

**EATCHIP GDLP/Local  
User ICD for POEMS**

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# DOCUMENT IDENTIFICATION SHEET

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### Abstract

The document describes the interface requirements in terms of the protocol for data exchange between a Ground data Link Processor/ Local User and the Pre-Operational European Mode S station, to be developed as part of the Initial Mode S programme.

### Keywords

data-link  
ATN

Mode S  
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SVC  
DLF

MSP  
GDLP

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**DOCUMENT APPROVAL**

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## ABBREVIATIONS

ADLP	Airborne Data Link Processor
ATN	Aeronautical Telecommunications Network
BITE	Built-In Test Equipment
COM	Transponder Communications capability
DC	Downlink Command
DCS	Downlink Current Status
DDS	Downlink Default Status
DLF	Data Link Function
ECA	Extended Capability report
EI	Exit Indicator
GDLP	Ground Data Link Processor
IC	Interrogator Control
LU	Local User
SDP	Site Dependant Parameter
SMF	System Management Function
UC	Uplink Command
UCS	Uplink Current Status
UDS	Uplink Default Status

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# GDLP/Local User ICD

## 1. INTRODUCTION

### 1.1 Purpose

This document describes the communication protocol between the pre-operational Mode S ground station and the Aeronautical Telecommunication Network (ATN) interface, i.e. the GDLP. The interface between the pre-operational Mode S ground station and the non-ATN access i.e. the Local User, shall use a sub-set of the proposed messages. The Data Link Function (DLF) that is described in the EATCHIP Pre-Operational Mode S Functional Specification controls the interface from the Mode S ground station with the GDLP, the Local User and internal applications.

### 1.2 General comments

Appendix A contains the service primitives and state tables, which are a formal definition of the protocol and therefore provides a more complete description of the required operation than the text in Chapter 3. In case of conflict between the text and the state tables, the state tables take precedence over the textual descriptions contained in section 3. It should be noted that verification of the message exchanges across the external interfaces is anticipated, rather than an assessment of the internal implementation of these tables. Appendix B contains a description of the messages used in the protocol.

Ref. 4 describes the ASTERIX Category 18 messages to be used across this interface.

It should be noted that the protocol described in this document does not provide a guaranteed service for end to end message delivery, and one way to provide this assurance is to implement an appropriate layer of the OSI model.

### 1.3 Related Documents

Ref 1 Volume III, Part 1, Chapter 5 to Amendment 71 of ICAO Annex 10 July 1995.

Ref 2 RDIF 'Radar Data Interchange Format' CAA Paper 87002, November 1991.

Ref 3 CCITT recommendation X25-88

Ref 4 POEMS DOCUMENT FOR ASTERIX CATEGORY 018 (Part6)  
Transmission of Mode S datalink Function Messages SUR.ET2.ST03.3112-  
SPC-01-00 edition 1.5, March 1999

Ref 5 EATCHIP POEMS Functional Specification, Document Ref. SUR-ET2-ST03.3110-SPC-01-00 edition 2.0

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## **2. INTERFACE REQUIREMENTS**

### **2.1 GDLP interface**

The DLF shall manage the physical access to the GDLP via X.25 or directly through LAP-B. The minimum line-speed shall be 19,200 bits per second, and shall be configurable up to 128kbs.

### **2.2 Local User interface**

The DLF shall manage the physical access to the Local User via X.25 or directly through LAP-B. The minimum line-speed shall be 19,200 bits per second, and shall be configurable up to 128kbs.

The Local User interface coordinates Specific Services requests from non ATN applications and sends them to the DLF. A subset of the messages defined for the GDLP and the pre-operational Mode S ground station shall be used for this local interface.

### **2.3 Connection management**

There are two GDLP connections and two Local User connections for the POEMS Mode S ground station.

Both active GDLP and Local User connections are made to the DCE at the link layer. Each connection shall be used by the application and use the complete X.25 stack. The alternative GDLP/LU link to the ground station is not connected.

A single (3 position) SDP (SDP\_IC) is used to indicate the authority of the GDLP and LU. In the absence of both the GDLP and LU, then authority can be set to the Interrogator.

If a GDLP/LU is available, only the active channel of the ground station is connected at the application layer with the GDLP and LU.

In case of failure of the active chain of the ground station there is an automatic switch over to the second chain. In this case a new application connection is established with the GDLP/LU.

In case the link between the ground station chain and the GDLP/LU is broken at the link layer, it is reported to the ground station BITE and connectivity is maintained by employing the alternative interface. In this case a new application connection is established with the GDLP/LU.



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### 3. DATA LINK FUNCTION (DLF)

#### 3.1 Functional architecture

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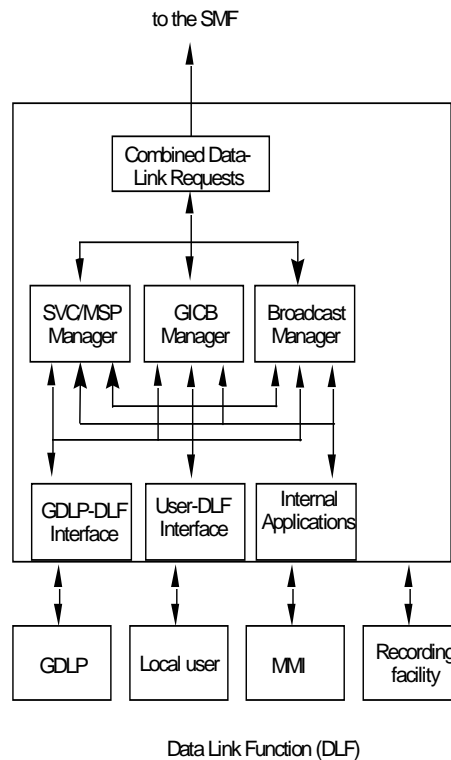


Figure 1: Data Link Function (DLF)

#### 3.2 Protocol Specification for GDLP/DLF interface

##### 3.2.1 Link management

###### 3.2.1.1 Connection procedures

###### 3.2.1.1.1 Messages issued by the GDLP

To initiate a connection, the GDLP sends an **Associate\_req** message to the DLF. This message is sent each T1 period (value in Table 2) until it receives an **Associate\_Resp** message from the DLF.

