract number.

4.19 A *demand contract message* indicates the contract type, the contract number and which of the optional ADS-C information is to be included in the ADS-C report.

4.20 A *demand response message* contains the basic ADS-C data (including the contract number) and the optional ADS-C data required in the demand contract.

4.21 An *event contract message* indicates the contract type, contains the contract number and an indication of the events to be reported on, together with thresholds (as required) for each event specified.

4.22 An *event contract response message* contains an identification of the event type and the required ADS-C data (including the contract number) for the particular event.

4.23 A *periodic contract message* indicates the contract type, the contract number, the required report interval, an indication of which of the optional ADS-C information is to be included in the periodic reports, and the modulus from the basic interval for each optional field to be included.

4.24 A *periodic response message* contains the basic ADS-C data (including the contract number)and the optional ADS-C data required in the periodic contract.

4.25 A *cancel contract message* contains an indication of the contract (i.e. periodic or event) and the contract number to be cancelled. A cancel contract message without a contract type parameter indicates that all ADS-C contracts with the ground system are to be cancelled.

4.26 An ADS-C message data glossary is provided in Appendix A to this chapter. The range and resolution for variables used in ADS-C messages is presented in Appendix B to this chapter.

Appendix A to Chapter 4

ADS-C MESSAGE DATA GLOSSARY

1. ADS-C MESSAGE DATA GLOSSARY

1.1 The following data are used as the ADS-C message variables, or components of the variables, and are shown here in alphabetical order:

ADS-C event report. ADS-C information consisting of a sequence of *event type* and *ADS-C report*.

ADS-C report. ADS-C information consisting of the following sequence:

- *position*;
- *time*;
- *FOM*;
-
  - *aircraft identification* (optional);
  - *projected profile* (optional);
  - *ground vector* (optional);
  - *air vector* (optional);
  - *meteorological information* (optional);
  -
- *extended projected profile* (optional).
- *Emergency/urgency condition* (optional)

Aircraft identification. A group of letters, figures or a combination thereof which is either identical to, or the code equivalent of the aircraft call-sign to be used in air-ground communications, and which is used to identify the aircraft in ground-ground air traffic services communications.

Air speed. Provides airspeed as a choice of the following: *Mach*, *IAS*, or *Mach* and *IAS.*

Air speed change. Provides the threshold of change for either Mach speed or indicated air speed that requires that the avionics generates an ADS-C report when the current aircraft speed differs more than the specified threshold from the air speed in the last ADS-C report.

Air vector. Provides the air vector as a sequence of *heading*, *air speed*, and *vertical rate*.

Cancel contract. Allows the ground to cancel event and/or periodic contracts in effect.

Contract number. Identify an ADS-C contract with an unique number, used in contracts and associated responses.

Contract type. Indicates which type of ADS-C contract is specified: demand, event, or periodic.

Demand contract. Indicates that an avionics is to generate an ADS-C report containing the indicated data upon receipt of the contract. The data that can be indicated includes: *aircraft identification*, *projected profile*, *ground vector*, *air vector*, *meteorological information*, , and *extended projected profile.*

Distance. Distance in non-SI units.

ETA. Estimated time of arrival at a waypoint.

Event contract. Indicates *event types* and the threshold for the specified event types.

Event type. An indication of what type of ADS-C event is specified:

- *vertical rate change*;
- *waypoint change*;
- *lateral deviation change*;
- *level change*;
- *level range deviation*;
- *airspeed change*;
- *ground speed change*;
- *heading change*;
- *extended projected profile change*;
- *FOM field change*;
- *track angle change and*.
- *Vertical deviation change*

Extended projected profile. Provides a sequence (1-128) of waypoint position data and ETA at the specified waypoint.

Extended projected profile change. Indicates that an ADS-C report is to be generated when there is a change in the extended projected profile.

Extended projected profile modulus. Sequence of *modulus* and *extended projected profile request.*

Extended projected profile request. A choice indicating whether the extended projected profile information is to be provided on a time or waypoint interval, and the interval of the specified choice.

