Network Manager Directorate

EUROCONTROL

Generic Requirements for an ATN/VDL Mode 2 Air/Ground Communications Service Provider

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DOCUMENT APPROVAL

The following table identifies all management authorities who have successively approved the present issue of this document.

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DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document.

EDITION NUMBER	EDITION DATE	REASON FOR CHANGE	PAGES AFFECTED
04-May-07	1.3	Incorporation of mutually agreed LIT comments	
16-Jun-08	1.4	Incorporation of requirements relating to • Compliance with ARINC 631-5 • VDL multi-freq • Integrity of IDRP routes • Non-AOC operators.	
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27-Jun-08	1.4.2	Incorporation of further comments following internal LINK review.	
05-Aug-08	1.4.3	Incorporation of all mutually agreed comments following review in readiness by LINK team for UAC Maastricht Call for Tender.	
14-Aug-08	1.5	Document updated and released for Maastricht Communication Service Call for Tender, after the LIT internal team review	
14-Nov-09	1.6	Incorporation of mutually agreed comments following LIT review.	
16-Mar-12	1.7	Update document to reflect: • Updated NPD • Compliance with ARINC 631-6 • Reference to emerging ETSI standards • Clarification of requirements relating to VDL multi-frequency following LIT discussion • Clarification of requirements relating to service to Non-AOC operators following LIT discussion.	
19-Dec-12	1.8	Incorporation of mutually agreed comments following stakeholder review: • Emphasize option of ANSP to connect directly to multiple Primary ACSPs, and implications for IDRP route advertisement to ANSP • Requirement to meet Service Levels when operating on a shared channel subject to overall load • Removal of relaxed Availability, Reliability and Continuity requirements applicable to	

		Pioneer Phase.	
29-Oct-13	1.9	Update document following internal review • Refer to SES DLS Implementing Rule • Refer to Community rather than EUROCONTROL DLS Spec • Clarify option for ANSP to connect directly to multiple ACSPs • Reproduce provisions from NPD relating to non-AOC operators	

REVIEW TABLE

Edition No.	Review type, scope, depth & focus	Reviewers	Date	Conclusion
1.9	Technical content, editorial	Isabelle Herail, David Isaac, Patrick Delhaise.	September 2013	Document updated.

Table of Contents

1. INTRODUCTION

Note: The purpose of this document is to provide a reference for use by ANSPs to form the basis of a contract or agreement with an ACSP for the provision of ATN/VDL Mode 2 service incompliance with the Sigle European Sky (SES) Data Link Services Implementing Rule (DLS IR) enacted by Regulation 29/2009. It takes into account analysis performed by EUROCONTROL to establish the appropriate requirements together with experience gained during the Pioneer Phase of the LINK 2000+ Programme. The document aims to specify the minimum requirements to be satisfied by an ACSP, although ANSPs may add additional requirements or adjust those in this document to reflect local circumstances (such as network architectures). The scope of the Evaluation Tests defined in the Annexes reflects for completeness the tests required by EUROCONTROL, but may be amended by ANSPs to conform with their local procedures. This document makes reference to the following ANSP Specific Requirements that should be provided in complimentary documentation:

- *ANSP Specified Service Volume – throughout which the ACSP is required to provide the service. In addition it also specifies the minimum number of flights within that volume that the ACSP is required to support.*

- *ANSP Specified Capacity – stating the minimum number of uplink and downlink ATC application messages per hour that the ACSP is required to support.*

- *ANSP Specified Neighbouring ANSPs – stating the neighbouring ANSPs to which the ACSP is required to provide connectivity.*

- *ANSP Specified Connection to the Primary ACSP – describing the connection and protocol to be implemented at Interface 'A'.*

1.1 Scope

1.1.1 This document provides the generic requirements specification for the provision of VDL Mode 2 Service supporting ATC data link services in the context of the Single European Sky (SES) Data Link Services Implementing Rule (DLS IR) enacted by Regulation 29/009. This comprises the requirements for the provision of ATN/VDL Mode 2 services to equipped aircraft using the data link ATC services provided by an Air Navigation Service Provider (ANSP).

1.2 Definitions

1.2.1 In this document:

- An "ACSP" refers to any Air/Ground Communications Service Provider (either Primary or Alternative).

- ANSP refers to an Air Navigation Service Provider providing ATC data link services in accordance with the requirements of the Data Link Services Implementing Rule.

- The "Primary ACSP" refers to the ACSP contracted to provide ATN/VDL2 services via a direct connection to a given ANSP.

  Note 1: It is expected that only one Primary ACSP will be contracted by an ANSP, but it is not excluded that an ANSP may contract with more than one ACSP.

  Note 2: An ANSP may itself act as the Primary ACSP. In such cases the requirements applicable to the Primary ACSP are also applicable to the ANSP.

- An "Alternative ACSP" refers to an ACSP which provides ATN/VDL2 service to equipped aircraft under the jurisdiction of a given ANSP, under an agreement that specifies that it is connected via the Primary ACSP to the ANSP.

- An "Equipped Aircraft" refers to an aircraft equipped for ATC Data Link Services in accordance with the Implementing Rule..

- The "Service" refers to the ATN/VDL Mode 2 Communications Service provided by an ACSP, operating in compliance with this specification, and for the purpose of providing ATC Data Link Services offered by an ANSP to equipped aircraft.

1.3 Semantics

1.3.1 Throughout this document the following words shall have the meanings prescribed:

"*shall*" denotes a mandatory requirement

"will" denotes a statement of intent

"should" denotes a preference.

1.4 References

[1] Link 2000+ Network Planning Document (CFC/Datalink/NPD), edition 3.007, November 2013

[2] EUROCONTROL SPECIFICATION on Data Link Services
EUROCONTROL-SPEC-0116
V 2.1 EUROCONTROL January 2009

[3] Inputs, Assumptions and Target Performances for VDL 2 Traffic Simulations.
V1.4 EUROCONTROL Feb 2005

[4] Interpretation of EUROCAE ED-120/RTCA DO-290 Performance Requirements.
V1.3 EUROCONTROL May 2007

[5] Supplement 6 to ARINC Specification 631: VHF Digital Link (VDL) Mode 2 Implementation Provisions.
ARINC Specification 631-6
ARINC Inc. November 2010

[6] Data Link Services (DLS) System; Community Specification for application under the Single European Sky Interoperability Regulation EC 552/2004; Requirements for ground constituents and system testing.
EN 303-214 Ver 1.2.1
European Telecommunication Standards Institute (ETSI) April 2012

Note: ETSI EN 303-214 is intended to be equivalent to the provisions of the EUROCONTROL SPECIFICATION on Data Link Services [2] relating to the ground system, with the addition of requirements on system testing.

[7] VHF air-ground Digital Link (VDL) Mode 2; Technical characteristics and methods of measurement for ground-based equipment; Part 1: Physical layer and MAC sub-layer.
EN 301 841-1 Ver 1.3.3 Early Draft
European Telecommunication Standards Institute (ETSI)

[8] VHF air-ground Digital Link (VDL) Mode 2; Technical characteristics and methods of measurement for ground-based equipment; Part 2: Upper layers.

EN 301 841-2 Ver 1.1.1
European Telecommunication Standards Institute (ETSI) March 2004

[9] VHF air-ground Digital Link (VDL) Mode 2; Technical characteristics and methods of measurement for ground-based equipment; Part 3: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE directive.
EN 301 841-3 Ver 1.1.3 Stable Draft
European Telecommunication Standards Institute (ETSI)

Note 1: ETSI EN 301 841-1, EN 301 841-2 and EN 301 841-3 are applicable to the Physical/MAC layers, higher layers, and conformance with the Radio and Telecommunications Terminal Equipment (R&TTE) directive respectively of ground based VDL Mode 2 equipment. Formal reference to the requirements of these ENs is expected to be incorporated into the current document following adoption and publication of all three ENs.

Note 2: EUROCONTROL is currently preparing a document, in consultation with stakeholders, outlining VDL Deployment Guidelines, including provisions relating to multi-frequency implementation. It is intended to reference this document once a mature version is available.

2. THE ATN/VDL MODE 2 OPERATIONAL COMMUNICATIONS SERVICE

2.1 Preamble

2.1.1 The Link 2000+ Programme has previously established a number of principles governing the provision of ATN/VDL2 service to ANSPs and equipped aircraft. These principles are intended to preserve the necessary freedom for aircraft operators to choose an ACSP in accordance with their policy for use of AOC communication. These principles now apply to the European deployment of ATC datalink in accordance with the Single European Sky (SES) Data Link Services Implementing Rule (DLS IR) enacted by Regulation 29/2009.

Note: By avionic design, there are technical obstacles preventing an aircraft to use one VDL2 service provider for its AOC communications and another for its ATC Communications.

2.1.2 A full explanation of the principles and their impact can be found in the Network Planning Document [1].

2.1.3 In accordance with these principles an ANSP will select a Primary ACSP to provide ATN/VDL2 service to equipped aircraft in the airspace under the jurisdiction of the ANSP. The ANSP will connect directly to the Primary ACSP. Any equipped aircraft may choose to use the ATN/VDL2 service available from the Primary ACSP to support ATC Data Link Services offered by the ANSP.

2.1.4 However, some operators may choose to use the ATN/VDL2 service offered by an Alternative ACSP *(e.g.* in order to maintain AOC communication with their existing provider) without a direct connection to the ANSP. Such Alternative ACSPs, will interconnect either directly or indirectly with the Primary ACSP to provide an ATN communication path to the ANSP.