On receipt of an **Associate\_req** from the GDLP, the DLF removes existing aircraft data associated with that link, resets internal timers/counters and replies with an **Associate\_resp** message. The D\_result field of the **Associate\_resp** is set to (**CAUSE=3h(finished),DIAG=0h(No diagnostic available)**).

---

This also specifies the use of a restart function, in the case of an already existing association.

#### 3.2.1.1.2 Messages issued by the DLF

To initiate a connection, the DLF sends an **Associate\_req** message to the GDLP. This message is sent each T1 period (value in Table 2) until it receives an **Associate\_Resp** message from the GDLP.

On receipt of an **Associate\_req** from the DLF, the GDLP removes existing aircraft data associated with that link, resets internal timers/counters and replies with an **Associate\_resp** message. The D\_result field of the **Associate\_resp** is set to **(CAUSE=3h(finished),DIAG=0h(No diagnostic available))** .

This also specifies the use of a restart function, in the case of an already existing association.

Upon establishment of the connection the DLF shall send to the GDLP an **Aircraft\_report** message for each unique aircraft in the Data Link coverage.

#### 3.2.1.1.3 Collision procedure

When either the GDLP or the DLF receives an **Associate\_req** message while waiting for an **Associate\_resp** message, an **Associate\_req** message collision occurs. The DLF acts as the master and ignores the **Associate\_req** received from the GDLP. When the GDLP receives the **Associate\_req**, the GDLP cancels the association establishment procedure it initiated and sends an **Associate\_resp** message to the DLF. The connection is complete when the DLF has received the **Associate\_resp**.

### 3.2.1.2 *Keep alive procedure*

#### 3.2.1.2.1 Messages issued by the GDLP

When GDLP has no messages to send to DLF, it periodically transmits **Keep\_alive** messages (periodicity: T2, refer to Table 2) to maintain the connection with the DLF.

#### 3.2.1.2.2 Messages issued by the DLF

When DLF has no messages to send to GDLP, it periodically transmits **Keep\_alive** messages (periodicity: T2, refer to Table 2) to maintain the connection with the GDLP.

### 3.2.1.3 *Disabling the connection*

#### 3.2.1.3.1 Messages issued by the GDLP

The GDLP disables a connection by sending an **Abort\_req** message or a **Release\_req** message to the DLF.

The abort procedure is used to terminate the connection between the GDLP and the DLF immediately. It can be used to abort an association establishment phase.

---

The Association release procedure is a confirmed exchange that is used to terminate the connection between the GDLP and the DLF gracefully. When the DLF can terminate the connection, it sends an **Release\_resp** with **D\_result** field set to (**CAUSE=3h(finished),DIAG=0h(No diagnostic available)**) and discards all aircraft data associated with that particular connection. If the DLF cannot immediately terminate the connection it sends a **Release\_resp** with **D\_result** field set to (**CAUSE=1h(rejected),DIAG=0h(No diagnostic available)**). The GDLP waits for a period T4 (see Table 2) before sending another **Release\_req**. The **Release\_req** shall be sent R4 times (see Table 2).

When no message has been received for a period T3 (see Table 2 & 4), GDLP sends an **Abort\_req** message to the DLF with **D\_result** optionally set to (**CAUSE=6h (invalid result),DIAG=8h(timer T3 expiry)**). No acknowledgement is expected. The GDLP purges all aircraft data associated with that link.

### 3.2.1.3.2 Messages issued by the DLF

As in 3.2.1.3.1.

### 3.2.1.4 Primitives and state tables

The service primitive and state tables are listed in Appendix A.

## 3.2.2 Routing information

### 3.2.2.1 Aircraft entry

#### 3.2.2.1.1 Messages issued by GDLP

None.

#### 3.2.2.1.2 Messages issued by DLF

Upon association establishment, the DLF shall send an **Aircraft\_report** for each unique Mode S aircraft in the datalink coverage fitted with the appropriate avionics equipment (providing a non-zero subnetwork version number in BDS 1,0) to the GDLP.

The DLF shall send an **Aircraft\_report** for each new unique Mode S aircraft that enters datalink coverage fitted with the appropriate avionics equipment (providing a non-zero subnetwork version number in BDS 1,0) to the GDLP.

In both cases described above, the indicators UCS and DCS of the data link status item contained in the **Aircraft\_report** sent by the DLF shall take the value of the indicators UDS and DDS.

The transponder communications capability (COM) and the datalink capability (ECA) shall be included in the report.

If the datalink capability (ECA) of the aircraft changes, the DLF sends an **Aircraft\_report** to notify the GDLP of the new capability.

### 3.2.2.2 Aircraft exit

#### 3.2.2.2.1 Messages issued by GDLP

None.

#### 3.2.2.2.2 Messages issued by DLF

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When the interrogator no longer has the aircraft in its datalink coverage, the DLF shall:

- a) discard all the pending requests and send appropriate negative acknowledgements with D\_result field set to (**CAUSE=2h(cancelled),DIAG=1h(Aircraft Exit)**) (except any transactions in progress)
- b) reject any new requests for this aircraft and send appropriate negative acknowledgements with D\_Result field set to (**CAUSE=1h(rejected),DIAG=1h(Aircraft Exit)**).
- c) attempt to complete the relevant procedure (acknowledgement or data delivery) for any transactions in progress.

The procedure can be considered as complete when one of the following occurs:

- the successful completion of any transactions in progress;
  - the track is cancelled or
  - the expiry of the associated interrogator delivery timers (POEMS FS 7.3.5.2)
- a) after completion of the procedure described in (c), or if there are no pending requests, send an **Aircraft\_report** message to the GDLP with the Aircraft Exit indicator EI of the Data\_link\_status field set to 1.

The Aircraft with duplicated addresses are not available for data-link through the GDLP. They are considered as not in the data-link coverage, but remain in surveillance responsibility.