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

Way point identifier. coded designator assigned to the route point specified as airport, navaid or fix name.

Following waypoint. Indicates the waypoint after the next waypoint as a *Position*.

FOM. Indicates the figure of merit of the current ADS-C data. The information consists of the *position accuracy* and indications 1) whether or not multiple navigational units are operating, and 2) whether or not ACAS is available.

FOM field change. Indicates that an ADS-C report is to be generated when any FOM field changes.

Ground speed. Provides ground speed in non-SI units.

Ground speed change. Provides the threshold of change for ground speed that requires the avionics to generate an ADS-C report when the current aircraft ground speed has differed by more than the specified threshold from the last ADS-C report.

Ground vector. A sequence of *track, ground speed,* and *vertical rate*.

Heading. Provides aircraft true or magnetic heading in degrees.

Heading change. Provides the threshold of change for heading in degrees that requires the avionics to generate an ADS-C report when the current heading has differed by more than the specified threshold from the last ADS-C report.

IAS. Indicated air speed.

.

Lateral deviation change: Provides the threshold of change for lateral value that requires the avionics to generate an ADS-C report when the current lateral deviation exceeds the specified threshold.

Latitude. Latitude in degrees, minutes, and seconds.
Level. Specifies level in non-SI units.

Level ceiling. The level above which a level range deviation event is triggered. Provided as a *level.*

Level change. Provides the threshold of change for level that requires the avionics to generate an ADS-C report when the current level differs by more than the specified threshold from the level in the last ADS-C report.

Level floor. The level below which a level range deviation event is triggered. Provided as a *level*.

Level range change. Threshold of change permissible between levels in consecutive ADS-C reports.

Longitude. Longitude in degrees, minutes, and seconds.

Mach. Airspeed given as a Mach number.

Mach and IAS. Airspeed provided as both *Mach* and *indicated airspeed*.

Meteorological information. A sequence of *wind direction*, *wind speed*, *temperature*, *humidity* and *turbulence*.

Modulus. Provides a multiplier on the basic ADS-C report interval.

Next time. Time at next waypoint.

Next waypoint. Specifies the next waypoint as a position.

Non-compliance notification. Used to indicate partial compliance to a contract.

Periodic contract. Provides the requirements for the generation of ADS-C reports. The periodic contract provides the reporting interval, and the modulus for when and what optional data to be included in an ADS-C periodic report.

Position. Provides aircraft position information using a sequence of *latitude*, *longitude*, and *level.*

Position accuracy. An indication of the navigational accuracy.

Projected profile. A sequence of *next waypoint*, *next time*, and *following waypoint*.

Reporting interval. Provides the required ADS-C reporting interval.

Report type. Indicates which type of ADS-C report is provided: demand, event or periodic.

Request type. A choice indicating which type of ADS-C request is being uplinked. The choices are as indicated below:

— cancel event contract;
— cancel periodic contract;
— demand contract;
— event contract;

— periodic contract; or
— cancel all contracts.

Temperature. Temperature in degrees Celsius.

Time. Time at position in YYMMDD and HHMMSS format.

Time stamp. In every report in YYMMDD and HHMMSS format.
Track. Provides track angle in degrees.

Track angle change. Provides the threshold of change for track angle in degrees which triggers avionics to generate an ADS-C report when the current track angle differs by more than the specified threshold from the track angle in the last ADS-C report.

Turbulence. Indicates severity of turbulence.

Vertical deviation change: Provides the threshold of change for vertical value that requires the avionics to generate an ADS-C report when the current vertical deviation exceeds the specified threshold.

Vertical rate. Rate of climb/descent (climb positive, descent negative).

Vertical rate change. The threshold of change for vertical rate that requires the avionics to generate an ADS-C report when the current vertical rate differs by more than the specified threshold from the vertical rate in the last ADS-C report.

waypoint change. Change in the next waypoint information.

Wind direction. Wind direction in degrees.

Wind speed. Wind speed in knots.

Appendix B to Chapter 4

ADS-C VARIABLES RANGE AND RESOLUTION

1. ADS-C VARIABLES RANGE AND RESOLUTION

Table III-4-B1 provides the required range and resolution for the message variables used in the ADS-C application.

