



EATMP - DIS

LINK 2000+ PROGRAMME

LINK 2000+ Services and Message Sets for Ground Implementation

Abstract

This document contains the LINK 2000+ services, message sets, functionalities and implementation issues for ATS Systems

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DOCUMENT CONTROL LOG

Section(s)	Date	Amendment Number	Reason for change and/or Change Note Number.
All	14-March-2001	0.A	New document
All	05-April-2001	0.B	Refinement of ACL, ACM and AMC messages; review of sections.
5.2	19-April-2001	0.C	Dm 9, 10 moved from "O" to "M"; Change of title
3	30-April-2001	0.D	Addition: Doc 9705, Ed. 2 + 1PDR (D-FIS) DL Recording Reqs Eurocae's WG 50
5.4; Annex A	08-February-2002	0.E	On request of France and endorsed by LINK2000+ OFG: Addition of 38 ACL messages, incl. 12 messages for radio communication failure (RCF). Update of availability of ground services.
All	05 March-2002	0.F	Editorial changes AMC: Addition of Um183 ACL: Addition of Um79 (M), Dm35 (O). Created separate section 5.2.3.6 for RCF-messages.
All	29 May-2002	0.G	Alignment with ED-110
2,3	01 July 2002	1.0	Renaming of LINK 2000+ phases
5.2 and 6.1	22 August 2002	1.1	Alignment with rectified version of ED-110 Incorporation of ACL extensions as per ED xxx.
6	02 September 2002	2.0	Removal of LINK Build 1B services
5.2.2;5.2.3	26 November 2002	2.1	Addition of Um157 and Um162 Removal Um228, Dm104 and Dm37
5.2.1; 5.2.3	25 May 2003	2.2	5.2.1 – Um183 added mandated text 5.2.3 - Um3 moved from "M" to "O"; Dm3, Dm4, Dm5 moved from "M" to "C"; Um162 added recommended text for display
5.2.1.4; 5.2.2.2	20 August 2003	2.3	5.2.1.4 – Dm89: addition of note 5.2.2.2 - Removal Um 159 from AMC

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KEYWORDS

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1. INTRODUCTION

This document contains information to support ATS units implementing the LINK 2000+ functionality. It describes the requirements and options for data link from a ground perspective.

2. LINK 2000+ SERVICES

The services, called LINKBuild1A, that will be implemented in Europe from 2002 onwards are the following:

- **ATN/VDL2 based services:**

DLIC	Data link Initiation Capability
ACM	ATC Communications Management
AMC	ATC Microphone Check
ACL	ATC Clearances

3. BASELINES, APPLICABLE TO THE MESSAGE SETS

The baseline1 documents to implement the 'LINKBuild1A' are:

- EUROCAE ED-110 and 10 Improvement Suggestion Forms (ISF) - Interoperability requirements Standard For ATN Baseline 1 (referred to as "ED-110").
- ICAO Doc 9705-AN956 - Manual of Technical Provisions for the Aeronautical Telecommunications Network (ATN), Second Edition (referred to as "ATN SARPs" or just "SARPs" in this document)

4. DATA LINK SUPPORT

There are certain pre-requisites for data link implementation on the Ground:

- Ground-Ground communication requires that Air Traffic Service providers inter-connect their national and regional X-25 based networks and that OLDI is implemented.
- A means to display data link messages and to elicit controller input (HMI)
- An accurate source of time - messages require timestamps and these shall be accurate to 1 second.
- VDL mode 2 shall be available including appropriate transmitter/receiver equipment

To implement data link, DLIC support is mandatory, implementers shall support the following CPDLC-based services:

- ACM
- AMC
- ACL

4.1 Implementation Issues

The way the data link application “plugs” into the communications infrastructure depends on its architecture and several approaches exist. Each centre has to decide how this is to be done.

5. SPECIFIC SERVICE REQUIREMENTS

Each of the different services have their specific functionality and their set of messages and, where applicable, message elements.

For the services using the CPDLC application the tables below list the mandatory and optional set of message elements derived from ED-110.

ED-110 fully describes how the services are to be implemented, including error handling.