In case one aircraft was in the data-link coverage and an other aircraft with the same address enters in the coverage, no aircraft entry shall be sent for the second one and the procedure described in steps a-d above shall be followed for the first one.

An aircraft is no longer considered to be within the data-link coverage if an SI code is used (globally or in a sector). In this case (which is equivalent to datalink map exit) an aircraft Exit shall be sent and the procedure described in a-d above shall be followed.

### 3.2.2.3 *Air-Ground Link update*

#### 3.2.2.3.1 Messages issued by GDLP

The IC flag (Interrogator Control) can be considered as a ‘token’ that indicates whether or not the GDLP/Local User is able to modify the interrogator’s ability to uplink/downlink frames (except GICB and broadcast which are always enabled) and the content of subsequent **Aircraft\_report** messages.

The interrogator can keep the ‘token’ and in this case (IC=1 for GDLP and Local User) neither the GDLP nor Local User are authorised to modify the interrogators ability. For IC=1, the DLF shall ignore all **Aircraft\_command** messages from the GDLP and issue an Aircraft report message to the GDLP indicating that the uplink/downlink current status remains.

If IC=0, the DLF shall react to all **Aircraft\_command** messages from the GDLP. The DLF shall comply with the D\_Data\_link\_command settings and respond accordingly with an **Aircraft\_report** message. At any time only the GDLP or Local User, but not both, can operate with IC=0. Setting of IC shall be user configurable. The default value of the interrogators ability is described by the UDS and DDS flags in the D\_Data\_link\_status item. These two values are independently user configurable.

The GDLP disconnects a connection with an aircraft by sending to the DLF an **Aircraft\_command** message with the commands UC and DC set to 1. On receipt of the message, the DLF discards all the pending requests (except any transactions in progress) and rejects any new requests for this aircraft. The DLF shall respond to the **Aircraft\_command** message with an **Aircraft\_report** *always* including the new data link status for this aircraft, by setting the indicators UCS and DCS to 1.

The GDLP enables/restores a connection with a particular aircraft by sending to the DLF an **Aircraft\_command** message with the commands UC and DC set to 0. The DLF shall respond to this **Aircraft\_command** message with an **Aircraft\_report** including the new data link status for this aircraft, by setting the indicators UCS and DCS to 0. The DLF shall extract any downlink messages and process any uplink requests coming from the GDLP concerning this aircraft.

### 3.2.2.3.2 Messages issued by DLF

The GDLP uses the report\_request field in the **Aircraft\_command** message to specify which data items are to be sent (position, capability etc.) for the specified aircraft. The DLF shall send an **Aircraft\_report** message which contains the requested parameters.

#### 3.2.2.3.2.1 II Code Change

The DLF shall send an **II\_code\_change** detailing the previous and the new II code, when the II code of the interrogator changes.

#### 3.2.2.3.2.2 Transponder communications capability (COM) change

When the Communications Capability (COM) of the transponder changes for a particular aircraft the DLF sends an **Aircraft\_report** to the GDLP with the new capability of the Aircraft, regardless of the status of the Report\_request in the **Aircraft\_command** message.

If the capability of the aircraft has changed, the following action shall take place:

Discard all pending requests for the particular aircraft and send the appropriate acknowledgements with D\_Result set to **(CAUSE=2h(cancelled),DIAG=4h(Insufficient or change in data link capability))**.

#### 3.2.2.3.2.3 Extended datalink Capability (ECA) Change

Changes concerning the availability of airborne DTE (one bit is dedicated to a specific DTE within the last two bytes of ECA field) shall be forwarded to the GDLP in an **Aircraft\_report** message, regardless of the status of the report\_request in the **Aircraft\_command** message.

## 3.2.3 Broadcast service

### 3.2.3.1 Uplink broadcasts

#### 3.2.3.1.1 Messages issued by GDLP

The DLF shall respond to receiving an **Uplink\_broadcast** message by sending an **Uplink\_broadcast\_ack** message indicating whether the request was accepted or rejected. The diagnostic field will detail why a broadcast had been rejected. The priority, the emitting power, the duration and the azimuth sectors are sent in the optional broadcast\_properties item. If the broadcast\_properties item is sent then every field shall contain valid data.

The GDLP shall uniquely assign the D\_broadcast\_number to each **Uplink\_broadcast** (ie the DLF will not receive from the GDLP an uplink broadcast with the same D\_broadcast number as a pending **Uplink\_broadcast**). Should a duplicated request arrive at the DLF, then the DLF shall reject it and set D\_result to (**CAUSE=1h(rejected),DIAG=6h(Duplicate request number)**) the acknowledgement.

If the **Broadcast\_properties** item is not present, the broadcast will be sent for 1 antenna revolution, at the maximum power and with the lowest priority. A broadcast with a high priority will temporarily delay a low priority broadcast

The DLF shall respond to a **Cancel\_uplink\_broadcast** from the GDLP and shall send to the GDLP an **Uplink\_broadcast\_ack** message with:

- a) if the D\_broadcast\_number was specified, and is still valid (ie present in the DLF database), the D\_broadcast\_number is included and the D\_result field is set to to (**CAUSE=2h(cancelled),DIAG=0h(No diagnostic available)**);
- b) if the D\_broadcast\_number was specified, but is not valid, the D\_broadcast\_number is included and the D\_result field is set to (**CAUSE=1h(rejected),DIAG=7h(Unknown request number)**);
- c) if no D\_broadcast\_number was specified ('cancel all'):
  - for those valid requests that have been cancelled, the D\_broadcast number is included and the D\_result field is set to (**CAUSE=2h(cancelled),DIAG=0h(No diagnostic available)**);
  - if no valid request can be cancelled (no pending requests), no D\_broadcast\_number is included and the D\_result field is set to (**CAUSE=1h(rejected),DIAG=7h(Unknown request number)**)

If the D\_Broadcast\_number was absent in the cancellation request, the DLF shall discard all the uplink broadcast requests.

If the D\_broadcast\_number was present in the cancellation request, the DLF shall discard the uplink broadcast request specified in the D\_broadcast\_number field.