Table III-4-B1. ADS-C variables range and resolution

Category	*Variables/parameters*	*Unit*	*Range*	*Resolution*
Aircraft identification		IA5	2 to 7 characters	N/A
Airspeed	Mach IAS (non-SI)	Mach number Knots	0.5 to 4.0 0 to 1100	0.001 1
Contract Number		Integer	0 to 255	1
Date	Year Month Day	Year Month of year Day of month	1996 to 2095 1 to 12 1 to 31	1 1 1
Distance	Distance (non-SI)	Nautical miles	1 to 8 000	1
Extended projected profile	Time interval Number of waypoints	Minutes Integer	15 minutes to 20 hours 1 to 128	1 1
Extended projected profile change - Waypoint change	Longitude/Latitude minutes	Minutes	0.01 to 59	0.01
Extended projected profile change - Level change	Level (non-SI)	Feet	10 to 1000	10
Extended projected profile change - Time change		Minutes	0.1 to 30	0.1
Extended projected profile change - Time percentage change		%	0.1 to 10	0.1
Extended projected profile change - Ground speed change	Ground speed (non-SI)	Knots	1 to 100	1
Extended projected profile change – Airspeed change	Mach	Mach number	0.01 to 1.0	0.01
Facility designator		Character string	4 to 8	N/A
FOM (position accuracy)		Integer	0 to 7	1
Ground speed	Ground speed (non-SI)	Knots	-50 to +2200	1
Ground speed change	Ground speed (non-SI)	Knots	0 to 300	1
Gross mass		Kg	0 to 1000000	10
Heading	—	Degrees	0.1 to 360	0.1

Heading change	—	Degrees	1 to 359	1
IAS		Knots	0 to 1 100	1
Lateral deviation change	Distance (non-SI)	Nautical miles	0.5 to 150	0.5
Latitude	Latitude degrees Latitude minutes Latitude seconds	Degrees Minutes Seconds	±90 0 to 59 0 to 59.9	1 1 0.1
Level	Pressure altitude (non-SI)	Feet	-750 to +100 000	10
Level range change	Level (non-SI)	Feet	10 to 5 000	10
Longitude	Longitude degrees Longitude minutes Longitude seconds	Degrees Minutes Seconds	±180 0 to 59 0 to 59.9	1 1 0.1
Mach		Mach number	0.5 to 4	0.001
Modulus		Integer	1 to 255	1
Reporting interval		Seconds Minutes	1 to 59 1 to 120	1 1
Temperature		Degrees Celsius	-100 to +100	1
Time	Hours Minutes Seconds	Hours of day Minutes of hour Seconds of minute	0 to 23 0 to 59 0 to 59	1 1 1
Track	Angle	Degrees	0.1 to 360	0.1
Track angle change		Degrees	1 to 359	1
Turbulence	Relative measure	Bit string	0 to 15*	N/A
Vertical deviation change	Altitude (non-SI)	Feet	100 to 5000	10
Vertical rate	Level (non-SI)	Feet/minute	±30 000	10
Vertical rate change		Feet/minute	±30 000	10
Waypoint identifier		IA5	1 to 5	N/A
Wind	Wind direction	Degrees True North	1 to 360	1
	Wind speed (non-SI)	Knots	0 to 300	1
* To be decided.				

ADG Note 1: Some FANS-1/A resolutions are different.

ADG Note 2: Any implications of changes in above Table (eg on CPDLC) may need to be assessed.

Chapter 5
ADS-C MESSAGE SEQUENCES

Note.— These sequence diagrams illustrate the expected message sequence for each ADS-C function, and do not include exception handling.

ADS-C DEMAND CONTRACT

5.1 The sequence of messages shown in Figure III-5-1 occurs when the ADS-C demand contract is sent and the avionics can comply with the request.

5.2 The sequence of messages shown in Figure III-5-2 occurs when the ADS-C demand contract is sent and the avionics cannot comply with the request.