For services using the CPDLC application:

- "Mandatory" means that all ground systems of participating states shall implement the messages and are available to the controller.

In case that a ground system wants to deviate from that rule, justification has to be given and approval has to be sought for by the LINK 2000+ community.

In cases where not supported uplink messages are required from certification or approval process, the ground system must be capable to emulate such messages without using the controller HMI.

Not supported downlink messages have to be properly decoded and responded with error message element UM162 or a UM159 'ERROR' (error information) + free text message element UM183, containing the text 'ELEMENT COMBINATION REJECTED – USE VOICE'.

This rule shall ensure a minimum level of harmonisation of the provision and use of CPDLC based data link services within the European airspace.

- "Optional" means that ground systems are free to implement and use the messages.

Note:

Per ED-110 the airborne side shall implement all baseline 1 uplink messages.

5.1 DLIC

5.1.1 Functionality

The DLIC service is air-initiated. The logon parameters provide aircraft identification and application addresses to ATS units for identification and flight plan correlation as well as for use in subsequent CPDLC.

ED-110 requires that the ground system support the “LOGON” service. Support of the “CONTACT” service is optional.

The “LOGON” service allows the aircraft to initiate the data link service. The “CONTACT” service allows the Ground System to request that an aircraft logon with another Ground System.

5.1.2 Implementation Issues

The objective of LINK 2000+ is to make sure that an aircraft only has to log on once for the European region. Once an aircraft has logged on, the parameters for data link will be passed between adjacent data link equipped centres using the OLDI ground-ground forwarding mechanism. Subsequent centres along the route will establish CPDLC services to the aircraft at the appropriate time, without further use of DLIC.

In case of failure of the OLDI ground-ground communications, air traffic service units shall use the "CONTACT" service to establish connection with the next centre.

Where data link equipped centres are not adjacent, aircrew shall use the "LOGON" service to establish DLIC connection with the next data link equipped centre.

5.2 CPDLC based Services

5.2.1 ACM

5.2.1.1 Functionality

ACM provides automated assistance to the aircrew and current and next controllers for conducting the transfer of ATC communications. ACM encompasses the change of voice channel, and when necessary, the termination and re-establishment of data link services.

In ED-110, ACM is described with two fundamental variants, identified as "Case A" and "Case B". LINK 2000+ mandates case A. This means that no instruction UM135 CONFIRM ASSIGNED LEVEL is carried with a CPDLC-End Request and that no DM38 ASSIGNED LEVEL is concatenated with a WILCO. This issue is addressed in ED-110.

5.2.1.2 "Mandatory" Uplink Messages

The Ground system must support the following Uplink ACM message elements:

UM 117 CONTACT [unitname] [frequency]
UM 159 ERROR [errorInformation]
UM 160 NEXT DATA AUTHORITY [facility]
UM 183 [free text] In a special case, text contains CURRENT ATC UNIT [.....] (see ED-110)
UM 227 LOGICAL ACKNOWLEDGEMENT

5.2.1.3 "Optional" Uplink Messages

The following Uplink ACM message element is optional for the Ground system:

UM 120 MONITOR [unitname] [frequency]

5.2.1.4 "Mandatory" Downlink Messages

The Ground system must support the following Downlink ACM message elements:

DM0 WILCO
DM1 UNABLE
DM2 STANDBY
DM62 ERROR [errorInformation]
DM63 NOT CURRENT DATA AUTHORITY
DM89 MONITORING [unitname] [frequency] ¹⁾
DM98 [freetext] (for additional error information)
DM99 CURRENT DATA AUTHORITY
DM100 LOGICAL ACKNOWLEDGEMENT
DM107 NOT AUTHORIZED NEXT DATA AUTHORITY ²⁾

- ¹⁾ Used in accordance with deviation from ED-110 submitted by LINK 2000+.
²⁾ Optional in ED-110, but mandatory in LINK 2000+ region

The ACM service has no optional downlink messages.

5.2.2 AMC

5.2.2.1 Functionality

AMC provides controllers with the capability to uplink an instruction for aircraft to check that they are not blocking a voice channel. No aircrew acknowledgement of the instruction is required.

