EUROCONTROL

EUROCONTROL

LINK 2000+ TEST FACILITY PROJECT

Automated CM/CPLDC Ground Tool - User Guidance Specifications

Ref.   : LINK2000/EEC/DOC/IH0617

Author   : Isabelle Herail

Rev. No.   : Issue 1.3

Date   : 29/04/11

DOCUMENT CONTROL LOG

SECTION	DATE	REV. NO.	REASON FOR CHANGE OR REFERENCE TO CHANGE
	24/07/06	Issue 1.0	Creation
	05/02/07	Issue 1.1	Upgrade for CM-CONTACT feature. Avionics pictures included.
	10/10/08	Issue 1.2	Chapter developed on tool's usage constraints: AircraftFlightID, grounded aircraft.
4.6	29/04/11	Issue 1.3	LFPYTEST CM application addressing information included

TABLE OF CONTENTS

1. Introduction

1.1   Scope

This document defines some User Guidance for the Airlines who intend to use the Automated CM/CPDLC Ground Test Tool which is part of the LINK2000+ Test Facility platform at Eurocontrol Bretigny.

1.2   Document Structure

This document is structured as follows:

- Chapter one – this chapter – provides an introduction to the document.

- Chapter two – Summary - provides an overview of the purpose of the Ground Automated Tool.

- Chapter three – Quick Start Guide – provides basic information on how to quickly use the tool.

- Chapter four provides information details on the ground automated tool.

1.3   References

1)	ED-110	Interoperability Requirements Standard For ATN Baseline 1

2. Summary

2.1 Automated tool objectives

In the context of LINK2000+ ATN/CPDLC deployment, an automated CM/CPDLC ground tool was requested by several Airlines equipped with LINK2000+ Baseline compliant ATN CMU or ATSU.

The automated tool, hosted at the Eurocontrol Experimental Center Bretigny on the LINK2000+ Test Facility platform, allows airlines:

- to verify proper CM/CPDLC equipment installation and functioning,

- to verify new software avionics releases (from a test mock-up or a test a/c in the hangar), before the software is installed on the first aircraft.

- to assist in aircrew CM/CPDLC familiarization.

The main interest for the airlines is to have a ground tool available to allow them to exercise CM/CPDLC from an aircraft, without any operator on the ground side.

The automated tool is not intended to be used in order to perform CMU/ATSU software Interoperability Testing.

Thus it is assumed that the avionics aimed at being connected to the automated tool has already been validated as being compliant with the LINK2000+ Baseline before the ground automated tool is used.

2.2 Automated Tool Accessibility

The automated ground tool supports CM/CPDLC end-to-end connectivity from any aircraft connected to the LINK2000+ ATN/VDL-M2 operational infrastructure either via ARINC or SITA Air/Ground Communication Service Providers.

On the ground side the automated tool is reachable through an EEC connection to SITA ACSP taking advantage of the full ACSPs internetworking which was set up end of 2007.

As EEC is not an operational Center the tool intends to be made available to Airlines, from Monday to Friday during Central European Time working hours. Any request to run a test outside the defined period of time might be feasible but with no guarantee of success, taking into account that network and system resources might be unavailable during the night or during the week-end.

3. Quick Start Guide

3.1   Before using the tool

3.1.1 CMU/ATSU Addressing Database Pre-requisites

The automated tool is identified as a ground ATC center with its own Ground Facility Designator.

The automated tool Ground Facility Designator is set to **LFPYTEST**; this is the value which has to be selected in the ATC CENTER field of the CMU/ATSU NOTIFY and LOGON pages.

Airbus and Honeywell avionics vendors have agreed to include LFPYTEST GFD and its relevant CM application presentation address in their avionics addressing database so that it is directly selectable on CMU/ATSU Logon page for manual Logon initiation.

For Rockwell Collins already equipped aircraft which do not have LFPYTEST as part of their addressing database, the automated tool has been enhanced with a functionality which allows blind CM-CONTACT (LFPYTEST) to be uploaded to an aircraft.

Note: you may have to contact your avionics vendor to get the appropriate addressing database.

3.1.2 Co-ordination with EEC

The usage of the automated tool from a real aircraft or a test mock-up always requires previous coordination between Eurocontrol and the Airline.