#### 3.2.3.1.2 Messages issued by DLF

On the completion of a broadcast request, the DLF shall send an **Uplink\_broadcast\_ack** message with the D\_result field set to (**CAUSE=3h(finished),DIAG=0h(No diagnostic available)**). The broadcast request is discarded by the DLF.

#### 3.2.3.2 Downlink broadcasts

The DLF shall send all the **Downlink\_broadcast** messages to the GDLP.

### 3.2.4 GICB service

#### 3.2.4.1 Messages issued by GDLP

The DLF shall respond to a **GICB\_extraction** message from the GDLP by sending a **GICB\_extraction\_ack** with the D\_result field set to (**CAUSE=0h(Accepted) or =1h rejected**). The request shall include the BDS register number.

The GDLP shall uniquely assign the D\_GICB\_number to each **GICB\_extraction** (ie the DLF will not receive from the GDLP a **GICB\_extraction** for an aircraft with the same GICB number as a pending **GICB\_extraction** for another aircraft). Should a duplicated request arrive at the DLF, then the DLF shall reject it and set D\_result to **(CAUSE=1h(rejected),DIAG=6h(Duplicate request number))** in the acknowledgement. The following parameters are options: D\_time (end of the request), D\_GICB\_periodicity, D\_GICB\_properties (periodicity constraint, asynchronous update, reply destination, priority).

Default values for these parameters are:

- a) If D\_time is missing, request lifetime will be until a link/GDLP/interrogator failure or aircraft exit,
- b) If D\_GICB\_properties is missing, there will be
  - no periodicity constraint (PC = 0),
  - no asynchronous update (AU = 0, NE=0),
  - reply destination will be only the GDLP (RD=0),
  - request priority will be set to 8 (medium value),
- c) If D\_GICB\_periodicity is not present in the **GICB\_extraction** message, the DLF will only try to perform a single extraction i.e. the request will end after the first successful extraction.

The DLF shall respond to a **Cancel\_GICB\_extraction** message, by sending a **GICB\_extraction\_ack** with:

- a) if the D\_GICB\_number was specified, and is still valid (ie present in the DLF database), the D\_GICB\_number is included and the D\_result field is set to **(CAUSE=2h(cancelled),DIAG=0h(No diagnostic available))**;
- b) if the D\_GICB\_number was specified, but is not valid, the D\_GICB\_number is included and the D\_result field is set to **(CAUSE=1h(rejected),DIAG=7h(Unknown request number))**;
- c) if no D\_GICB\_number was specified ('cancel all'):
  - for those valid requests that have been cancelled, the D\_GICB number is included and the D\_result field is set to **(CAUSE=2h(cancelled),DIAG=0h(No diagnostic available))**;
  - if no valid request can be cancelled (no pending requests), no D\_GICB\_number is included and the D\_result field is set to **(CAUSE=1h(rejected),DIAG=7h(Unknown request number))**.
- d) If the D\_GICB\_number was absent in the cancellation request, the DLF shall discard all the GICB requests for the aircraft specified and if the FFFFFFFh address is used then all GICB requests for all aircraft are discarded.
- e) If the D\_GICB\_number was present in the cancellation request, the DLF shall discard the GICB requests specified in the D\_GICB\_number field.

#### 3.2.4.2 Messages issued by DLF

The **GICB\_response** message from the DLF to the GDLP indicates whether or not the extraction of a BDS was successfully completed.

If the extraction was successful, the message contains the register content with D\_result set to **(CAUSE=3h(finished),DIAG=0h(No diagnostic available))** for a **single shot extraction** or to **(CAUSE=5h(In progress),DIAG=0h(No diagnostic available))**.



However, if the interrogators antenna beam has passed the aircraft the DLF shall send to the GDLP a **GICB\_response** message(s) indicating at least the GICB request number(s) that have failed and the attempted extraction time. The D\_result field will be set to (**CAUSE=4h(Delayed),DIAG=0h(No diagnostic available)**). For the requests which had set the periodicity constraint indicator to 0, and extraction failed even after re-interrogation within the beamdwell, the next attempt will take place on the next scan (i.e. several attempts within the requested extraction period can be made to obtain a successful extraction). For the requests that had the periodicity constraint indicator to 1, and extraction failed even after re-interrogation within the beamdwell, the next attempt will take place at a time according to the requested periodicity.

If the request's lifetime is over or if it was a "single shot" extraction, the DLF sends to the Local User a **GICB\_extraction\_ack** with the D\_result field set to (**CAUSE=3h(finished),DIAG=0h(No diagnostic available)**).

### 3.2.5 SVC/MSP downlink messages

#### 3.2.5.1 Messages issued by GDLP

None

#### 3.2.5.2 Messages issued by DLF

The DLF sends each downlink packet to the GDLP with a **Downlink\_packet** message.

An invalid LV field shall be notified to the GDLP by means of the D\_Result field in a **Downlink\_packet** set to (**CAUSE=6h(Invalid Result),DIAG=5h(Invalid LV field)**). This field is normally absent in the **Downlink\_packet**, and is only present to indicate this condition. In this case the DLF does not know the length of the downlink packet and shall include the entire downlink frame received in the downlink Mode S packet message.

### 3.2.6 SVC/MSP uplink data flow

#### 3.2.6.1 Flow control procedures

The following terms are used to define flow control:

- XON\_level: queue level at which the DLF sends an XON message to the GDLP and at which uplink flow will be resumed.
- XOFF\_level1: queue level at which the DLF sends an XOFF message to the GDLP and at which uplink flow will be stopped.
- XOFF\_level2: queue level at which DLF reaches physical queue limit

When the DLF is saturated with data-link requests to a particular aircraft (XOFF\_level1), the DLF sends to the GDLP a **Data\_XOFF** message including the aircraft address. If the message contains a single aircraft address set to FFFFFFFH, the GDLP shall stop sending any uplink packet requests to that interrogator. If the message contains a list of Mode S addresses different from FFFFFFFH, the GDLP shall stop sending any uplink packet requests to the specified aircraft.