Note: The terms Primary ACSP and Alternative ACSP are applicable only in the context of a specified ANSP. The Primary ACSP to a particular ANSP may also act as the Alternative ACSP to a neighbouring ANSP. Further explanation is available in the Network Planning Document [1].

2.1.5 ANSPs may elect to connect directly to two or more ACSPs, in which case each such ACSP shall act as a Primary ACSP. This architecture imposes additional requirements relating to the advertisement of IDRP Routes by the ACSP to the ANSP, as described in paragraph 2.4.3.2 of this document.

2.1.6 This specification identifies the minimum ATN/VDL2 service requirements that an ACSP must comply with, in order to offer connectivity to support ATC Data Link Services to equipped aircraft.

2.2 Provision of the Service

2.2.1 An ACSP shall offer connectivity to support ATC Data Link Services from an ANSP only when written authorization has been issued by that ANSP.

Note: ANSPs may further specify the aircraft to which the connectivity will be offered.

2.2.2 Such authorization will not be given until the ACSP has demonstrated compliance with this specification by successful completion of the Validation Procedures specified in Section 3 of this document as well as compliance with any additional requirements specified by the ANSP.

2.2.3 An ACSP shall provide a written undertaking to the ANSP to maintain compliance with the requirements of this document during operational service.

Note: In the case of the Primary ACSP, such an undertaking should form part of the contract with the ANSP. In the case of an Alternative ACSP, the undertaking may take the form of a contract, but other forms of agreement are not excluded.

2.2.4 Authorization to offer connectivity to support ATC Data Link services to equipped aircraft may be withdrawn from an ACSP in the event that non-compliance during operational service on the part of an ACSP with any requirement specified by this document has not been corrected by the procedure described in section 2.6.

2.2.5 The Primary ACSP shall offer connectivity to support ATC Data Link Services to any equipped aircraft (including non-AOC aircraft) operating under the jurisdiction of the ANSP.

2.3 Service Volume

2.3.1 An ACSP shall provide service within the ANSP Specified Service Volume.

2.4 Functional Requirements

2.4.1 An ACSP shall comply with all applicable requirements specified by the Community Specification on Data Link Services [6].

Note: The Community Specification on Data Link Services defines detailed requirements, explanatory materials and conformity assessment materials relating to the ground constituents, providing means of compliance (MOC) associated with the Single European Sky Implementing Rule on Data Link Services (Regulation 29/2009). The Community Specification includes requirements for compliance with ICAO Annex 10 and ARINC 631.

2.4.2 Service Boundaries

2.4.2.1 Figure 1 illustrates the scope of the service and the service boundaries.

Note: Figure 1 illustrates the case of an ANSP with a single direct connection to a Primary ACSP, which is interconnected with other Alternative ACSPs. However, it is not excluded that an ANSP

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may implement direct connections to more than one Primary ACSP (i.e. via multiple instantiations of Interface A). In such an event, special considerations apply to the advertisement of IDRP Routes
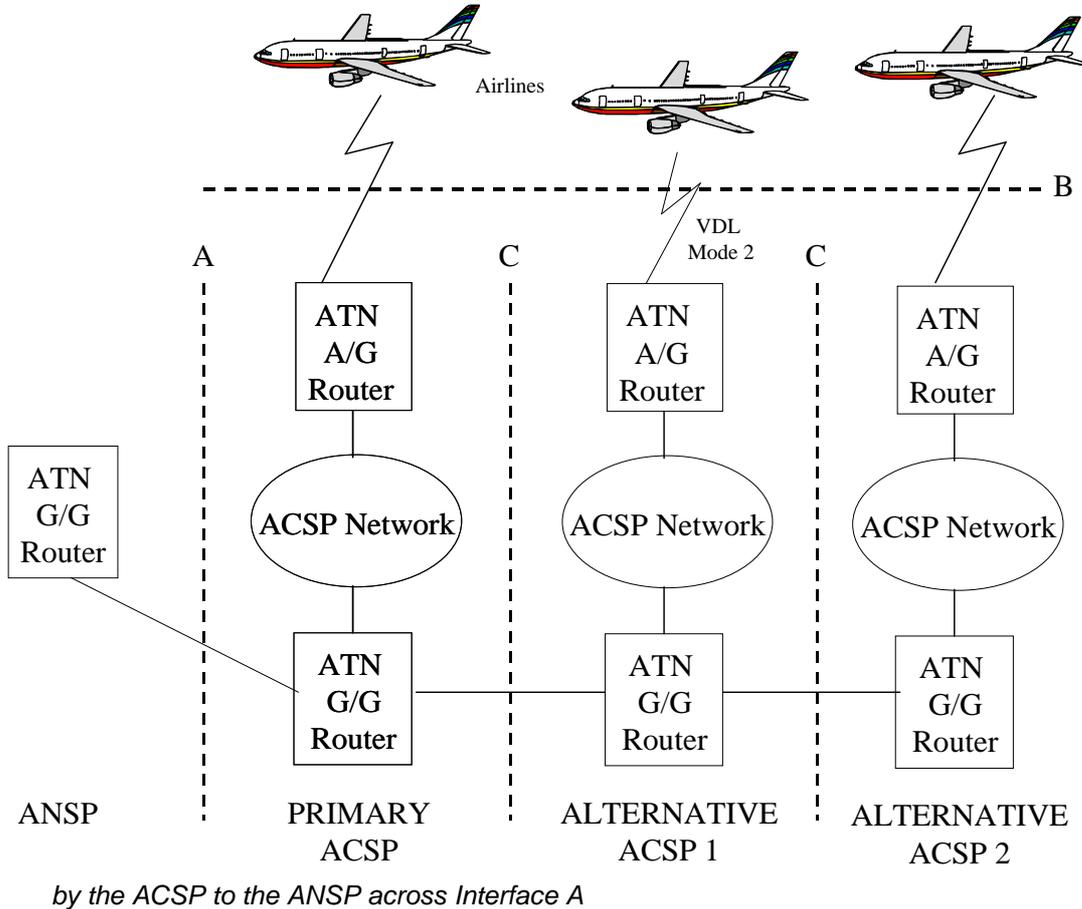

by the ACSP to the ANSP across Interface A

Figure 1 Service Interfaces

2.4.2.2   An ACSP shall provide the service to equipped aircraft (Reference Point 'B' in Figure 1) as specified below in section 2.4.4.

2.4.2.3   The Service provided shall be an ICAO ATN compliant communications service permitting communication between the ANSP and an equipped aircraft using VDL Mode 2 as the air/ground communications service.

2.4.2.4   An ACSP shall provide an ATN Air/Ground Router as part of its service.

Note 1: Although the description of the required service makes reference to separate ACSP Ground/Ground and Air/Ground Routers, this is not intended to force the separation of these functional entities into separate physical units.

Note 2: Reference point 'B' is assumed to be located at the aircraft's VHF antenna.

2.4.2.5   An ACSP shall be responsible for configuring and maintaining its systems in order to ensure that the required communications service is provided in accordance with the Service Level requirements given in section 2.5.

2.4.3   Reference Point 'A' Connection to ANSP

2.4.3.1   The service interface at Reference Point 'A' shall comply with the requirements of the ANSP Specified Connection to the Primary ACSP.

2.4.3.2   The ACSP shall advertise IDRP Routes via Interface A to enable end-to-end communication between the ANSP and aircraft reachable via the Primary ACSP, and those reachable via interconnected Alternative ACSPs. In the event that the ANSP is directly connected to more than one Primary ACSP, all IDRP Routes advertised to the ANSP shall include sufficient information to enable the ANSP to determine the optimum route to an aircraft (with the possible exception of aircraft without a preferred ACSP), in accordance with the ANSP's requirements. Generic prefixes will not allow such a determination.

Note 1: Two possible approaches can be foreseen when the ANSP is directly connected to interconnected ACSPs. ANSPs may require ACSPs to advertise long prefixes representing routes to individual aircraft. However, this would imply receipt of routing information updates every time an aircraft connects or disconnects from the ATN, and ANSPs should be aware of the considerable burden on the loading and configuration of their G/G Routers that could arise as a result. ACSPs are recommended to avoid such an approach except where it is specifically required by an ANSP. Alternatively, route prefixes to individual airlines or operators may be advertised to the ANSP by the preferred ACSP of those airlines/operators. This would avoid an excessive burden on the G/G Router associated with routes to individual aircraft. However, additional arrangements might be needed in the case of non-AOC operators without a preferred provider; either long prefixes to individual aircraft could be advertised in such cases, or else a generic prefix which would apply in the absence of a more specific prefix, recognising that ATN traffic routed by means of a generic prefix might be transferred sub-optimally via the ACSP interconnection.

Note 2: Furthermore, when directly connected to interconnected ACSPs, Routing policies must be implemented in the ANSP's G/G Router, taking into account the routes advertised by the ACSP, to ensure that wherever possible the shortest path to an aircraft is selected for end-to-end communication, and to avoid re-advertisement of mobile or fixed routes received from one adjacent ACSP to other adjacent ACSPs, which could lead to inappropriate traffic routing and transit.

2.4.4 Reference Point 'B' Service Provision to Equipped Aircraft

2.4.4.1 Any ACSP providing ATN/VDL2 service to equipped aircraft under the jurisdiction of a given ANSP shall provide an interface at Reference Point 'B' in accordance with the following requirements.