In order to perform such coordination, please send an email to the LINK2000+ Test Facility manager, Isabelle HERAIL, in order:

- To provide EEC with the aircraft ID (24 bits ICAO address) of the test aircraft, as an aircraft filter on the aircraft identifier is applied at the Logon step.

- To co-ordinate on date and time planned for the test, Central European Time working hours.

3.2   Constraints

3.2.1 Logon ATC center

The Logon address of the ground automated tool is **LFPYTEST**.

Note: This is the value which has to be selected in the ATC CENTER field of the CMU/ATSU NOTIFY and LOGON pages

3.2.2 Aircraft location

<u>**When used from an Airline equipped aircraft:**</u>

A Logon request - LOGON or NOTIFY actions from the CMU/ATSU equipment - to LFPYTEST, shall only be sent from a grounded aircraft.
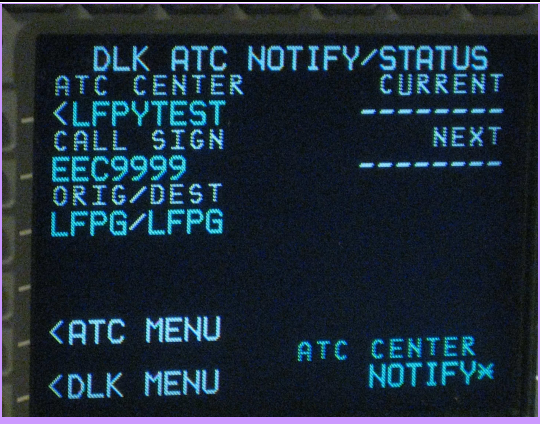
3.2.3 Logon CallSign

The Logon CallSign (AircraftFlightID) shall always be set to **EEC9999.**

Note: if a different CallSign is received in the Logon indication, the Logon request will not be answered by the tool and will fail on board due to tts timer expiry.

3.3   Practising CM/CPLDC with the Ground Automated tool

A typical test session between a LINK2000+ CMU/ATSU and the ground automated tool is described in the table below.

PHASE	DESCRIPTION	
LOGON	- From CMU/ATSU the aircrew sends a LOGON request to **LFPYTEST** - If the LOGON is accepted (the aircraft ID is in the ground tool filter list, the aircraft is not logged on yet and a maximum of five aircraft are not connected yet), the tool sends a positive LOGON response back.	DLK ATC NOTIFY/STATUS ATC CENTER CURRENT <LFPYTEST -------- CALL SIGN NEXT EEC9999 -------- ORIG/DEST LFPG/LFPG <ATC MENU ATC CENTER <DLK MENU NOTIFY*

PHASE	DESCRIPTION	
CURRENT **DATA** **AUTHORITY**	- Shortly after the LOGON response has been sent, the ground tool initiates the CPDLC connection and waits for the CURRENT DATA AUTHORITY message from the aircraft. - A CPDLC session timer of 20 minutes is started on the ground. The main objective of the session timer is to limit the CPDLC connection duration of an aircraft and allow concurrent "pending" test aircraft to connect. - A free text message is uploaded to announce LFPYTEST as the Current ATC Unit.	
ACCEPTANCE	- Once the Current ATC Unit message has been notified, the ground tool notifies the aircrew that they are connected to a test system and waits for the crew to accept the test conditions. - The crew has to select ROGER message to further continue exercising CPDLC with the test tool. If an UNABLE response is received or the response timer expires, the CPDLC connection is aborted by the ground side.	

PHASE	DESCRIPTION	
CPDLC DOWNLINK MESSAGES PROCESS	- When the ROGER response is received on the ground, the tool sends a free text message inviting the crew to send downlink requests; it also indicates how to proceed to trigger the uplink clearances sequence.	
	- When a downlink request is received, the tool automatically returns an operational response. The response is taken from a list of four pre-configured responses. If the same downlink request is received several times during a same CPDLC session, the tool rotates on the potential responses.	
	- When the crew wants to move to the uplink messages sequence, they downlink a REQUEST DIRECT TO UP000 (fixname) as indicated in previous freetext message. - The tools replies with an AFFIRM message and starts uplinking the ground clearances.	