When the DLF is able to process new incoming uplink packet requests (XON\_level), it sends a **Data\_XON** message to the GDLP. If the message contains an aircraft address set to FFFFFFFH, the GDLP is granted permission again to send uplink packet requests. If the message contains aircraft address(es) different from FFFFFFFH, the GDLP is granted permission to send uplink packet requests to each aircraft specified.

The flow control shall be performed with the following constraints:

- XOFF\_level1  $\geq$  0.9(XOFF\_level2)

- $XON\_level \geq 0.33(XOFF\_level1)$

The two ratios shall be user configurable.

### 3.2.6.2 Messages issued by GDLP

#### 3.2.6.2.1 SVC/MSP packets

The DLF shall respond to an **Uplink\_packet** message with an **Uplink\_packet\_ack** message; the **D\_result** field set to (**CAUSE=0h(Accepted),DIAG=0h(No diagnostic available)**) if the packet can be processed by the DLF, or to (**CAUSE=1h(Rejected),DIAG=0h(No diagnostic available)**) if the packet can not be processed. *Optionally, if the packet cannot be processed due to the uplink flow being disabled, then the DLF shall respond with **D\_result** field set to (**CAUSE=1h(Rejected),DIAG=10h(Uplink flow disabled)**).* A request can be rejected due to a lack of resources or if there is an invalid parameter. If the request is accepted, the DLF stores the packet in the appropriate aircraft queue.

The GDLP shall uniquely assign the **D\_packet\_number** to each **Uplink\_packet** (ie the DLF will not receive from the GDLP an uplink packet for an aircraft with the same packet number as a pending **Uplink\_packet** for another aircraft). Should a duplicated request arrive at the DLF, then the DLF shall reject it and set **D\_result** to (**CAUSE=1h(rejected),DIAG=6h(Duplicate request number)**); the acknowledgement.

The DLF shall respond to a **Cancel\_uplink\_packet** message by sending an **Uplink\_packet\_ack** with:

- a) if the **D\_packet\_number** was specified, and is still valid (ie present in the DLF database), the **D\_packet\_number** is included and the **D\_result** field is set to (**CAUSE=2h(Cancelled),DIAG=0h(No diagnostic available)**);
- b) if the **D\_packet\_number** was specified, but is not valid, the **D\_packet\_number** is included and the **D\_result** field is set to (**CAUSE=1h(rejected),DIAG=7h(Unknown request number)**);
- c) if no **D\_packet\_number** was specified ('cancel all'):
  - for those valid requests that have been cancelled, the packet number(s) are included in the **D\_packet\_number\_list** and the **D\_result** field is set to (**CAUSE=2h(Cancelled),DIAG=0h(No diagnostic available)**);
  - if no valid request can be cancelled (no pending requests), no **D\_packet\_number\_list** is included and the **D\_result** field is set to (**CAUSE=1h(rejected),DIAG=7h(Unknown request number)**);

If the **D\_packet\_number** was absent in the cancellation request, the DLF shall discard all the **Uplink\_packet** requests.

If the **D\_packet\_number** was present in the cancellation request, the DLF shall discard the **Uplink\_packet** requests specified in the **D\_packet\_number** field

The cancellation request may be for one aircraft packet, all aircraft packets or all the packets. The DLF discards the appropriate packets, and if the FFFFFFFh address is used then all packets for all aircraft are discarded.

### 3.2.6.3 Messages issued by DLF

The DLF shall send an **Uplink\_packet\_ack** message to the GDLP with the **D\_result** field set to (**CAUSE=3h(Finished),DIAG=0h(No diagnostic available)**) when the interrogator has completed the uplink frame transmission.

The DLF shall send an **Uplink\_packet\_ack** message to the GDLP with the D\_result field set to **(CAUSE=2h(Cancelled),DIAG=0h(No diagnostic available))** for the packet(s) that have been cancelled.

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### 3.3 Protocol Specification for Local User / DLF interface

#### 3.3.1 Link management

##### 3.3.1.1 Connection procedures

###### 3.3.1.1.1 Messages issued by the Local User

To initiate a connection the Local User sends an **Associate\_req** message to the DLF. This message is sent each T1 period (value in Table 2) until the Local User receives an **Associate\_Resp** message from the DLF.

On receipt of an **Associate\_req** from the Local User interface, the DLF removes existing aircraft data associated with that link, resets internal timers/counters and replies with an **Associate\_resp** message. The D\_result field of the **Associate\_resp** is set to (**CAUSE=3h(Finished),DIAG=0h(No diagnostic available)**).

This also specifies the use of a restart function, in the case of an already existing association.

###### 3.3.1.1.2 Messages issued by the DLF

To initiate a connection, the DLF sends an **Associate\_req** message to the Local User. This message is sent each T1 period (value in Table 2) until it receives an **Associate\_Resp** message from the Local User.

On receipt of an **Associate\_req** from the DLF, the Local User removes existing aircraft data associated with that link, resets internal timers/counters and replies with an **Associate\_resp** message. The D\_result field of the **Associate\_resp** is set to (**CAUSE=3h(finished),DIAG=0h(No diagnostic available)**).

This also specifies the use of a restart function, in the case of an already existing association.

Upon establishment of the connection the DLF shall send to the Local User an **Aircraft\_report message** for each unique aircraft in the Data Link coverage.

###### 3.3.1.1.3 Collision procedure

When either the Local User or the DLF receives an **Associate\_req** message while waiting for an **Associate\_resp** message, an **Associate\_req** message collision occurs. The DLF acts as the master and ignores the **Associate\_req** received from the Local User. When the Local User receives the **Associate\_req**, the Local User cancels the association establishment procedure it initiated and sends an **Associate\_resp** message to the DLF. The connection is complete when the DLF has received the **Associate\_resp**.

##### 3.3.1.2 Keep alive procedure

###### 3.3.1.2.1 Messages issued by the Local User

When Local User has no messages to send to DLF, it periodically transmits **Keep\_alive** messages (periodicity: T2, refer to Table 2) to maintain the connection with the DLF.