2.4.4.2 The VDL Mode 2 Service provided shall be compliant with ARINC Specification 631-6 "VHF Digital Link Implementation Provisions" [5]. The ACSP shall support all functionality specified by ARINC 631-6 [5] PICS as Mandatory for a Ground provider, and shall not implement functionality prohibited by these PICS.

2.4.4.3 The ACSP shall support VDL Mode 2 operation on the number of frequencies necessary to ensure that the Service Level Requirements specified by Section 2.5 are maintained, subject to the allocation of VHF frequencies to VDL Mode 2 by the appropriate regulatory authorities. The ACSP shall be capable of operating on VDL frequencies shared with other ACSPs, including en-route frequencies as well as those dedicated exclusively for use by aircraft on the ground. Service Level Requirements shall be satisfied on a shared VDL frequency provided the overall load on the frequency remains consistent with guidelines issued by the EUROCONTROL Data Link Services Central Reporting Office (CRO). The ACSP shall exercise frequency management with the objective of maintaining compliance with the Service Level Requirements for all connected aircraft at all times. The ACSP shall support monitoring of the use of shared VDL frequencies through the provision of mutually agreed data to the CRO and other regulatory bodies nominated by the ANSP. The ACSP shall comply with guidance issued by the CRO to ensure an efficient utilisation of shared VDL capacity.

Note: EUROCONTROL simulations indicate that at least three frequencies will be required to support VDL Mode 2 operation following full implementation.

2.4.4.4 The ACSP shall implement the Autotune procedure specified in ARINC 631-6 [5] to maintain the Service Level Requirements of Section 2.5 for communication with airborne aircraft, whenever this cannot be achieved on a single frequency. When so required, the ACSP shall be capable of sending an Autotune command in an uplinked Ground Requested Air Initiated Handoff command, as well as in the uplink response to both a Link Establishment request or Air Initiated Handoff request.

2.4.4.5 The ACSP shall implement the Autotune procedures in advance of the preceding requirements, if required by the ANSP or appropriate regulatory authority.

Note 1: The ANSP may require earlier implementation of Autotune, for example, to reduce the risk of disruption to the VDL service arising from a rapid growth in traffic, that would occur if Autotune was not implemented in sufficient time. Autotune may also be required by frequency regulatory authorities to enforce efficient use of the available spectrum.

Note 2: ACSPs are recommended to put Autotune functionality in place as soon as practicable in order to minimise risk of en-route VDL congestion arising from rapid growth in the number of CPDLC equipped aircraft.

2.4.4.6   The ACSP shall also be capable of supporting dedicated ground frequencies, by means of the Gnd and Air Frequency Support Lists, in accordance with ARINC 631-6 [5], subject to the availability of appropriate frequencies. The ACSP shall also implement functionality to detect an aircraft that fails to transfer away from a dedicated frequency on take-off, and issue an Autotune to such an aircraft so as to transfer it to a frequency appropriate for airborne use.

Note: It has been found that under certain conditions, some avionics may not transfer to an airborne frequency on take-off. This is likely to leave aircraft on a dedicated ground frequency while airborne, decreasing the capacity of the ground frequency, and risking disruption to end-to-end communication with the aircraft. The ACSP may detect the condition by examining the AVLC A/G bit of a downlink AVLC frame received on a dedicated ground frequency.

2.4.4.7   When multi-frequency operation is in use, the ACSP shall support the Frequency Recovery procedure by inclusion of en-route frequency/VGS pairs in the Air Frequency Support List (except where a Gnd FSL is advertised), in accordance with ARINC 631-6 [5]. The Air FSL broadcast on any non-CSC frequency shall advertise the CSC. Each Air FSL shall include only VGS addresses that are expected to be reachable by an aircraft connected to the VGS advertising the FSL.

Note: ICAO VDL standards require that Frequency Recovery is performed only using an FSL received on the current link. Advertisement of a VGS address in an FSL that is not reachable within the coverage of the VGS advertising the FSL will frustrate the objectives of Frequency Recovery. Accordingly, the Air FSL advertised by each VGS is expected to be tailored to reflect the local coverage.

2.4.4.8   The ACSP shall take all practicable measures to avoid degradation of VDL Mode 2 performance and/or capacity arising from co-site effects between VDL Ground Stations operating on a single frequency, or on different frequencies.

2.4.4.9   When multi-frequency operation is in use, the ACSP shall implement a frequency management strategy to ensure that continuous VDL connectivity is maintained when an aircraft leaves the coverage of its current frequency while remaining in the ACSP's CSC coverage.

Note: In the event that an aircraft loses VDL connectivity due to flying out of coverage of its current frequency, the aircraft will attempt Frequency Recovery by reference to an airborne FSL, or else will return to the CSC. Either of these actions is likely to lead to an interruption in VDL connectivity due to the time taken to attempt different freq/VGS pairs advertised in the AirFSL, or else acquire the PECT on the CSC. The ACSP is required to avoid such interruption, for example by autotuning the aircraft to another frequency before loss of connectivity occurs.

2.4.4.10   The VDL Mode 2 Service shall provide access to an ICAO ATN compliant communications service provided by the ACSP via an ACSP operated Air/Ground Router in accordance with the requirements of the Community Specification [6].

2.4.4.11   The service offered by the ACSP's ATN Ground/Ground Router shall be compliant with ICAO ATN standards for a Class 4 Router in accordance with the requirements of the Community Specification [6].

2.4.4.12   The ACSP's ATN Ground/Ground Router should implement the agreed resolution of PDR M2110003 ("IDRP Connection Recovery Problem").

Note: The above PDR is mandatory for Aircraft and Air/Ground Routers.

2.4.4.13 The ACSP shall propagate IDRP routes to aircraft over the air-ground link using the generic prefixes 'All AINSC' fixed (47002701) and 'All ATSC' fixed (47002781), with route aggregation applied in both cases.

Note: The above requirement is not intended to prohibit temporary advertisement of non-aggregated routes for testing or troubleshooting purposes, provided that any such temporary condition avoids any significant effect on the performance of the operational network.

2.4.4.14 It is recommended that routes using the generic prefixes 'All AINSC' and 'All ATSC' should be statically configured in the ACSP's Air/Ground router(s), to avoid the reduction process and ensure that only one advertisement of the routes occurs after IDRP connectivity has been established between air and ground.

2.4.4.15 The ACSP's Air/Ground router(s) shall never propagate to an aircraft (AINSC or ATSC mobile) any route prefixes received from an aircraft in IDRP UPDATE PDUs.

Note: This requirement is aimed at ensuring robustness of the ATN Routing environment. It prevents erroneous propagation of both ground routes (i.e. with ground route in the NLRI and airborne RDI in the RD Path attributes) and airborne routes (i.e. with airborne route in the NLRI and airborne RDI in the RD Path attributes).

2.4.4.16 The ACSP's Air/Ground router(s) shall never propagate to a ground adjacency (AINSC or ATSC fixed) any route prefixes received from an aircraft in IDRP UPDATE PDUs, except for those carrying the aircraft's own RDI route prefix.

Note: This requirement is also aimed at ensuring robustness of the ATN Routing environment. It prevents erroneous propagation of both ground routes (i.e. with ground route in the NLRI - airborne in the RD Path attributes), and airborne routes unrelated to the connected aircraft RDI (i.e. with a different RDI prefix in the NLRI and RD PATH attributes).

2.4.4.17 The ACSP's VDL Mode 2 Service and ATN Air/Ground Router shall provide a communications path between equipped aircraft and the ANSP's ATN Ground/Ground Router. The ACSP's ATN Air/Ground Router(s) shall advertise to each aircraft, using IDRP, a route capable of reaching the ANSP's Routing Domain.

2.4.4.18 The ACSP's Air/Ground Router(s) shall provide a communications path between equipped aircraft and the ATN Ground/Ground Routers of all neighbouring ANSPs nominated by the contracting ANSP. The ACSP's ATN Air/Ground Router(s) shall advertise to each aircraft, using IDRP, a route capable of reaching the nominated ANSP Routing Domains. In addition, IDRP routes to all equipped aircraft shall be advertised to the nominated neighbouring ANSPs. The end-to-end communication service between equipped aircraft and the nominated neighbouring ANSP shall satisfy the same Service Level Requirements as for the contracting ANSP, as specified by Section 2.5.

Note 1: The above requirements are specified to allow transfer of communications to take place by means of the ACM service specified by the Community Specification [6].

Note 2: It is anticipated that connectivity with neighbouring ANSPs will be supported either directly by the Primary ACSP or else via an interconnection with one or more Alternative ACSPs. However, other solutions are not excluded.

2.4.4.19 The ACSP shall ensure that aircraft of non-AOC Operators can establish ATN connectivity, and maintain that connectivity when crossing an ANSP boundary that also involves a change of Primary ACSP, provided that:

a) the ACSP offers ATN/VDL coverage at the aircraft's location

b) the ACSP has appropriate contractual arrangements with the relevant ANSPs to convey CPDLC messages as a Primary or Alternative provider

c) the non-AOC Operator's avionics have been qualified for operation on the ACSP's network

d) the non-AOC operator has entered into an agreement with the ACSP in which the ACSP commits to deliver the operator's ATC/ATN messages free of charge, and also addresses liability and other relevant matters.