5.3 The sequence of messages shown in Figure III-5-3 occurs when the ADS-C demand contract is sent and the avionics cannot comply fully with the request.

ADS-C EVENT CONTRACT

5.4 The sequence of messages shown in Figure III-5-4 occurs when an ADS-C event contract is sent and the avionics can comply with the request.

5.5 The sequence of messages shown in Figure III-5-5 occurs when the ADS-C event contract is sent and the avionics cannot comply with the request.

5.6 The sequence of messages shown in Figure III-5-6 occurs when the ADS-C event contract is sent and the avionics cannot comply fully with the request.

ADS-C PERIODIC CONTRACT

5.7 The sequence of messages shown in Figure III-5-7 occurs when an ADS-C periodic contract is sent and the avionics can comply with the request.

5.8 The sequence of messages shown in Figure III-5-8 occurs when the ADS-C periodic contract is sent and the avionics cannot comply with the request.

5.9 The sequence of messages shown in Figure III-5-9 occurs when the ADS-C periodic contract is sent and the avionics cannot comply fully with the request.

Chapter 6
ADS-C PROCEDURES

INTRODUCTION

6.1 As stated earlier in the document, operational requirements do not necessarily need a technical solution, but may be satisfied by the institution of suitable local or interfacility procedures.

PROCEDURES FOR EFFECTIVE USE OF ADS-C

6.2 Advance information on the data link capabilities of participating aircraft needs to be known to the appropriate ground facilities. While this is envisaged as being contained in the flight plan, procedures must be in place to enable this information to be exchanged between units in areas where other methods of indicating aircraft intent are used.

6.3 In line with current practice, the transferring ground system will advise the receiving ground system of the capabilities and intent of the aircraft wishing to enter the receiving ground system airspace to permit proper entry of the information into the receiving ground system automation.

6.4 While at least four ADS-C contracts may be simultaneously in force, appropriate local procedures will need to be in place to ensure that non-current contracts are dropped in sufficient time to allow the receiving ground system to set up the controlling ADS-C contract. Such procedures will also take care of the case where aircraft are crossing from airspace where an ADS-C service is provided into non-ADS-C airspace, to ensure closure of all ADS-C contracts, and thus efficient use of resources.

6.5 The probability exists that errors may be input into the aircraft navigation system prior to departure. Since ADS-C is by definition dependent on the on-board navigation system, procedures will be required to ensure pre-departure conformance checking in order to correct these errors.

6.6 As ADS-C will be implemented regionally to different levels of capability, with a mixed-equipage aircraft fleet, procedures will be necessary between adjacent ATS facilities to ensure efficient levels of service to all aircraft users.

6.7 It is anticipated that specific ATC procedures will be developed as experience is gained with the system, and as appropriate separation minima are developed for global use.

6.8 ATS providers should ensure that the number of separation standards applied in a given airspace are kept to a minimum.

6.9 In a mixed environment, the source of surveillance data should be readily apparent to the controller.

6.10 In a mixed environment, procedures must be in place to ensure that all sources of the display refresh rate will be synchronous regardless of the source of surveillance information data.

Chapter 7
EXCEPTION HANDLING

HANDLING OF MESSAGES RECEIVED OUT OF SEQUENCE

7.1 The sequencing of messages between an airborne system and a ground system is dependent on the type of contract established.

7.2 If the ground system receives messages of the same contract type out of sequence, as determined by the time stamping of the messages, the ground system will terminate that contract and notify both the controller and the airborne system.

NON-RECEIPT OF MESSAGES

7.3 Non-receipt of requested ADS-C demand and periodic reports will be a matter for local implementation.

7.4 Non-receipt of requested baseline information as part of an event contract will be a matter for local implementation.

Note.— Non-receipt of ADS-C event reports may be undetectable.

INVALID DATA AND LOGICAL ERRORS

7.5 Ground systems will be capable of detecting logical errors and invalid data. In these circumstances the controller will be notified.