###### 3.3.1.2.2 Messages issued by the DLF

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When DLF has no messages to send to Local User, it periodically transmits **Keep\_alive** messages (periodicity: T2, refer to Table 2) to maintain the connection with the Local User.

### 3.3.1.3 *Disabling the connection*

#### 3.3.1.3.1 Messages issued by the Local User

The Local User disables a connection by sending an **Abort\_req** message or a **Release\_req** message to the DLF.

The abort procedure is used to terminate the connection between the Local User and the DLF immediately. It can be used to abort an association establishment phase.

The Association release procedure is a confirmed exchange that is used to terminate the connection between the Local User and the DLF gracefully. When the DLF can terminate the connection, it sends an **Release\_resp** with D\_result field set to **(CAUSE=3h(finished),DIAG=0h(No diagnostic available))** and discards all aircraft data associated with that particular connection. If the DLF cannot immediately terminate the connection it sends a **Release\_resp** with D\_result field set to **(CAUSE=1h(rejected),DIAG=0h(No diagnostic available))**. The Local User waits for a period of T4 (see Table 2) before sending another **Release\_req**. The **Release\_req** shall be sent R4 times (see Table 2).

When no message has been received for the last T3 s (Table 2 & 4), Local User sends an **Abort\_req** message to the DLF, with D-result optionally set to **(CAUSE=6h(Invalid result),DIAG=8h(Timer T3 expiry))**. No acknowledgement is expected. The Local User purges all aircraft data associated with that link.

#### 3.3.1.3.2 Messages issued by the DLF

As in 3.3.1.3.1

### 3.3.1.4 *Primitives and state tables*

The service primitive and state tables are listed in Appendix A.

## 3.3.2 **Routing information**

### 3.3.2.1 *Aircraft entry*

#### 3.3.2.1.1 Messages issued by Local User

None.

#### 3.3.2.1.2 Messages issued by DLF

Upon association establishment, the DLF shall send an **Aircraft\_report** for each unique Mode S aircraft in the datalink coverage fitted with the appropriate avionics equipment (providing a non-zero subnetwork version number in BDS 1,0) to the Local User.

The DLF shall send an **Aircraft\_report** for each new unique Mode S aircraft that enters datalink coverage fitted with the appropriate avionics equipment (providing a non-zero subnetwork version number in BDS 1,0) to the Local User..

In both cases described above, the indicators UCS and DCS of the data link status item contained in the **Aircraft\_report** sent by the DLF shall take the value of the indicators UDS and DDS.

The transponder communications capability (COM) and the datalink capability (ECA) shall be included in the report.

If the datalink capability (ECA) of the aircraft changes, the DLF sends an **Aircraft\_report** to notify the Local User the position and the new capability.

### 3.3.2.2 *Aircraft exit*

#### 3.3.2.2.1 Messages issued by Local User

None.

#### 3.3.2.2.2 Messages issued by DLF

When the interrogator no longer has the aircraft in its datalink coverage, the DLF shall:

- a) discard all the pending requests and send appropriate negative acknowledgements with D\_result field set to (**CAUSE=2h(cancelled),DIAG=1h(Aircraft Exit)**) (except any transactions in progress)
- b) reject any new requests for this aircraft and send appropriate negative acknowledgements with D\_Result field set to (**CAUSE=1h(rejected),DIAG=1h(Aircraft Exit)**).
- c) attempt to complete the relevant procedure (acknowledgement or data delivery) for any transactions in progress.

The procedure can be considered as complete when one of the following occurs:

- the successful completion of any transactions in progress;
- the track is cancelled or
- the expiry of the associated interrogator delivery timers (POEMS FS 7.3.5.2)

- a) after completion of the procedure described in (c), or if there are no pending requests, send an **Aircraft\_report** message to the Local User with the Aircraft Exit indicator EI of the Data\_link\_status field set to 1.

The Aircraft with duplicated addresses are not available for data-link through the Local User. They are considered as not in the data-link coverage, but remain in surveillance responsibility.

In case one aircraft was in the data-link coverage and an other aircraft with the same address enters in the coverage, no aircraft entry shall be sent for the second one and the procedure described in steps a-d above shall be followed for the first one.

An aircraft is no longer considered to be within the data-link coverage if an SI code is used (globally or in a sector). In this case (which is equivalent to datalink map exit) an aircraft Exit shall be sent and the procedure described in a-d above shall be followed.

### 3.3.2.3 *Air-Ground Link update*

#### 3.3.2.3.1 Messages issued by Local User

The IC flag (Interrogator Control) can be considered as a 'token' that indicates whether or not the GDLP/Local User is able to modify the interrogator's ability to uplink/downlink frames (except GICB and broadcast which are always enabled) and the content of subsequent **Aircraft\_reports**.

The interrogator can keep the 'token' and in this case (IC=1 for GDLP and Local User) neither the GDLP nor Local User are authorised to modify the interrogators ability. For IC=1, the DLF shall ignore all **Aircraft\_command** messages from the Local User and issue an Aircraft report message to the Local User indicating that the uplink/downlink current status remains.

If IC=0, the DLF shall react to all **Aircraft\_command** messages from the Local User. The DLF shall comply with the D\_Data\_link\_command settings and respond accordingly with an **Aircraft\_report** message. At any time only the GDLP or Local User, but not both, can operate with IC=0. Setting of IC shall be user configurable. The default value of the interrogators ability is described by the UDS and DDS flags in the D\_Data\_link\_status item. These two values are independently user configurable.

The Local User disconnects a connection with an aircraft by sending to the DLF an **Aircraft\_command** message with the commands UC and DC set to 1. On receipt of the message, the DLF discards all the pending requests (except any transactions in progress) and rejects any new requests for this aircraft. The DLF shall respond to the **Aircraft\_command** message with an **Aircraft\_report** *always* including the new data link status for this aircraft, by setting the indicators UCS and DCS to 1.

The Local User enables/restores a connection with a particular aircraft by sending to the DLF an **Aircraft\_command** message with the commands UC and DC set to 0. The DLF shall respond to this **Aircraft\_command** message with an **Aircraft\_report** including the new data link status for this aircraft, by setting the indicators UCS and DCS to 0. The DLF shall extract any downlink messages and process any uplink requests coming from the Local User concerning this aircraft.