Note: The Data Link Services Implementing Rule requires Non-AOC Operators to equip with data link avionics. The Network Planning Document (NPD) specifies a set of principles and constraints, which have been mutually agreed among stakeholders, for the provision of ATN/VDL service supporting CPDLC to non-AOC operators. The relevant provisions from the NPD are reproduced above.

2.4.4.20 In the event that the ACSP is unable to provide an ATN/VDL service to a non-AOC aircraft for the purpose of CPDLC in accordance with the foregoing paragraph, the ACSP shall either refuse a connection request from that aircraft, or else shall disconnect the aircraft if a link already exists.

Note: The refusal of a connection or else disconnection will serve as a signal to a non-AOC aircraft that it should seek service from another ACSP to support CPDLC. This contrasts with the typical preference of an AOC aircraft to maintain AOC with the preferred ACSP.

2.4.4.21 If the ACSP operates more than one A/G Router, then following a VDL handoff between VGSs connected to different A/G Routers, the ACSP shall take measures to minimize the time during which an obsolete air-ground IDRP route is maintained via an A/G Router through which an aircraft is no longer reachable.

Note: When an aircraft performs a handoff from one VGS to another, the old link is maintained for the value of TG5, with a default value of 60s on the ground. If the new VGS is connected to a different A/G router, then in the worst case, an obsolete IDRP route via the old A/G Router could be advertised to adjacent G/G Routers during this period. If this route has equal merit to the IDRP route via the new A/G Router, then uplink traffic may continue to be routed via the old A/G Router. Since the old link may no longer be functional (the default value of TG5 on the aircraft is only 20s) this is likely to lead to undesirable delays and/or TP4 re-transmissions.

2.4.5 Reference Point 'C' ACSP Inter-Connection

2.4.5.1 The service interface at Reference Point 'C' will be subject to commercial and technical agreement between the two applicable ACSPs.

2.4.5.2 The Primary ACSP:

a) shall implement a technical means to allow Alternative ACSPs to interconnect with it, so as to provide a communications path to the ANSP

b) shall use its best efforts to facilitate the establishment of interconnections to Alternative ACSPs with which the ANSP has established agreements

c) shall not take any action which may obstruct the interconnection of Alternative ACSPs.

2.4.5.3   Interconnected ACSPs shall establish Service Level Agreements and Operating Procedures between them to ensure that overall service level requirements of section 2.5 are satisfied when the end-to-end path traverses the network of more than one ACSP.

2.4.5.4   An ACSP providing an interconnection at Reference Point 'C' shall design and maintain their system so as to route communication traffic bi-directionally via that interface without imposition of any deficit in performance or quality of service compared to communication traffic to/from its own network, except when such a deficit arises from external factors outside the ACSP's control.

2.5   Service Level Requirements

2.5.1   The level of service provided shall conform to the applicable parts of the Community Specification [6], and to the specific requirements listed below.

2.5.2   Capacity

2.5.2.1   The service provided shall be capable of maintaining the service level requirements while carrying the minimum number of uplink and downlink application level messages (inc. LACK) specified by the ANSP per aircraft per unit of time in support of the ATC Data link Service.

Note: A requirement of 60 uplink and downlink application messages per flight hour is consistent with the CPDLC message load assumed for the conduct VDL Mode 2 capacity simulations [3].

2.5.2.2   The Primary ACSP shall be capable of supporting the number of flights simultaneously logged-on to the ATC Data Link Service within the Service Volume, as specified by the ANSP.

Note 1: The Primary ACSP is required to make ATC Data link Services accessible to aircraft which are not customers of that ACSP's AOC service.

Note 2: It is the ACSP's responsibility to ensure that its service has sufficient capacity to meet these requirements, for all the aircraft customers to which it offers a service, and irrespective of the level of demand for AOC services.

2.5.3   Performance

2.5.3.1   The service shall provide a transit delay meeting or better than the transit delay specified in Table 1 measured between Reference Point 'A' (the ATN Ground/Ground Router of the ANSP) and an aircraft using the service, taking into account any delay introduced by the ground network of any ACSPs providing an interconnection.

	95% of all messages	**99 % of all messages**
Ground to air transit delay	4 seconds	8 seconds
Air to ground transit delay	4 seconds	8 seconds

Table 1 Transit Delay Requirements

2.5.3.2   The transit delay requirements of Table 1 shall be satisfied over each contiguous published Air Traffic Service Route through the Service Volume specified by section 2.3.

Note: For practical purposes, the above transit delay requirements will be expected to be satisfied, aggregated between uplink and downlink directions, between Reference Point 'A' and the ARINC 750/429 interface of an ARINC 750 compliant VHF Data Radio (VDR). In the event that the requirements are not met due to an excessive Media Access Delay reported by the VDR, additional investigation will be necessary to ascertain the origin of the delay.

2.5.4 Availability, Reliability and Continuity of Service

2.5.4.1 The Availability, Reliability and Continuity of Service shall be as specified in Table 2 for the end-to-end communications path segment between reference points 'B' and 'A'.

2.5.4.2 An ACSP shall ensure that the applicable requirements are met at all times during which the ANSP provides an operational ATC Service.

	Requirement	Interpretation
Availability	99.99%	The proportion of the scheduled hours of operation during which the data link service shall be available, over the entire area in which service is provided and at adequate power levels required for normal operations.
Reliability	99.99%	The probability that the system will successfully deliver a message within 40 seconds.
Continuity of Service	6 min max. outage	The maximum permitted time between service failure and the restoration of the service.

Table 2 Availability, Reliability and Continuity of Service

2.5.5 Integrity

2.5.5.1 An ACSP shall satisfy the Integrity requirements specified by Table 3 below.

	Requirement	Interpretation
Integrity	10^{-5}	The undetected bit error rate for the service shall be better than 1 in 10^5 for network level packets transferred between reference points 'B' and 'A'.

Table 3 Data Integrity Requirements

2.5.6   Priority

2.5.6.1   An ACSP's ATN Routers shall enforce CLNP packet priority.

2.5.6.2   Higher priority packets shall be forwarded before lower priority packets in the same outgoing queue.

2.5.6.3   If an ATN Router discards packets due to congestion then lower priority packets shall be discarded before higher priority packets are discarded.

2.5.6.4   The VDL Mode 2 Ground Station should uplink any ATC messages queued for uplink before uplinking other messages.

Note: This desirable requirement is intended to differentiate between ATN and e.g. AOA messages. It is not intended to require that the VGS references or even has access to CLNP priority.

2.5.7   Safety and Security

2.5.7.1   An ACSP shall ensure that only authorised users have access to their part of the Aeronautical Telecommunication Network.

2.5.7.2   The ANSP shall determine who is an "authorised user".

Note 1: The term "authorised users" embraces both ground systems and equipped aircraft.

Note 2: A potential threat exists from unauthorised access to the ATN permitting a ground user to masquerade as a valid airborne user.

2.5.7.3   In consultation with the ANSP, an ACSP shall establish procedures and rules for users that want to use the ATN/VDL Mode-2 network for test purposes, which have potential to impact on the operational service provided by the ANSP.

2.5.7.4   An ACSP shall ensure that test users do not interfere with the operational network users.

2.5.8   Maintenance

2.5.8.1   An ACSP shall monitor and maintain the communications service and the systems used to provide the service in order to ensure that the specified service levels are achieved.

2.5.8.2   An ACSP shall undertake to correct in a timely fashion any significant non-compliance with applicable Standards (including any subsidiary normative standard) discovered during provision of the Service.

2.6   Performance Monitoring and Network Management

2.6.1   An ACSP shall monitor all system functions within the scope of the service level requirements.

2.6.2   An ACSP shall identify to the ANSP all recording and data logging mechanisms currently supported by their ATN/VDL Mode 2 network.

2.6.3   In addition:

a)   The ACSP shall nominate a Manager who is personally accountable for the delivery and maintenance of the ATN/VDL service in accordance with the requirements of this document.

b) An ACSP shall develop and agree with the ANSP or its nominated Agent prior to commencing the service a manual of fault reporting procedures, practices and escalation procedures in order to define, communicate and remedy faults and deficiencies.

c) An ACSP shall install data recording and logging functions at critical points of observation in the network to support fault and performance analysis. Logging of network activity shall be performed against UTC time to facilitate correlation with other sources of information. The ACSP shall agree with the ANSP or its nominated Agent which points of observation will be subject to logging, but as a minimum, it is expected that they will include the VGS, the A/G Router, and where implemented, Reference Point 'C'.

d) An ACSP shall provide upon user request (i.e. the ANSP or its nominated Agent and Airline customer) all necessary technical assistance, normally within one working day, including (but not limited to) provision of logs of ATN and VDL traffic against UTC time, to facilitate technical investigations into performance of the Service.

e) An ACSP providing an interconnection with an Alternative ACSP shall co-operate fully with the ANSP or its nominated Agent and interconnected ACSPs to achieve a timely resolution of any technical problems identified in the service level of data traffic carried through the interconnection.

f) An ACSP shall develop and agree with the ANSP or its nominated Agent a problem reporting procedure to notify the users (i.e. the ANSP and Airline customer) of detected problems, including any degradation in the service, the impact on the service and the progress of the solution. The ACSP shall respond to reasonable requests from the ANSP to minimise the operational impact of any problem or degradation.

g) An ACSP shall provide a clearly identified "Point of Contact" that can be contacted whenever the ANSP or its nominated Agent experiences technical problems with the services provided by the ACSP.

h) An ACSP shall analyse and attempt to resolve the reported problems and, if appropriate, take the required corrective actions needed to maintain the service.

i) The identified "Point of Contact" shall be available at all times during which the ANSP is providing an operational ATC Service

j) An ACSP shall provide a monthly Performance Level Report showing the service level achieved for the service provided. The required content of the Report will be established by the ANSP or its nominated Agent; it should contain as much as practicable the information specified in Annex A.

k) This report shall be sent to the ANSP and/or its nominated Agent electronically within 10 (ten) calendar days from the end of the subject month.

l) An ACSP shall give at least 1 day advanced notice of scheduled network maintenance activities and the type of activity. The ACSP shall highlight any degradation in service expected from the activity, and shall respond to reasonable requests from the ANSP or its nominated Agent to minimise the operational impact of such degradation.

m) An ACSP shall provide to the ANSP and/or its nominated Agent not less than 14 days notice of any changes to the architecture, configuration or software versions of any component of the ATN/VDL network involved in provision of the Service. The ACSP shall highlight any degradation in service expected from the activity, and shall respond to reasonable requests from the ANSP or its nominated Agent to minimise the operational impact of such degradation.