PHASE	DESCRIPTION	
CPDLC UPLINK MESSAGES PROCESS	- The tool sends the uplink messages taken from a list of predefined uplink clearances. The list includes the most common messages currently used at Maastricht UAC. - When a clearance is received on the CMU/ATSU, the aircrew selects the appropriate response (or leaves the response timer to expire). - When the response from the air side is received on the ground, the automated tool moves to the next clearance in the table after a 10 seconds delay. - Once the uplink sequence is completed a relevant freetext message is sent to the crew.	

CPDLC connection TERMINATION	• The air side may terminate a CPDLC connection by sending a LOGOFF/TERMINATE from the CMU/ATSU at any convenient time.
	
	• The ground tool may terminate the CPDLC connection for several reasons:
	
	    - The aircraft does not accept the conditions at the acceptance phase.
	
	    - The CPDLC session timeout expires. A free text message is sent to the crew before the ground disconnects.	

3.4   After a test session

All CPDLC exchanges performed with an aircraft during a testing session with the automated ground tool are logged for further analysis.

An Airline may request the relevant logs related to a test session, to the LINK2000+ Test Facility manager.

The aircraft ID date and start time of the session will have to be mentioned in order to properly retrieve the relevant file.

An example of CPDLC ground automated tool registered log file is provided in ANNEX A – Automated Tool CPDLC Log file.

Please note that a common CM log file is also registered by the automated tool. In case of LOGON failures being notified on board an aircraft, some investigations may also be conducted and the reason why for the failure may be provided to the Airline if some evidence of Logon indication has been registered in the Log file (Logon failures might be due to network issues).

3.5   Recommendation

Please do not reboot your CMU/ATS during a test session or you will have to wait until the session is terminated on the ground test tool before you are able to perform a new one.

In case of abnormal termination of CMU/ATSU during a test session, the test tool will terminate the session after it has been notified of a Provider Abort due to TP4 timer expiry that is 6 minutes. All CM-Logon attempt before this timer expiry will be unsuccessful.

4. Automated Tool Information details

4.1   CM-CONTACT process

The automated tool allows the upload of LFPYTEST GFD and CM application address to an aircraft via blind CM-CONTACT (LFPYTEST) requests sent to the aircraft.

In order to be able to send a CM-CONTACT request to an aircraft, the aircraft CM application address has to be known in advance.

The CM-CONTACT requests are uploaded to the aircraft:

- o   During a period of maximum 12 hours after the start time provided by the airline.

- o   Until a CM-CONTACT confirmation successful/not successful is received by the automated tool.

After a CM-CONTACT confirmation successful/not successful has been received the automated tool stops sending the CM-CONTACT requests. The GFD/CM application address shall then be available from the CMU LOGON page

Please note that currently the Rockwell Collins CMU does not keep in non volatile memory the GFDs and addresses which are uploaded dynamically via CM-CONTACT requests. **This means that any GFD learnt via CM-CONTACT indications will be lost after a CMU reset.**

4.2 CPDLC downlink requests process

4.2.1 Downlink messages

The automated tool proceeds with following downlink request/information received from the air side as per LINK2000+ Message set:

Message number	Message Definition
DM6	REQUEST (level)
DM9	REQUEST CLIMB TO (level)
DM10	REQUEST DESCENT TO (level)
DM18	REQUEST (speed)
DM22	REQUEST DIRECT TO (position)
DM27	REQUEST WEATHER DEVIATION UP TO (specifiedDistance) (direction) OF ROUTE
DM32	PRESENT LEVEL (level)
DM37	MAINTAINING LEVEL (level)
DM38	ASSIGNED LEVEL (level)
DM81	WE CAN ACCEPT (level) AT (time)
DM89	MONITORING (unitname) (frequency)
DM106	PREFERRED LEVEL (level)
DM109	TOP OF DESCENT (time)

The variant parameters supported on reception (downlink) by the ground Automated Test Tool are defined in the table bellow. Downlink messages received with other units parameters are ignored (no LACK sent back).