5.2.2.2 "Mandatory" Uplink Messages

The following Uplink ACM message element is mandatory for the Ground system:

UM157 CHECK STUCK MICROPHONE [frequency]
--

5.2.3 ACL

5.2.3.1 Functionality

ACL provides the following exchanges:

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

The messages, presented in paragraphs 5.2.3.2 till 5.2.3.6, are intended for use in non-time critical situations and may be applied instead of or in combination with voice communications.

5.2.3.2 "Mandatory" Uplink Messages

The following table shows the mandatory uplink message elements applicable to **all LINK2000+** ground systems in context of Linkbuild1A:

UM0 UNABLE
UM1 STANDBY
UM19 MAINTAIN [level]
UM20 CLIMB TO [level]
UM23 DESCEND TO [level]
UM74 PROCEED DIRECT TO [position]
UM159 ERROR [errorInformation]
UM162 SERVICE UNAVAILABLE ¹⁾
UM183 [freetext] (for additional error information)
UM190 FLY HEADING [degrees]
UM227 LOGICAL ACKNOWLEDGMENT

¹⁾ Text 'SERVICE UNAVAILABLE' is just an ICAO intention. It is recommended to use the text 'MESSAGE NOT SUPPORTED BY THIS UNIT' for display in the aircraft.

5.2.3.3 "Optional" Uplink Messages

The following table shows the "Optional" Uplink messages for baseline1 ground systems:

UM3 ROGER
UM4 AFFIRM
UM5 NEGATIVE

UM26	CLIMB TO REACH [level] BY [time]
UM27	CLIMB TO REACH [level] BY [position]
UM28	DESCEND TO REACH [level] BY [time]
UM29	DESCEND TO REACH [level] BY [position]
UM46	CROSS [position] AT [level]
UM47	CROSS [position] AT OR ABOVE [level]
UM48	CROSS [position] AT OR BELOW [level]
UM51	CROSS [position] AT [time]
UM52	CROSS [position] AT OR BEFORE [time]
UM53	CROSS [position] AT OR AFTER [time]
UM54	CROSS [position] BETWEEN [time] AND [time]
UM55	CROSS [position] AT [speed]
UM61	CROSS [position] AT AND MAINTAIN [level] AT [speed]
UM64	OFFSET [specifiedDistance] [direction] OF ROUTE
UM72	RESUME OWN NAVIGATION
UM79	CLEARED TO [pos] VIA [route clearance]
UM80	CLEARED [route clearance]
UM82	CLEARED TO DEVIATE UP TO [specifiedDistance] [direction] OF ROUTE
UM92	HOLD AT [position] AS PUBLISHED MAINTAIN [level]
UM94	TURN [direction] HEADING [degrees]
UM96	CONTINUE PRESENT HEADING
UM106	MAINTAIN [speed]
UM107	MAINTAIN PRESENT SPEED
UM108	MAINTAIN [speed] OR GREATER
UM109	MAINTAIN [speed] OR LESS
UM116	RESUME NORMAL SPEED
UM123	SQUAWK [code]
UM133	REPORT PRESENT LEVEL
UM148	WHEN CAN YOU ACCEPT [level]
UM165	THEN ¹⁾
UM171	CLIMB AT [verticalRate] MINIMUM
UM172	CLIMB AT [verticalRate] MAXIMUM
UM173	DESCEND AT [verticalRate] MINIMUM
UM174	DESCEND AT [verticalRate] MAXIMUM
UM179	SQUAWK IDENT
UM196	[freetext]
UM203	[freetext]
UM205	[freetext]
UM211	REQUEST FORWARDED
UM213	[facilitydesignation] ALTIMETER [altimeter]
UM215	TURN [direction] [degrees]
UM222	NO SPEED RESTRICTION
UM231	STATE PREFERRED LEVEL
UM232	STATE-TOP-OF-DESCENT

¹⁾ It is strongly recommended not to use UM165 "THEN" for concatenation. Should local authorities decide to use UM165, it is recommended to fully define the message elements that may be concatenated using "THEN" and to assess all risks that may lead to ambiguities for the aircrew.