3. EVALUATION OF THE COMMUNICATION SERVICE

3.1 Evaluation Process

3.1.1 Prior to offering any operational ATN VDL Mode 2 Service, an ACSP shall complete a process of evaluation to the satisfaction of the ANSP. The evaluation process shall consist of the following steps:

a) Delivery of documentary evidence to the ANSP

b) Completion of laboratory acceptance tests

c) Completion of flight tests demonstrating fitness-for-purpose

3.2 Delivery of Documentary Evidence

3.2.1 The ACSP shall deliver to the ANSP documentation providing evidence of the ability of the ACSP's ATN and VDL Mode 2 system to satisfy the end-to-end functional and service level requirements specified by this document. The documentation delivered shall include (but not be limited to) the items listed in Annex B.

3.2.2 The ANSP will review this documentation to verify that it includes the necessary evidence of conformance with the end-to-end requirements.

3.2.3 The ACSP shall provide any additional evidence of conformance with requirements specified by this document reasonably required by the ANSP.

3.3 Laboratory Acceptance Tests

3.3.1 The ACSP shall perform a series of Laboratory Acceptance Tests to demonstrate end-to-end ATN connectivity with the ANSPs systems, together with performance and robustness of the VDL Mode 2 Service. The expected configuration and scope of these Acceptance Tests is described in Annex C.

3.3.2 Prior to conduct of the Acceptance Tests, the ACSP shall prepare an Acceptance Test Specification detailing the configuration and conduct of all tests to be performed. The Acceptance Test Specification shall include (but not be limited to) the tests described in Annex C.

3.3.3 The Acceptance Test Specification shall be subject to review by the ANSP. Any additional tests reasonably required by the ANSP to demonstrate interoperability with the ANSP's system shall be included.

3.3.4 The ANSP may require its representatives to witness the conduct of Acceptance Tests by the ACSP.

3.3.5 Following completion of the Acceptance Tests, the ACSP shall deliver an Acceptance Test Report to the ANSP, detailing all results. The ACSP shall also make available all logs and records collected during the conduct of the tests.

3.3.6 The ANSP may elect, at its sole discretion, to accept documentary evidence of satisfactory completion of certain Acceptance Tests by the ACSP on a previous occasion, without requiring further conduct of such Tests.

Note: Specific tests described in Annex C are intended to demonstrate functionality of the interface to the ANSP, and such tests will normally be required by each ANSP.

3.4   Flight Tests

3.4.1   The ACSP shall co-operate with the ANSP in arranging the conduct of flight tests to demonstrate that the ATN/VDL Mode 2 Service is fit for the intended purpose. The flight testing shall be performed over routes specified by the ANSP.

Note 1: Flight testing is intended to demonstrate that adequate coverage is provided by the ACSP's VGSs along major ATS routes through airspace under the jurisdiction of the ANSP. In addition it seeks to give confidence that functionality such as VDL handoffs are robust under real world conditions. The ANSP will take into account the size and architecture of the airspace when specifying the duration and routes over which flight trials are required.

Note 2: The arrangements for flight testing, including commercial considerations, will be the subject of agreement between the ANSP and the ACSP. Either a dedicated flight test or else conduct of tests with an airline customer's aircraft on revenue earning flights will be considered suitable to meet the requirements.

3.4.2   Throughout every flight test, a continuous exchange of uplink and downlink CPDLC messages shall be maintained, at a nominal rate of not less than one message every 10 seconds in each direction.

Note: The requirement for a continuous exchange of CPDLC messages may be achieved by a 'tuning test' involving an uplink of an erroneous CPDLC message, soliciting a downlink CPDLC ERROR response, without involvement of the CDU or the aircrew.

3.4.3   Prior to conduct of the flight test, a Flight Test Specification shall be prepared detailing the configuration, and conduct of the proposed flight tests, including the aircraft and the routes to be flown. The Flight Test Specification shall be subject to review of the ANSP and all reasonable requests for change shall be incorporated.

3.4.4   The pass criteria for the flight tests shall be that while the aircraft remains in airspace within which the ACSP is required to provide coverage:

a)   An IDRP adjacency shall be maintained with the aircraft

b)   No interruption shall occur to the continuous exchange of CPDLC messages

c)   No CPDLC message shall fail to be delivered

d)   The Transit Delay requirements specified by this document shall be satisfied over each individual ATS route along which the test aircraft has flown.

3.4.5   Following completion of the Flight Tests, a Flight Test Report shall be prepared, detailing all results. The ACSP shall also make available all logs and records collected during the conduct of the tests.

3.4.6   The ANSP may elect, at its sole discretion, to accept documentary evidence of satisfactory completion of certain Flight Tests by the ACSP on a previous occasion, without requiring further conduct of such Tests.

4.   OBSERVATION PERIOD OF OPERATIONAL SERVICE

4.1   Observation Process

4.1.1   Following successful completion of the evaluation process in accordance with Section 3 above, the ACSP will be permitted to offer an operational service for a limited period constituting the Observation Period. The Observation Period shall last for a period specified by the ANSP.

Note: Typically the Observation Period will last for a period of 3 months.

4.1.2   During the observation period, the ANSP will monitor the functionality and performance of the Service provided by the ACSP, and also the compliance of the ACSP with the performance monitoring and network management requirements (Section 2.6 refers).

4.1.3   The ANSP may impose certain constraints on the service to be offered during the observation period (e.g. limits to the airlines permitted to use the Service) in order to facilitate the monitoring of the service.

4.1.4   Any shortcomings detected in the Service during the observation period will be addressed by means of the procedures outlined in Section 2.6 of this document.

4.1.5   Once all outstanding issues have been resolved to the satisfaction of the ANSP, the ACSP's ATN/VDL Mode 2 Service will be declared fully operational, and any remaining constraints will be withdrawn.

ANNEX A – CONTENT OF ACSP's MONTHLY PERFORMANCE REPORT

Note: The following material describes the content of regular reports required from ACSPs during the LINK 2000+ Pioneer phase. A more extensive set of performance indicators are currently being prepared, in coordination with ANSPs and ACSPs, and will be included here when available.

A.1 Overall Report on Quality of Service

- Availability of VGSs (percentage, failure)
- Availability of AGR routers (percentage, failure)
- Availability of Network Infrastructure
- Explanations of failures (if any).

A.2 Statistics

A.2.1 Statistics on Aircraft

- Number of aircraft connected and handled
- Graphical representation of the trend for aircraft.

A.2.2 Statistics on VGSs

A.2.2.1 At AVLC layer

- Per VGS, number of Link Establishments (Received, Rejected, Accepted)
- Per VGS, number of Handoffs (Received, Rejected, Accepted)
- Graphical representation of the trend for LE/HO
- Analysis when LE/HO rejected (Which VGS, Aircraft ID, Date/Time, LE/HO, Reason)
- Per VGS, statistics per frame type exchanged with aircraft : INFO (sent, received) - SREJ (sent, received) - FRMR (sent, received) - DISC (sent, received)
- Graphical representation of the trend for AVLC frames (INFO, SREJ, FRMR).

A.2.2.2 At 8208 layer

- Per VGS, number of 8208 PDUs sent to/received from aircraft
- Per VGS, number of 8208 PDUs sent to/received from AGR routers
- Graphical representation of the trend for 8208 PDUs.

A.2.3 Statistics on AGRs

- Per AGR, number of 8208 PDUs sent to/received from VGSs
- Graphical representation of the trend for 8208 PDUs
- Per AGR, number of CLNP DT and ER NPDUs (sent,received)
- Graphical representation of the trend for CLNP DT and ER NPDUs .

A.2.5 Report of executed and planned changes to the network

ANNEX B – DOCUMENTATION REQUIREMENTS

B.1   Introduction

The ACSP is required to provide the ANSP with documentary evidence that the ACSP's ATN and VDL Mode 2 systems are capable of satisfying the end-to-end functional and service level requirements specified by this document.

Where necessary, the ACSP will be expected to make an appropriate allocation of service level requirements (e.g. performance, availability, reliability and continuity) between the different components of the system, and to provide evidence that each component is capable of meeting the relevant allocation.