Parameter	Definition
[level]	Flight Level
[speed]	Indicated speed in kts
[position]	Fix name (LatLon)
	Navaid (LatLon)
	Airport
[distanceSpecified]	Distance in nm
[frequency]	VHF frequency in MHz 0.005 MHz steps
[degrees]	Degrees Magnetic
[verticalRate]	Vertical Rate unit ft/mn
[altimeter]	Altimeter unit HectoPascal

Table 1– List of Downlink Variant parameters

4.2.2 Responses to downlink messages

The tool automatically returns a response to any request received from the aircraft, provided the request requires a response.

A ground response is taken from a configurable list of four potential answers for each downlink message as defined in Table 2– List of Ground Operational Response.

If the same downlink request is received several times during the same CPDLC session, the tool rotates on the potential responses.

If the response is a STANDBY message, the next response in the table defined for the message is sent after LACK timer delay (tr timer delay).

The operational response returned by the automated tool may lead to a subsequent reply from the aircraft.

Downlink Message	RESP 1	RESP 2	RESP 3	RESP 4
REQUEST (level)	UNABLE	MAINTAIN LEVEL(level)	STANDBY	REQUEST FORWARDED
REQUEST CLIMB TO (level)	STANDBY	CLIMB TO(level)	UNABLE	REQUEST FORWARDED
REQUEST DESCENT TO (level)	UNABLE	DESCENT TO(level)	STANDBY	REQUEST FORWARDED
REQUEST (speed)	STANDBY	MAINTAIN PRESENT SPEED	UNABLE	REQUEST FORWARDED
REQUEST DIRECT TO (position)	UNABLE	PROCEED DIRECT TO(position)	STANDBY	REQUEST FORWARDED
REQUEST WEATHER DEVIATION UP TO (specifiedDistance) (direction) OF ROUTE	STANDBY	CLEARED TO DEVIATE UP TO (specifiedDistance) (direction) OF ROUTE	UNABLE	REQUEST FORWARDED

Table 2– List of Ground Operational Responses

4.3   CPDLC uplink requests process

4.3.1 Uplink clearances list

Upon reception of the specific downlink message from the air side, **REQUEST DIRECT TO UP000**, the tool starts uplinking some pre-configured clearances.

The list of clearances is defined in a configuration file. *The list content may be modified according to Airlines feedback.*

The list includes the most common messages currently used at Maastricht UAC.

The values allocated to the message parameters are as well part of the configuration table and may be changed on relevant Airlines feedback.

The current uplink messages and parameter values are as shown in Table 3 – List of Ground Uplink Messages Sequence:

Message number	Uplink Clearance
20	CLIMB TO (FL310)
23	DESCENT TO (FL290)
74	PROCEED DIRECT TO (LIMBU)
117	CONTACT (LFPYTEST,CENTER,BRETIGNY) (132780)
123	SQUAWK (7777)
157	CHECK STUCK MICROPHONE (132780)
179	SQUAWK IDENT
215	TURN (RIGHT) (030)

Table 3 – List of Ground Uplink Messages Sequence

4.3.2 Uplink clearances process

After sending a clearance, in case an operational response is expected, the tool pends for the operational response; in such a case the *tts* timer is started in accordance with Ref 1) document.

If a STANDBY DL response is received (DM 2) the *tts* timer is reset and the tool continues pending for the operational response.

An uplink transaction is considered to be closed whenever:

- No operational response is expected;

- If an operational response is expected:

    o The reception of the operational response,

    o Or the reception of an ERROR (DM 62) message,

    o Or eventually, the expiration of the tts timer.

Once an uplink transaction is closed, the tool moves to the next uplink message in the clearances list.

Once the uplink sequence is completed the following UM183 message is sent to the aircrew: "**UPLINK SEQUENCE COMPLETED. TO RUN AGAIN SEND REQUEST DIRECT UP000**"

4.4   Timers

4.4.1 Session Timer

The automated tool is managing a session timer in order to limit the CPDLC connection time for a connected aircraft and to allow connections of different aircraft.

The session timer is a configurable value which is currently set to 20 minutes.

When the CPDLC session timer expires, a UM183 message, **"CPDLC TEST SESSION TERMINATED",** is sent to the CMU/ATSU.

After LACK has been received or the tr timer expires for the UM183 message, the automated tool generates a CPDLC User Abort Request.

4.4.2 Standard Timers

The automated tool manages other timers as defined by the document mentioned in Ref 1) document.