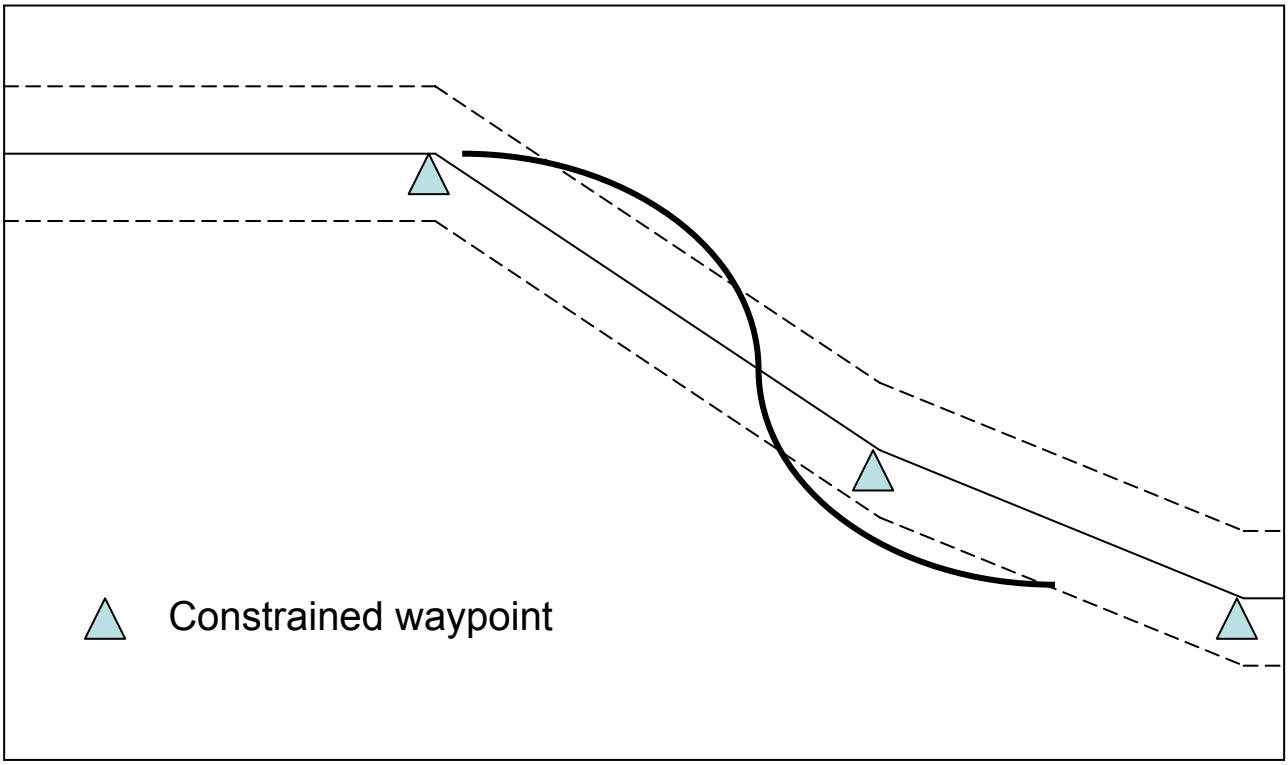

Fig III-3- X Vertical deviation change event contract

APPENDIX C

ISSUES AND RESOLUTIONS TABLES

1.1 Operational/Technical Issues Table

NB 1: The considerations in this table apply only to Link 2000+ baseline Version 1.3 (7/03/06) and do not include any pioneer a/c.)

NB 2: The Link 2000+ message set comprises the ATN B1 message elements supporting ACM, ACL, and AMC per paragraph 2.2.3.4, Table 2 4, of ED-110B/DO-280B, ATN B1 INTEROP Standard.

No.	Issue	Op or Safety	Hazard / Ops effect	Resolutions
1(a)	Some NAT-essential CPDLC (Ph 4) messages are not included in the requirements for Link 2000+ message set *NB 1: ADG/1 agreed that, since the start of NAT Phase 4 CPDLC was now scheduled for Q1 2007, it would be wasted effort to consider Phase 3 in any detail.* *NB 2: Requirements for Regions outside the NAT will need to be addressed via the DLSG*	O/S	NAT (Phase 4) CPDLC services cannot be supported by Link 2000+ aircraft. Missing messages have been identified.	ATN aircraft operating in a FANS-1/A environment must include additional messages. Resolution agreed.