B.1.1   Functional Requirements

- CLNP and IDRP PICS for both ACSP Air/Ground and ground routers

- X.25 PICS for the ground router

- Reference Documentation of the ACSP Air/Ground Router

- Reference Documentation of the ACSP Ground Router

- VDL Mode 2 PICS for the VGS

- Reference Documentation of the VGS

The above documentations shall specify the implemented values of all configurable timers, counters and other parameters defined by ICAO and/or other applicable normative standards.

B.1.2   Capacity

- A report showing the ACSP has performed testing while simulating establishment of multiple aircraft mobile links and IDRP adjacencies on their Air/Ground router, demonstrating compliance with the Capacity Requirements stated in this document.

- A report showing the ACSP has performed testing with multiple simulated aircraft IDRP routes received on their ground router, including a repetitive exercise consisting of adding IDRP routes, checking IDRP routes prefixes and removing IDRP routes, demonstrating compliance with the Capacity Requirements stated in this document.

- A report showing the ACSP has performed testing while simulating establishment of multiple mobile links, traffic exchanges and clear of connectivity on one VGS, demonstrating compliance with the Capacity Requirements stated in this document.

B.1.3   Performance

- A report on performance tests done by the ACSP on their Air/Ground ATN Router, demonstrating consistency with the Performance Requirements stated in this document.

- A report on performance tests done by the ACSP on their Ground ATN Router, demonstrating consistency with the Performance Requirements stated in this document.

- A report on performance tests performed by the ACSP on their VGSs, demonstrating consistency with the Performance Requirements specified by this document.

B.1.4   Priority

- A functional description of the ACSP's ATN priority management mechanism.

- A/G and Ground Routers logs from simulations performed in the ACSP's Laboratory illustrating the action of the priority management mechanism.

- A functional description of the implementation of priority management within the ACSP's VDL Mode 2 system.

- VGS traces illustrating the action of priority management with both ATC and AOC traffic involved.

B.1.5   Safety and Security Policy

- IDRP policy rules put in place on both Air/Ground and Ground routers.

- RIF Known BIS attributes defined by the ACSP in the Air/Ground router configuration.

- Mechanisms / rules put in place at VSGs to satisfy safety and security requirements.

B.1.6   ATN Availability, Reliability and Continuity

- An overall description of the ACSP's technical measures to satisfy the Availability, Reliability and Continuity requirements.

- Results on Endurance Tests performed by the ACSP in their laboratory on Air/Ground and Ground ATN systems, supplemented by operational experience where possible.

- A description of redundancy systems/mechanisms which are put in place for both Air/Ground and Ground ATN systems.

- A description of the recovery procedure for both Air/Ground and Ground ATN systems in case of software and hardware failures.

- Results on Endurance Tests performed by the ACSP in their laboratory on VDL Mode 2 VGSs and other components, supplemented by operational experience where possible.

- A description of redundancy systems/mechanisms which are put in place for VDL Mode 2 VGS sand other components.

- A description of the recovery procedure for VDL Mode 2 VGSs and other components in case of software and hardware failures.

B.1.7   VDL Coverage

- Expected geographical coverage from the ACSP's individual VDL Ground Stations providing the service within the volume of airspace in which the ANSP requires ATN/VDL Service, taking into account line-of-sight considerations and ground topography. It is expected that the coverage will be given at a range of altitudes, including (but not limited to) the minimum and maximum altitudes of the relevant airspace.

ANNEX C – LABORATORY ACCEPTANCE TEST PROCEDURES

C.1   Configuration

This testing aims to verify the ACSP's end-to-end ATN VDL-M2 communication chain, by performing CM/CPDLC exchanges between air and ground applications. In addition it seeks to demonstrate the robustness of VDL Mode 2 handoffs under a variety of conditions.

It is foreseen that this testing will be performed using the configuration illustrated in Figure C.1 below. Alternative configurations may be utilised, provided they support the functionality required for the performance of the tests, subject to agreement of the ANSP.
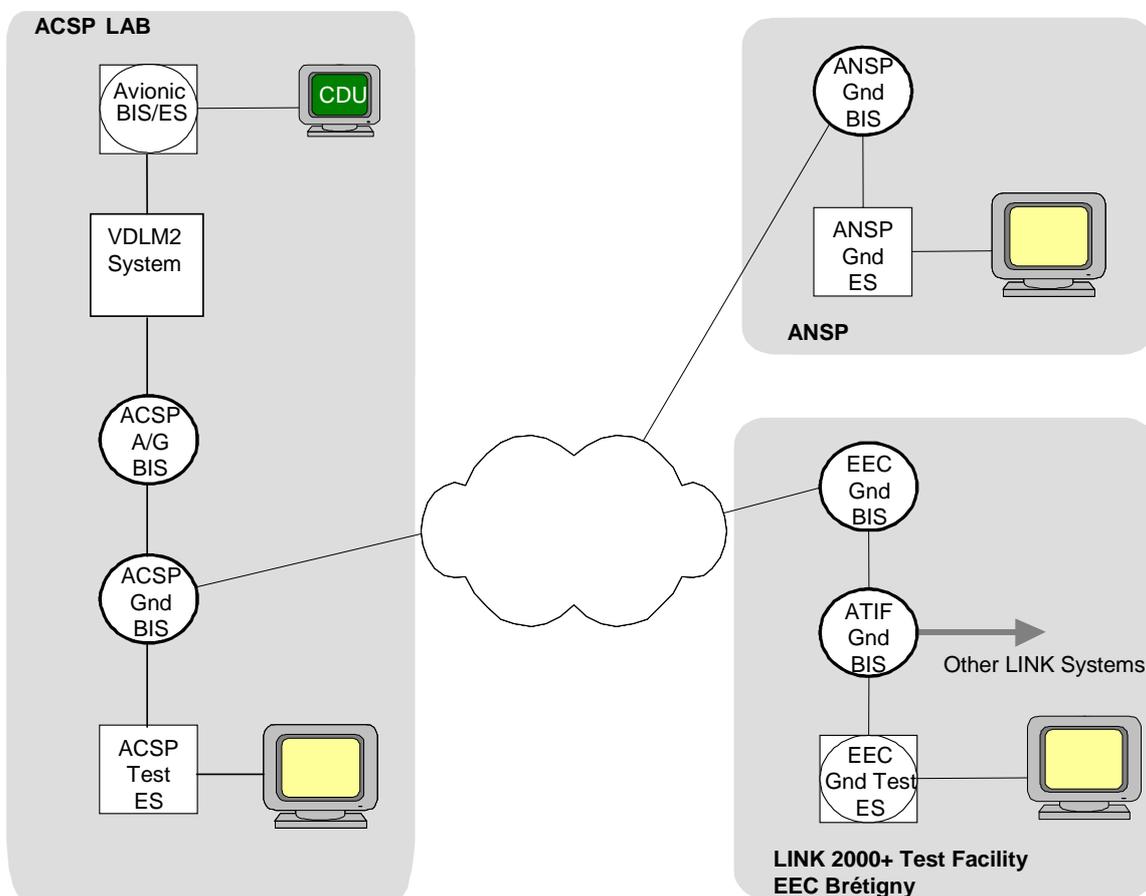

Figure C.1: Laboratory Test Configuration

Certain tests require the generation of continuous CPDLC traffic from the ground side. Such continuous traffic is also referred to as a tuning test in this document. It refers to invalid uplink CPDLC messages that generate downlink ERROR messages sent by the aircraft as an automatic answer (no display on the CDU). The message exchange is repeated at a regular interval (typically 3, 5 or 10 seconds). In order to perform tuning tests, a Test ES must be provided which is capable of generating such continuous CPDLC messages. This Test ES may in principle be located at the ANSP, at the ACSP's Laboratory, or else at the ATN Test Facility at EEC Brétigny, subject to the objectives of individual tests. It may be more convenient to conduct the tests involving handoff

using a Test ES at the ACSP's Laboratory, since it will be necessary to adjust attenuators in conjunction with operation of the Test ES.