#### 3.3.2.3.2 Messages issued by DLF

The Local User uses the report\_request field in the **Aircraft\_command** message to specify which data items are to be sent (position, capability etc.) for the specified aircraft. The DLF shall send an **Aircraft\_report** message which contains the requested parameters.

##### 3.3.2.3.2.1 II Code Change

The DLF shall send an **II\_code\_change** detailing the previous and the new II code, when the II code of the interrogator changes.

##### 3.3.2.3.2.2 Transponder communications capability (COM) change

When the Communications Capability (COM) of the transponder changes for a particular aircraft the DLF sends an **Aircraft\_report** to the Local User with the new capability of the Aircraft, regardless of the status of the Report\_request in the **Aircraft\_command** message.

If the capability of the aircraft has changed, the following action shall take place:

Discard all pending requests for the particular aircraft and send the appropriate acknowledgements with D\_Result set to **(CAUSE=2h(Cancelled),DIAG=4h(Insufficient or change in data link capability))**.

##### 3.3.2.3.2.3 Extended datalink Capability (ECA) Change

Changes concerning the availability of airborne DTE (one bit is dedicated to a specific DTE within the last two bytes of ECA field) shall be forwarded to the Local User in an **Aircraft\_report** message, regardless of the status of the report\_request in the **Aircraft\_command** message.

### 3.3.3 Broadcast service

#### 3.3.3.1 Uplink broadcasts

##### 3.3.3.1.1 Messages issued by Local User

The DLF shall respond to receiving an **Uplink\_broadcast** message by sending an **Uplink\_broadcast\_ack** message indicating whether the request was accepted or rejected. The diagnostic field will detail why a broadcast had been rejected. The priority, the emitting power, the duration and the azimuth sectors are sent in the optional **broadcast\_properties** item. If the **broadcast\_properties** item is sent then every field shall contain valid data.

The Local User shall uniquely assign the **D\_broadcast\_number** to each **Uplink\_broadcast** (ie the DLF will not receive from the Local User an uplink broadcast with the same **D\_broadcast** number as a pending **Uplink\_broadcast**). Should a duplicated request arrive at the DLF, then the DLF shall reject it and set **D\_result** to (**CAUSE=1h(rejected),DIAG=6h(Duplicate request number)**) the acknowledgement.

If the **Broadcast\_properties** item is not present, the broadcast will be sent for 1 antenna revolution, at the maximum power and with the lowest priority. A broadcast with a high priority will temporarily delay a low priority broadcast

The DLF shall respond to a **Cancel\_uplink\_broadcast** from the Local User and shall send to the Local User an **Uplink\_broadcast\_ack** message with:

- a) if the **D\_broadcast\_number** was specified, and is still valid (ie present in the DLF database), the **D\_broadcast\_number** is included and the **D\_result** field is set to (**CAUSE=2h(Cancelled),DIAG=0h(No diagnostic available)**);
- b) if the **D\_broadcast\_number** was specified, but is not valid, the **D\_broadcast\_number** is included and the **D\_result** field is set to (**CAUSE=1h(rejected),DIAG=7h(Unknown request number)**);
- c) if no **D\_broadcast\_number** was specified ('cancel all'):
  - for those valid requests that have been cancelled, the **D\_broadcast** number is included and the **D\_result** field is set to (**CAUSE=2h(cancelled),DIAG=0h(No diagnostic available)**);
  - if no valid request can be cancelled (no pending requests), no **D\_broadcast\_number** is included and the **D\_result** field is set to (**CAUSE=1h(rejected),DIAG=7h(Unknown request number)**),.

If the **D\_Broadcast\_number** was absent in the cancellation request, the DLF shall discard all the uplink broadcast requests.

If the **D\_broadcast\_number** was present in the cancellation request, the DLF shall discard the uplink broadcast request specified in the **D\_broadcast\_number** field.

##### 3.3.3.1.2 Messages issued by DLF

On the completion of a broadcast request, the DLF shall send an **Uplink\_broadcast\_ack** message with the result field set to (**CAUSE=3h(Finished),DIAG=0h(No diagnostic available)**). The broadcast request is discarded by the DLF.

#### 3.3.3.2 Downlink broadcasts

The DLF shall send all the **Downlink\_broadcast** messages to the Local User.



### 3.3.4 GICB service

#### 3.3.4.1 Messages issued by Local User

The DLF shall respond to a **GICB\_extraction** message from the Local User by sending a **GICB\_extraction\_ack** with the D\_result field set (**CAUSE=0h(Accepted) or 1h(Rejected)**) The request shall include the BDS register number.

The Local User shall uniquely assign the D\_GICB\_number to each **GICB\_extraction** (ie the DLF will not receive from the Local User a **GICB\_extraction** for an aircraft with the same GICB number as a pending **GICB\_extraction** for another aircraft). Should a duplicated request arrive at the DLF, then the DLF shall reject it and set D\_result to (**CAUSE=1h(rejected),DIAG=6h(Duplicate request number)**) in the acknowledgement.

The following parameters are options: D\_time (end of the request), D\_GICB\_periodicity, D\_GICB\_properties (periodicity constraint, asynchronous update, reply destination, priority).

Default values for these parameters are:

- a) If D\_time is missing, request lifetime will be until a link/Local User/interrogator failure or aircraft exit,
- b) If D\_GICB\_properties is missing, there will be
  - no periodicity constraint (PC = 0),
  - no asynchronous update (AU = 0, NE=0),
  - reply destination will be only the Local User (RD=0),
  - request priority will be set to 8 (medium value),
- c) If D\_GICB\_periodicity is not present in the **GICB\_extraction** message, the DLF will only try to perform a single extraction i.e. the request will end after the first successful extraction.