1b	When carrying out the comparison of NAT-essential CPDLC (Ph 4) messages against the Link 2000+ message set, it was noted that some Link 2000+ messages are not included in the NAT Phase 4 message set. Operational advice on how these messages should be handled is needed.	O	LINK 2000+ messages not included in the NAT Phase 4 CPDLC message set have been identified.	Ground systems need to accommodate these downlink messages but uplink messages should not necessitate any accommodation requirements. The resolution for the downlink messages identified is that Ground systems should reject them and reply appropriately, namely "MESSAGE NOT SUPPORTED BY THIS ATS UNIT". Resolution agreed.
1(c)	Some FANS-1/A messages are not planned for NAT (Phase 4). These have been identified.	O	Not an issue for NAT/EUR but may affect other Regions.	Not an issue for the NAT but may affect other Regions. Wider consultation will be performed by the ADG and the ICAO Secretariat. For the downlink messages, the aircraft would receive a UM162 response message and display to the flight crew either SERVICE UNAVAILABLE or MESSAGE NOT SUPPORTED BY THIS ATS UNIT, depending on the vintage of the aircraft.
2	Parameter differences between ATN and FANS1/A ADS-C & CPDLC need to be considered. AFN and ATN context management parameter differences also need consideration.	O	Reduced operational flexibility.	Parameter differences have been identified between the LINK 2000+ ATN messages and the FANS 1/A messages. Further work is needed on parameter differences.

3a	ADS-C function is not included in the requirements for Link 2000+.	O	Current NAT ADS WPR service cannot be used for position reporting by these aircraft.	There were two options here: 1. Use current ADS-C SARPs functionality (Doc 9705, Edition 2 + PDRs). 2. Evolve the ADS-C SARPs to include new improvements (if feasible within one year). DLSG has agreed that option 2 should be followed and ADG has developed proposals for draft changes. (Ref DLSG/3, WP03) Resolution agreed.
3b	ADS-C ATN needs to be at the appropriate quality of service (including level of integrity) for route conformance monitoring and to detect loss of separation.		ATN aircraft would need different operational procedures for position reporting, because ADS functionality could not be used.	Resolution to be determined. The target quality of service for ADS-C in the future environment needs to be defined. The ATN protected mode can provide a level of integrity equivalent to the FANS-1/A CRC algorithms (ARINC 622).
4a	The requirements for Link 2000+ lack SATCOM (Data-3) capability.	O	Long range communication capability, e.g., SATCOM (Data-3) is required to support oceanic use of ATN datalink.	Existing ATN avionics need to be modified to add the capability to use SATCOM (Data-3) for the air/ground link. Current indications from avionics manufacturers are that, if an aircraft is already equipped for SATCOM (Data-3), then providing ATN connectivity is feasible. (NB: VDL/SATCOM [& vice versa] transfers for ATN have not previously been tested). Need to check with Data Link Service Providers (DSPs) and others to see if there are any ground network implications. (SITA have advised that satellite Ground Earth Stations (GESs) have had a Data-3 capability since the mid-90s). Business issues need to be considered for maintenance/selection of a network with respect to the charging mechanisms for data traffic. Resolution agreed.