The configuration of the VDL Mode 2 system at the ACSP's Laboratory is expected to be as shown in Figure C.2 below. As a minimum requirement, the avionics must be connected to at least two VGSs, each independently attenuated in order to allow VDL Mode 2 handoffs to be performed from one VGS to another.
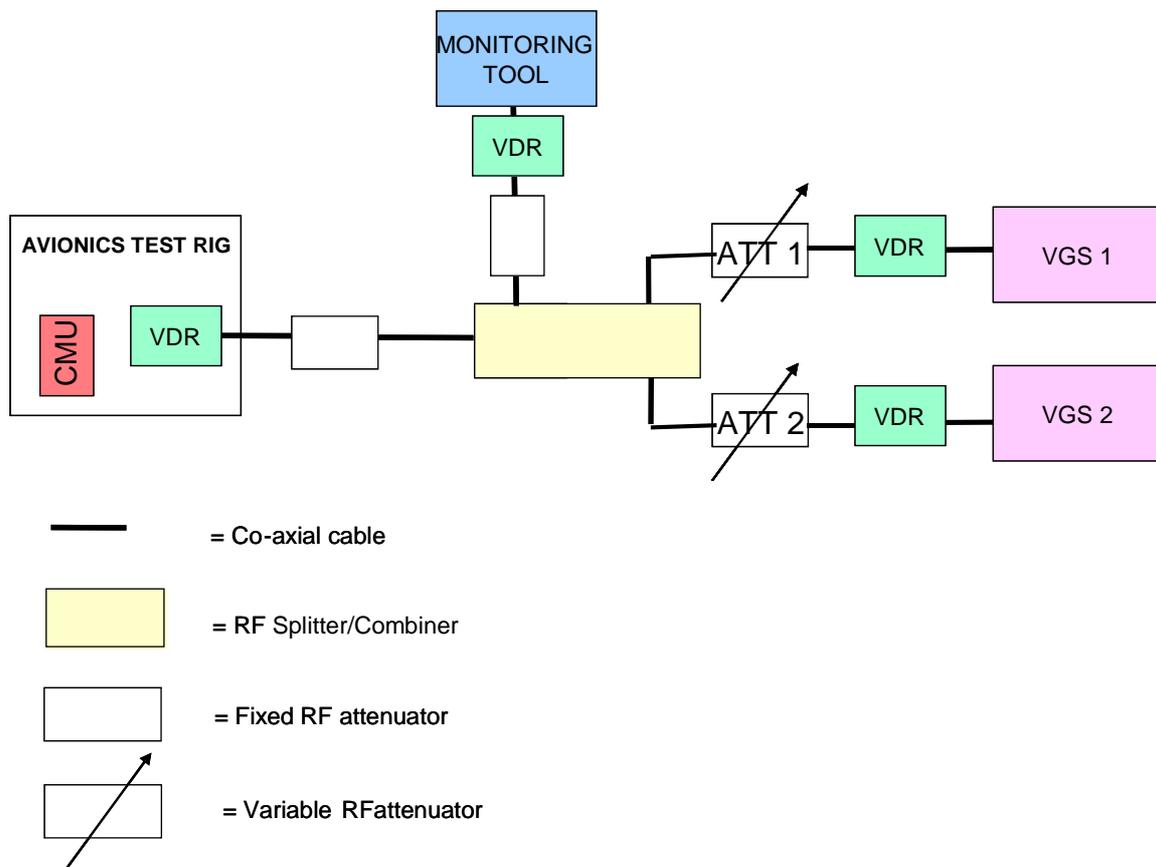

Figure C.2: VDL Mode 2 System at ACSP's Laboratory

C.2   Test Descriptions

C.2.1   ACSP Air/Ground System Connectivity

Test Reference	*TST_LAB_AGS_CONNECT*
Objective	This test aims at checking the connectivity events that occur on the ground side once the "Air/Ground ACSP system" is started up. (The air side is not started yet)

Document Title:	Document Reference:
Generic Requirements for an ATN/VDL Mode 2 Air/Ground Communications Service Provider (ACSP)	CFC/Datalink/ACSPGEN

Preamble	ANSP ground router is up and running
Related Requirements	**Functional Requirements**
Configuration	As in Section E.1. The ANSP BIS is located at the ANSP's premises connected via the operational interface to the ACSP.
Description	• Power up the Air/Ground ACSP system • Once ground-ground IDRP adjacency is established between ANSP and ACSP ground routers, issue Echo Requests with Security (ATSC Class A, ATSC No Pref) from EEC ground router to ACSP ground router.
Observation Points	• Check connectivity is established between the ACSP Air/Ground system and ANSP ground router • Check IDRP connectivity is established between both ANSP and ACSP ground ATN routers • Check ACSP routes are propagated by the ACSP ground router to the ANSP ground adjacency • Check that routes propagated by ANSP router are present on the ACSP system side. • Check that Echo replies are received as answers to the Echo Requests sent by ANSP ground router • Check GSIFs are sent by both VGSs of the system
Expected Output	VGS logs/Monitoring Tool Logs/Air-Ground router logs
PASS Criteria	• Ground/Ground IDRP adjacency established between ACSP and ANSP ground routers • Routing Domain prefix routes with security to the remote system available on both routers • Echo replies from ACSP ground router received at ANSP router

C.2.2 Aircraft Connectivity

Test Reference	*TST_LAB_AIR_CONNECT*
Objective	This test aims at checking the connectivity sequence which occurs once the airborne system is started up
Preamble	TST_LAB_AGS_CONNECT
Related Requirements	**Functional Requirements**
Configuration	As in Section E.1. The ANSP BIS is located at the ANSP's premises connected via the operational interface to the ACSP.
Description	• Power up the air system • Once routes to the aircraft are available on ANSP ground router, issue Echo Requests with Security (ATSC Class A, ATSC No Pref) from ANSP ground router to the airborne router.
Observation Points	• Check GSIFs from both VGSs are received by the aircraft • Check an AVLC connection is issued with one of the VGSs

	• Check 8208 and IDRP connections are established between the air and the Air/Ground router • Check the Air/Ground router propagates at least one ground route to the air • Check the aircraft routing domain prefix routes are propagated to ANSP router by the ACSP ground router. • Check that Echo replies are received as answers to the Echo Requests sent by ANSP router
Expected Output	Air logs/VGS logs/Monitoring Tool Logs/Air-Ground router logs
PASS Criteria	• Air/Ground ATN connectivity established • Routing domain prefix routes to the aircraft, with security, are available on ANSP side • Echo replies from airborne router received on ANSP router

C.2.3 Basic CPDLC End To End Connectivity

Test Reference	*TST_LAB_CPDLC_END_TO_END*
Objective	This test aims at checking that the CPDLC end to end connectivity is provided via the ACSP infrastructure, by exercising a basic CPDLC scenario between the air side and the EEC Ground End System
Preamble	TST_LAB_AGS_CONNECT and TST_LAB_AIR_CONNECT performed
Related Requirements	**Functional Requirements, Service Performance**
Configuration	As in Section E.1. The role of the ANSP BIS and ES may be performed either by the ANSP or by the Link 2000+ Test Facility.
Description	• Initiate a LOGON from the air side • Establish a CPDLC connection from the ANSP ground side • Send a downlink request/Uplink the answer • Send an Uplink request/Downlink the answer
Observation Points	• Check CM-LOGON indication is received an the ground side and CM-LOGON response is received on the air side • Check CPDLC connection is established • Check CPDLC exchanges are performed both ways • Check VDL-M2 traffic exchanges
Expected Output	Air logs/VGS logs/Monitoring Tool Logs/Air-Ground router logs
PASS Criteria	• Continuity of service: IDRP connectivity and ESs Transport Connectivity are established. • Application exchanges successful with Round Trip delays less than 2.5 seconds

Note 1: Round Trip delays "less than 2.5 seconds" were developed from the observations of the transit delays noticed during LAB testing both with ARINC and SITA ACSPs. A margin of 0.5 second has been added in case of any congestion problems at CLNP level.

Note 2: A value of 4secs is stated to be the Transit Delay requirement (both ways for 95% of all messages) in the Generic Requirements but it is intended to be met in an operational environment with multiple aircraft involved.

C.2.4 CPDLC continuous traffic without handoff

Test Reference	*TST_LAB_TUNING_10s_WITHOUT_HANDOFF*
Objective	This test aims at checking that the whole end to end chain is robust and capable enough to support continuous traffic at 10 seconds interval rate.
Preamble	TST_LAB_CPDLC_END_TO_END
Related Requirements	**Service Performance, Service Integrity, Service Reliability**
Configuration	As in Section E.1. The role of the ANSP BIS and ES may be performed either by the ANSP or by the Link 2000+ Test Facility.
Description	• Set a tuning test with 10s interval rate on the ground side • Leave the test running for an hour
Observation Points	• Check CPDLC exchanges are performed both ways • Check End-to-End Round Trip (R/T) delays for the exchanges • Check VDL-M2 traffic exchanges • Check Air/Ground IDRP connectivity • Check ESs Transport Connectivity
Expected Output	Air logs/VGS logs/Monitoring Tool Logs/Air-Ground router logs
PASS Criteria	• Continuity of service : IDRP connectivity and ESs Transport Connectivity are kept established during the whole test session • Exchanges with average R/T delays less than 2.5 seconds • No more than one CPDLC message on the ground ES pending for some reply

Note: the number of pending messages has been developed from previous LAB testing observations with both ARINC and SITA.

The same test as above is repeated with a tuning period set to 5 seconds:

Test Reference	*TST_LAB_TUNING_5s_WITHOUT_HANDOFF*
Objective	This test aims at checking that the whole end to end chain is robust and capable enough to support continuous traffic at 5 seconds interval rate.
Preamble	TST_LAB_CPDLC_END_TO_END
Related Requirements	**Service Performance, Service Integrity, Service Reliability**
Configuration	As in Section E.1. The role of the ANSP BIS and ES may be performed either by the ANSP or by the Link 2000+ Test Facility.
Description	• Set a tuning test with 5s interval rate on the ground side

	• Leave the test running for an hour
Observation Points	• Check CPDLC exchanges are performed both ways
	• Check End-to-End R/T trip delays for the exchanges
	• Check VDL-M2 traffic exchanges
	• Check Air/Ground IDRP connectivity
	• Check ESs Transport Connectivity
Expected Output	Air logs/VGS logs/Monitoring Tool Logs/Air-Ground router logs
PASS Criteria	• Continuity of service : IDRP connectivity and ESs Transport Connectivity are kept established during the whole test session
	• Exchanges with average R/T delays less than 2.5 seconds
	• No more than one CPDLC message on the ground ES pending for some reply

The test is repeated with a tuning period set to 3 seconds, *TST_LAB_TUNING_3s_ WITHOUT_HANDOFF* and is performed for a period of 15 minutes, for OBSERVATION only.