The aircraft is required to make an operationally correct response to all the messages listed in the above tables

If any other messages not listed in baseline 1 are sent by a Ground System, the aircraft may respond in an operationally correct manner, but it is also allowed to respond with an error indicating that the message is not supported.

5.2.3.4 "Mandatory" Downlink Messages

The table below shows the request and information messages for baseline 1ground systems:

DM0	WILCO
DM1	UNABLE
DM2	STANDBY
DM6	REQUEST [level]
DM9	REQUEST CLIMB TO [level]
DM10	REQUEST DESCENT TO [level]
DM22	REQUEST DIRECT TO [position] ¹⁾
DM62	ERROR [errorInformation]
DM65	DUE TO WEATHER
DM66	DUE TO AIRCRAFT PERFORMANCE
DM98	[freetext] (for additional information)
DM100	LOGICAL ACKNOWLEDGMENT

¹⁾ Optional in ED110, but mandatory for LINK 2000+ region.

5.2.3.5 "Optional" Downlink Messages

The following table shows the "Optional" Downlink messages for baseline1 ground systems:

DM18	REQUEST [speed] ¹⁾
DM27	REQUEST WEATHER DEVIATION UP TO ¹⁾ [specifiedDistance] [direction] OF ROUTE

¹⁾ Some ground system may reject this message

5.2.3.6 "Conditional" Downlink Messages

The table below shows the following conditional message elements:

DM3	ROGER (C.10)
DM4	AFFIRM (C.9)
DM5	NEGATIVE C.9)
DM32	PRESENT LEVEL [level] (C.1)
DM81	WE CAN ACCEPT [level] AT [time] (C.3)
DM82	WE CANNOT ACCEPT [level] (C.3)
DM106	PREFERRED LEVEL [level] (C.5)
DM109	TOP OF DESCENT [time] (C.6)

C.1: If UM133 supported then Mandatory else Optional.

C.3: If UM148 supported then Mandatory else Optional.

C.5: If UM231 supported then Mandatory else Optional.

C.6: If UM232 supported then Mandatory else Optional.

C.9: If UM message with response type A/N or Y is used then Mandatory else Inhibited.

C.10: If UM message with response type R is used then Mandatory else Inhibited.

6. USE OF LOGICAL ACKNOWLEDGEMENT

In European airspace use of LACK is **mandatory** and is used in ACM and ACL message exchange.

Downlink Messages	Uplink Messages
DM100 LOGICAL ACK.	UM227 LOGICAL ACK.

7. RECORDING REQUIREMENTS

The new ICAO rules (Annex 11, Chapter 6, 12th edition) require the recording of all digital data communications to and from the ground. Data link communications include, but are not limited to, automatic dependent surveillance (ADS), controller-pilot data link communications (CPDLC) and data link-flight information services (D-FIS).

The functional specifications for ground recording are published in ED-111. Copies can be obtained from EUROCAE.

ANNEX A: CONFORMANCE STATEMENT

Applicants claiming conformance to the LINKbuild 1/A services and message sets for ground implementation shall complete the conformance statement below.