4b	Consider technical implications of the transition from oceanic to domestic operations (and vice versa) – including timer and multiple sub-network connectivity issues.	O/S	Disrupt continuity of communication services.	Further work required to address transfers from SATCOM to VDL2 & vice versa. Need to check with DSPs and others to see if there are any ground network implications. SITA advise that they cannot comment on this issue since no one has yet attempted to carry out such transfers between ATN subnetworks. However, they believe that, if the ATN Router is set up correctly a transfer should work as the Router should have different timer values set for the two air/ground communication media.
5	Oceanic ATN connectivity needs to be defined and tested.	O	No confidence in system performance.	Regional Groups will decide how best to address this issue. Interfacing with adjacent areas must be considered. Resolution agreed – local implementation issue.
6	ATN timers for oceanic operation need to be defined (VDL2 & SATCOM timer requirements likely to differ).	O/S	Mismatched timers would result in repeated loss of data link connection(s)	This issue has an impact on both workload and safety. Detailed study is required to determine resolution for issues such as message latency timers.
7	Consider log-on & handover sequences and mitigate FANS-1/A differences (ATN latency timer issues).	O	Disrupt continuity of communication services.	Analysis of the operational steps and message exchanges differences to be performed.
8	Ground based HMI and procedures implications of possible differences in ATN & FANS-1/A message sets.	O	Operational disparities.	Need to cater for some message wording differences between FANs-1/A and ATN messages. Also, need to consider response attributes, use of free text, etc. Solutions will need to be assessed for their impact on the aircraft and flight deck procedures. International guidance and criteria are needed on how and when it is appropriate to use free text. Resolution agreed.
9	Absence of CPDLC integration and automation in ATN aircraft, including auto-load and auto-trigger of reports.			[DLSG Issue. Moved to section 1.2.

10	Consider operational implications of the transition from oceanic to domestic operations (and vice versa), including dialogue timers.	O/S	Embedded in ED110B/DO-280B are several timers above the CPDLC application (e.g., that can discard a received message, terminate an open dialogue etc). These will need to have different values defined for the ocean and interoperability mechanisms (both air & ground) defined and implemented to reset the timers as the a/c passes from continental to oceanic airspace (and vice versa).	ED-110B/DO-280B should not make timer values fixed. This issue should be considered in the finalisation of ED-110B/DO-280B. Is a static value for the LACK timer acceptable? Operational timers include tts, ttr, tr and latency timers - are they all needed in the aircraft? a) in continental airspace? b) In oceanic airspace?

1.2 Strategic/Business Case/Policy Issues Table

No	Issue	Op or Safety	Hazard / Ops effect	Comments
1	Not apparent when there will be a substantial volume of ATN-capable traffic on the NAT. *NB 1: ATN capable aircraft are defined as those meeting the requirements of the LINK Baseline document – ref section 1.2, 4th bullet.*	O	Need sufficient traffic/demand to justify cost involved in accommodating ATN traffic.	An action was placed at DLSG/2 to obtain this data – not an ADG issue.
9	Absence of CPDLC integration and automation in ATN aircraft, including auto-load and auto-trigger of reports.	O	Potential for human error and missed reports.	Not an accommodation issue at this moment because it is not a stated requirement for autoload and auto trigger of reports at this moment. DLSG should be asked to confirm this for other Regions. CPDLC automation is highly desirable and might be a requirement in the future. CPDLC automation may be required in order to meet the integrity and performance requirements for operations in a specific area. *NB 2: the requirement also needs to be confirmed on DATALINK – until then it is not a firm accommodation issue.* *NB 3: Lack of CPDLC integration renders CPDLC position reporting problematic since all position data would have to be manually entered by the flight crew. This would rule out CPDLC position reporting as an alternative to ADS WPR. (It is NAT IMG`s stated policy that any position data in data link position reports must be automatically entered. It is recognized that transcription errors can occur if such data is entered manually and, for safety reasons, this must be avoided.*

No	Issue	Op or Safety	Hazard / Ops effect	Comments
11	The accommodation of ATN aircraft in FANS-1/A airspace will require the definition of a revised ATN baseline which should be an update of ED-110B/DO-280B in order to ensure backwards compatibility with domestic operations. Upgrade to the new baseline is the responsibility of States. For example, European data link operations based on the ATN baseline 1 will not require the upgrade to the new baseline.	O	Need appropriate interoperability standards.	The issues identified in this paper indicate that an ATN baseline 2 definition is needed to define a set of data link services and applications that can be used worldwide in both oceanic and domestic airspace and that would eventually replace FANS-1/A. The issue resolutions, such when using static timers across regions of airspace, and follow-on NAT trials specification, under consideration by the ADG, should contribute to the validation of these interoperability standards.