C.2.5   Tuning tests with handoffs based on SQP dropping

Test Reference	*TST_LAB_TUNING_10s _HANDOFF_SQP*
Objective	This test aims at checking that the ACSP Air/Ground system is robust and capable enough to support continuous traffic at 10 seconds interval rate while handoffs between both VGSs of the Air/Ground system are exercised.
Preamble	• TST_LAB_CPDLC_END_TO_END,
	• Establishment of attenuators settings: set the attenuators of both VGSs to give a reported SQP of 2 at the CMU. For the VGS not currently connected, this can be achieved by monitoring the GSIF frames received by the CMU. This is referred to as the 'normal' setting.
Related Requirements	**Functional Requirements, Service Performance, Service Integrity, Service Reliability**
Configuration	As in Section E.1. The role of the ANSP BIS and ES may be performed by the ACSP Laboratory.
Description	• Set a tuning test with 10s interval rate on the ground side
	Handoff sequence:
	• Progressively reduce the setting of the attenuator for the VGS with a current AVLC connection to the CMU (ATT 1) in 1 dB steps. Wait for 20 seconds between each step.
	• Verify that handoff due to SQP dropping occurs
	• Wait 5 minutes
	• Return attenuator ATT 1 to the normal setting giving SQP 2
	• Wait 3 minutes
	• Progressively reduce the setting of the attenuator ATT 2 in 1 dB

	steps. Wait for 20 seconds between each step.
	• Verify that handoff due to SQP dropping occurs
	• Wait 5 minutes
	• Return attenuator ATT 2 to the normal setting giving SQP 2
	• Wait 3 minutes
	• Repeat the Handoff sequence 10 times
Observation points	• Check exchanges are performed both ways • Check VDL-M2 traffic exchanges • Check VDL8208 connectivity establishment/release on the Air/Ground router • Check Air/Ground IDRP Connectivity • Check ESs TP4 Connectivity
Expected Output	Air logs/VGS logs/Monitoring Tool Logs/Air-Ground router logs
PASS Criteria	• Continuity of service : Air/Ground IDRP connectivity and ESs Transport Connectivity are kept established during the whole test session • Uplink messages are received on the air side • Downlink replies are received on the ground side • No more than three messages pending for some reply on the ground

The same test as above is repeated with a tuning period set to 5 seconds:

Test Reference	*TST_LAB_TUNING_5s _HANDOFF_SQP*
Objective	This test aims at checking that the ACSP Air/Ground system is robust and capable enough to support continuous traffic at 5 seconds interval rate while handoffs between both VGSs of the Air/Ground system are exercised.
Preamble	• TST_LAB_CPDLC_END_TO_END, • Establishment of attenuators settings: set the attenuators of both VGSs to give a reported SQP of 2 at the CMU. For the VGS not currently connected, this can be achieved by monitoring the GSIF frames received by the CMU. This is referred to as the 'normal' setting.
Related Requirements	**Functional Requirements, Service Performance, Service Integrity, Service Reliability**
Configuration	As in Section E.1. The role of the ANSP BIS and ES may be performed by the ACSP Laboratory.
Description	• Set a tuning test with 5s interval rate on the ground side Handoff sequence: • Progressively reduce the setting of the attenuator for the VGS with a current AVLC connection to the CMU (ATT 1) in 1 dB steps. Wait for 20 seconds between each step.

	• Verify that handoff due to SQP dropping occurs	
	• Wait 5 minutes	
	• Return attenuator ATT 1 to the normal setting giving SQP 2	
	• Wait 3 minutes	
	• Progressively reduce the setting of the attenuator ATT 2 in 1 dB steps. Wait for 20 seconds between each step.	
	• Verify that handoff due to SQP dropping occurs	
	• Wait 5 minutes	
	• Return attenuator ATT 2 to the normal setting giving SQP 2	
	• Wait 3 minutes	
	• Repeat the Handoff sequence 10 times	
Observation points	• Check exchanges are performed both ways • Check VDL-M2 traffic exchanges • Check VDL8208 connectivity establishment/release on the Air/Ground router • Check Air/Ground IDRP Connectivity • Check ESs TP4 Connectivity	
Expected Output	Air logs/VGS logs/Monitoring Tool Logs/Air-Ground router logs	
PASS Criteria	• Continuity of service : Air/Ground IDRP connectivity and ESs Transport Connectivity are kept established during the whole test session • Uplink messages are received on the air side • Downlink replies are received on the ground side • No more than five messages pending for some reply on the ground	

The test is repeated with a tuning period set to 3 seconds, *TST_LAB_TUNING_3s _HANDOFF_SQP*, for OBSERVATION only. Handoffs are performed twice in both directions.

C.2.6 CPDLC tests with handoffs triggered by failed downlinks

Separate tests are performed for the situations where re-transmissions occur initially on the air side, *TST_LAB _HANDOFF_AIR_RETRANS,* and when they occur initially on the ground side, *TST_LAB _HANDOFF_GROUND_RETRANS*.

Test Reference	*TST_LAB _HANDOFF_AIR_RETRANS*
Objective	This test aims at checking that the ACSP air ground system is able to support sequences of handoffs based on retransmissions when detected by the air side first.
Preamble	TST_LAB_CPDLC_END_TO_END, Establish attenuators in both VGSs to settings giving SQP 2, and establish AVLC with VGS 1.

Related Requirements	Functional Requirements, Service Performance, Service Integrity, Service Reliability
Configuration	As in Section E.1. The role of the ANSP BIS and ES may be performed by the ACSP Laboratory.
Description	Handoff sequence: • Wait until exchange of IDRP KEEPALIVE PDUs is successfully achieved. • Insert additional 30dB of attenuation in attenuator of VGS with current AVLC link to CMU (ATT 1). • Send a downlink request from MCDU pages. • Verify from CMU log that downlink transmission fails on N2 re-tries, handoff to alternative VGS is achieved, IDRP is maintained, and downlink message is delivered successfully via new VGS. • Wait 5 minutes • Restore ATT 1 to previous setting giving SQP 2. • Wait until some GSIF is received from VGS1 • Wait until exchange of IDRP KEEPALIVE PDUs is successfully achieved. • Introduce additional 30dB attenuation into VGS with current AVLC link to CMU (ATT 2). • Send a downlink request from MCDU pages. • Verify from CMU log that downlink transmission fails on N2 re-tries, handoff to alternative VGS is achieved, IDRP is maintained, and downlink message is delivered successfully via new VGS. • Wait 5 minutes • Restore ATT 2 to previous setting giving SQP 2 • Wait until some GSIF is received from VGS2 • Repeat above sequence 3 times
Observation points	• Check exchanges are performed both ways • Check VDL-M2 traffic exchanges • Check VDL8208 connectivity establishment/release on the Air/Ground router • Check Air/Ground IDRP connectivity • Check ESs TP4 Connectivity
Expected Output	Air logs/VGS logs/Monitoring Tool Logs/Air-Ground router logs
PASS Criteria	• Continuity of service : Air/Ground IDRP connectivity and ESs Transport Connectivity are kept established during the whole test session • The downlink messages reach the ground ES.

Test Reference	*TST_LAB _HANDOFF_GROUND_RETRANS*
Objective	This test aims at checking that the ACSP air ground system is able to support sequences of handoffs based on retransmissions when detected by the ground side first.
Preamble	TST_LAB_CPDLC_END_TO_END Establish attenuators in both VGSs to settings giving SQP 2, and establish AVLC with VGS 1.
Related Requirements	**Functional Requirements, Service Performance, Service Integrity, Service Reliability**
Configuration	As in Section E.1. The role of the ANSP BIS and ES may be performed by the ACSP Laboratory.
Description	Handoff sequence: • Wait until exchange of IDRP KEEPALIVE PDUs is successfully achieved. • Insert additional 30dB of attenuation in attenuator of VGS with current AVLC link to CMU (ATT 1) • Send an uplink request from ground system. • Wait 10 seconds • Send a downlink request from MCDU pages from a different dialogue type to the uplink. • Verify from CMU log that downlink transmission fails on N2 re-tries, handoff to alternative VGS is achieved, • Verify IDRP is maintained, uplink message is delivered successfully via new VGS, and downlink message is delivered successfully via new VGS. • Wait 5 minutes • Restore ATT 1 to previous setting giving SQP 2. • Wait until some GSIF is received from VGS1 • Wait until exchange of IDRP KEEPALIVE PDUs is successfully achieved. • Introduce additional 30dB attenuation into VGS with current AVLC link to CMU (ATT 2). • Send an uplink request from ground system. • Wait 10 seconds • Send a downlink request from MCDU pages from a different dialogue type to the uplink. • Verify from CMU log that downlink transmission fails on N2 re-tries, handoff to alternative VGS is achieved

	• Verify IDRP is maintained, uplink message is delivered successfully via new VGS, and downlink message is delivered successfully via new VGS. • Wait 5 minutes • Restore ATT 2 to previous setting giving SQP 2 • Wait until some GSIF is received from VGS2 • Repeat above sequence 3 times
Observation points	• Check exchanges are performed both ways • Check VDL-M2 traffic exchanges • Check VDL8208 connectivity establishment/release on the Air/Ground router • Check Air/Ground IDRP connectivity • Check ESs TP4 Connectivity
Expected Output	Air logs/VGS logs/Monitoring Tool Logs/Air-Ground router logs
PASS Criteria	• Continuity of service : Air/Ground IDRP connectivity and ESs Transport Connectivity are kept established during the whole test session • The uplink messages reach the air side. • The downlink messages reach the ground ES.