Uplink messages- Ground User		
	LinkBuild1/A	Applicant
Operational Elements	Status	Status
UM0 UNABLE	M	
UM1 STANDBY	M	
UM3 ROGER	O	
UM4 AFFIRM	O	
UM5 NEGATIVE	O	
UM19 MAINTAIN [level]	M	
UM20 CLIMB TO [level]	M	
UM23 DESCEND TO [level]	M	
UM26 CLIMB TO REACH [level] BY [time]	O	
UM27 CLIMB TO REACH [level] BY [position]	O	
UM28 DESCEND TO REACH [level] BY [time]	O	
UM29 DESCEND TO REACH [level] BY [position]	O	
UM46 CROSS [position] AT [level]	O	
UM47 CROSS [position] AT OR ABOVE [level]	O	
UM48 CROSS [position] AT OR BELOW [level]	O	
UM51 CROSS [position] AT [time]	O	
UM52 CROSS [position] AT OR BEFORE [time]	O	
UM53 CROSS [position] AT OR AFTER [time]	O	
UM54 CROSS [position] BETWEEN [time] AND [time]	O	
UM55 CROSS [position] AT [speed]	O	
UM61 CROSS [position] AT AND MAINTAIN [level] AT [speed]	O	
UM64 OFFSET [specifiedDistance] [direction] OF ROUTE	O	
UM72 RESUME OWN NAVIGATION	O	
UM74 PROCEED DIRECT TO [position]	M	
UM79 CLEARED TO [position] VIA [routeClearance]	O	
UM80 CLEARED [route clearance]	O	
UM82 CLEARED TO DEVIATE UP TO [specifiedDistance] [direction] OF ROUTE	O	
UM92 HOLD AT [position] AS PUBLISHED MAINTAIN [level]	O	
UM94 TURN [direction] HEADING [degrees]	O	
UM96 CONTINUE PRESENT HEADING	O	
UM106 MAINTAIN [speed]	O	
UM107 MAINTAIN PRESENT SPEED	O	
UM108 MAINTAIN [speed] OR GREATER	O	
UM109 MAINTAIN [speed] OR LESS	O	
UM116 RESUME NORMAL SPEED	O	
UM117 CONTACT [unitname] [frequency]	M	
UM120 MONITOR [unitname] [frequency]	O	
UM123 SQUAWK [code]	O	
UM133 REPORT PRESENT LEVEL	O	
UM148 WHEN CAN YOU ACCEPT [level]	O	
UM157 CHECK STUCK MICROPHONE [frequency]	M	
UM159 ERROR [errorInformation]	M	
UM160 NEXT DATA AUTHORITY [facility]	M	
UM162 SERVICE UNAVAILABLE	M	
UM165 THEN	O	
UM171 CLIMB AT [verticalRate] MINIMUM	O	
UM172 CLIMB AT [verticalRate] MAXIMUM	O	
UM173 DESCEND AT [verticalRate] MINIMUM	O	
UM174 DESCEND AT [verticalRate] MAXIMUM	O	
UM179 SQUAWK IDENT	O	
UM183 [freetext]	M	
UM190 FLY HEADING [degrees]	M	

UM196 [freetext]	O	
UM203 [freetext]	O	
UM205 [freetext]	O	
UM211 REQUEST FORWARDED	O	
UM213 [facilitydesignation] ALTIMETER [altimeter]	O	
UM215 TURN [direction] [degrees]	O	
UM222 NO SPEED RESTRICTION	O	
UM227 LOGICAL ACKNOWLEDGMENT	M	
UM228 REPORT ETA [position]	O	
UM231 STATE PREFERRED LEVEL	O	
UM232 STATE-TOP-OF-DESCENT	O	

Downlink messages- Ground User		
	LinkBuild 1/A	Applicant
Operational Elements	Status	Status
DM0 WILCO	M	
DM1 UNABLE	M	
DM2 STANDBY	M	
DM3 ROGER	C	
DM4 AFFIRM	C	
DM5 NEGATIVE	C	
DM6 REQUEST [level]	M	
DM9 REQUEST CLIMB TO [level]	M	
DM10 REQUEST DESCENT TO [level]	M	
DM18 REQUEST [speed]	O	
DM22 REQUEST DIRECT TO [position]	M	
DM27 REQUEST WEATHER DEVIATION UP TO [specifiedDistance] [direction] OF ROUTE	O	
DM32 PRESENT LEVEL [level]	C	
DM62 ERROR [errorInformation]	M	
DM63 NOT CURRENT DATA AUTHORITY	M	
DM65 DUE TO WEATHER	M	
DM66 DUE TO AIRCRAFT PERFORMANCE	M	
DM81 WE CAN ACCEPT [level] AT [time]	C	
DM82 WE CANNOT ACCEPT [level]	C	
DM89 MONITORING [unitname] [frequency]	M	
DM98 [freetext]	M	
DM99 CURRENT DATA AUTHORITY	M	
DM100 LOGICAL ACKNOWLEDGMENT	M	
DM106 PREFERRED LEVEL [level]	C	
DM107 NOT AUTHORIZED NEXT DATA AUTHORITY	M	
DM109 TOP OF DESCENT [time]	C	