Timer Definition	Timer	Default value
CPDLC termination timer Time to wait for the operational response	tts	120 seconds
CPDLC technical timer response Time to wait for the Logical Acknowledgment	tr	40 seconds
CPDLC future time		2 seconds
CPDLC latency timer		40 seconds

All the timers are configurable values.

4.5 Number of Connected Aircraft

The tool is configured to accept a maximum of five simultaneous connected aircraft.

4.6 Naming and Addressing Information

See in the table below relevant ATN and Context Management application addressing information for the ground automated tool hosted at the EEC.

GFD	ATN NSAP Address						CM TSEL
LFPYTEST	47002781	836575	00	115059	0001	000047473131	01	0101

5. ANNEX A – Automated Tool CPDLC Log file

5.1   Log file Format

The log collects CPDLC connection events (CPDLC-Start, CPDLC User Abort, and CPDLC Provider Abort) and all CPDLC uplink/downlink messages exchanges.

Each CPDLC message uplink or downlink is logged with appropriate date/time information; Logical Acknowledgment messages are also registered.

For each CPDLC uplink or downlink message, the registered information is:

Item	Uplink	Downlink
The way of the exchange	Sent	Received
The timestamp conveyed in the message	Sent message block at dd/mm/yyyy hh:mm:ss	Received message block (sent at dd/mm/yyyy hh:mm:ss)
The message ID	msg id x	msg id x
The message Reference number	In response to msg x	In response to msg x
If LACK is requested or not	with request for Logical Ack	with request for Logical Ack

5.2   Log file Example


```
Session Log for 0x400001

01/02/07 15:27:26 peer=93 with request for Logical Ack
01/02/07 15:27:26 peer=93 CURRENT ATC UNIT LFPYTEST,BRETIGNY,CENTER
01/02/07 15:27:26 peer=93
01/02/07 15:27:32 peer=93 Received message block (sent at 01/02/2007 15:27:29), msg id 1
01/02/07 15:27:32 peer=93 in response to msg 2
01/02/07 15:27:32 peer=93 LOGICAL ACKNOWLEDGMENT
01/02/07 15:27:32 peer=93
01/02/07 15:27:42 peer=93 Sent message block at 01/02/2007 15:27:42, msg id 3
01/02/07 15:27:42 peer=93 with request for Logical Ack
01/02/07 15:27:42 peer=93 YOU ARE CONNECTED TO A TEST SYSTEM,PLEASE CONFIRM NO CPDLC INSTRUCTION WILL BE EXE
CUTED
01/02/07 15:27:42 peer=93
01/02/07 15:27:44 peer=93 Received message block (sent at 01/02/2007 15:27:43), msg id 2
01/02/07 15:27:44 peer=93 in response to msg 3
01/02/07 15:27:44 peer=93 LOGICAL ACKNOWLEDGMENT
01/02/07 15:27:44 peer=93
01/02/07 15:27:49 peer=93 Received message block (sent at 01/02/2007 15:27:49), msg id 3
01/02/07 15:27:49 peer=93 in response to msg 3
01/02/07 15:27:49 peer=93 with request for Logical Ack
01/02/07 15:27:49 peer=93 ROGER
01/02/07 15:27:49 peer=93
01/02/07 15:27:49 peer=93 Sent message block at 01/02/2007 15:27:49, msg id 4
01/02/07 15:27:49 peer=93 in response to msg 3
01/02/07 15:27:49 peer=93 LOGICAL ACKNOWLEDGMENT
01/02/07 15:27:49 peer=93
01/02/07 15:27:59 peer=93 Sent message block at 01/02/2007 15:27:59, msg id 5
01/02/07 15:27:59 peer=93 with request for Logical Ack
01/02/07 15:27:59 peer=93 PLEASE PROCEED WITH DOWNLINK REQUESTS. TO START UPLINK REQUEST, SEND REQUEST DIREC
T TO UP000, THANK YOU
01/02/07 15:27:59 peer=93
01/02/07 15:28:04 peer=93 Received message block (sent at 01/02/2007 15:28:01), msg id 4
01/02/07 15:28:04 peer=93 in response to msg 5
01/02/07 15:28:04 peer=93 LOGICAL ACKNOWLEDGMENT
01/02/07 15:28:04 peer=93

                                    Close
```