The DLF shall respond to a **Cancel\_GICB\_extraction** message, by sending a **GICB\_extraction\_ack** with:

- a) if the D\_GICB\_number was specified, and is still valid (ie present in the DLF database), the D\_GICB\_number is included and the D\_result field is set to (**CAUSE=2h(Cancelled),DIAG=0h(No diagnostic available)**)
- b) if the D\_GICB\_number was specified, but is not valid, the D\_GICB\_number is included and the D\_result field is set to (**CAUSE=1h(rejected),DIAG=7h(Unknown request number)**);
- c) if no D\_GICB\_number was specified ('cancel all'):
  - for those valid requests that have been cancelled, the D\_GICB number is included and the D\_result field is set to (**CAUSE=2h(Cancelled),DIAG=0h(No diagnostic available)**);
  - if no valid request can be cancelled (no pending requests), no D\_GICB\_number is included and the D\_result field is set to (**CAUSE=1h(rejected),DIAG=7h(Unknown request number)**).
- d) If the D\_GICB\_number was absent in the cancellation request, the DLF shall discard all the GICB requests for the aircraft specified and if the FFFFFFFh address is used then all GICB requests for all aircraft are discarded.
- e) If the D\_GICB\_number was present in the cancellation request, the DLF shall discard the GICB requests specified in the D\_GICB\_number field.

#### 3.3.4.2 Messages issued by DLF

The **GICB\_response** message from the DLF to the Local User indicates whether or not the extraction of a BDS was successfully completed.

If the extraction was successful, the message contains the register content with D-result set to **(CAUSE=3h(finished),DIAG=0h(No diagnostic available)) for a single shot extraction or to (CAUSE=5h(In progress),DIAG=0h(No diagnostic available))**.

However, if the interrogators antenna beam has passed the aircraft the DLF shall send to the Local User a **GICB\_response** message(s) indicating at least the GICB request number(s) that have failed and the attempted extraction time. The D\_result field will be set to **(CAUSE=4h(Delayed),DIAG=0h(No diagnostic available))**. For the requests which had set the periodicity constraint indicator to 0, and extraction failed even after re-interrogation within the beamdwel, the next attempt will take place on the next scan (i.e. several attempts within the requested extraction period can be made to obtain a successful extraction). For the requests that had the periodicity constraint indicator to 1, and extraction failed even after re-interrogation within the beamdwel, the next attempt will take place at a time according to the requested periodicity.

If the request's lifetime is over or if it was a "single shot" extraction, the DLF sends to the Local User a **GICB\_extraction\_ack** with the D\_result field set to **(CAUSE=3h(finished),DIAG=0h(No diagnostic available))**.

### 3.3.5 MSP downlink messages

#### 3.3.5.1 Messages issued by Local User

None

#### 3.3.5.2 Messages issued by DLF

The DLF sends each downlink packet to the Local User in with a **Downlink\_packet** message.

An invalid LV field shall be notified to the Local User by means of the D\_Result field set to **(CAUSE=6h(Invalid Result),DIAG=5h(Invalid LV field))** in a Downlink\_packet. This field is normally absent in the Downlink\_packet, and is only present to indicate this condition. In this case the DLF does not know the length of the downlink packet and shall include the entire downlink frame received in the downlink Mode S packet message.

The SVC packets will be discard by the Local User.

### 3.3.6 MSP uplink data flow

#### 3.3.6.1 Flow control procedures

The following terms are used to define flow control:

- XON\_level: queue level at which the DLF sends an XON message to the Local User and at which uplink flow will be resumed.
- XOFF\_level1: queue level at which the DLF sends an XOFF message to the Local User and at which uplink flow will be stopped.
- XOFF\_level2: queue level at which DLF reaches physical queue limit

When the DLF is saturated with data-link requests to a particular aircraft (XOFF\_level1), the DLF sends to the GDLP a **Data\_XOFF** message including the aircraft address. If the message contains a single aircraft address set to FFFFFFFH, the Local User shall stop sending any uplink packet requests to that interrogator. If the message contains a list of Mode S addresses different from FFFFFFFH, the Local User shall stop sending any uplink packet requests to the specified aircraft.

When the DLF is able to process new incoming uplink packet requests (XON\_level), it sends a **Data\_XON** message to the Local User. If the message contains an aircraft address set to FFFFFFFH, the Local User is granted permission again to send uplink packet requests. If the message contains aircraft address(es) different from FFFFFFFH, the Local User is granted permission to send uplink packet requests to each aircraft specified.

The flow control shall be performed with the following constraints:

- XOFF\_level1 >=0.9(XOFF\_level2)
- XON\_level>=0.33(XOFF\_level1)

The two ratios shall be user configurable.

### 3.3.6.2 Messages issued by Local User

#### 3.3.6.2.1 MSP packets

The DLF shall respond to an **Uplink\_packet** message with an **Uplink\_packet\_ack** message; the result field set to (**CAUSE=0h(Accepted),DIAG=0h(No diagnostic available)**) if the packet can be processed by the DLF, or (**CAUSE=1h(Rejected),DIAG=0h(No diagnostic available)**) if the packet can not be processed. *Optionally, if the packet cannot be processed due to the uplink flow being disabled, then the DLF shall respond with D\_result field set to (**CAUSE=1h(Rejected) ,DIAG=10h(Uplink flow disabled)**).* A request can be rejected due to a lack of resources or if there is an invalid parameter. If the request is accepted, the DLF stores the packet in the appropriate aircraft queue.

The Local User shall uniquely assign the D\_packet\_number to each Uplink\_packet (ie the DLF will not receive from the Local User an uplink packet for an aircraft with the same packet number as a pending Uplink\_packet for another aircraft). Should a duplicated request arrive at the DLF, then the DLF shall reject it and set D\_result to (**CAUSE=1h(rejected),DIAG=6h(Duplicate request number)**) in the acknowledgement.

The DLF shall respond to a **Cancel\_uplink\_packet** message by sending an **Uplink\_packet\_ack** with:

- a) if the D\_packet\_number was specified, and is still valid (ie present in the DLF database), the D\_packet\_number is included and the D\_result field is set to (**CAUSE=2h(Cancelled),DIAG=0h(No diagnostic available)**);
- b) if the D\_packet\_number was specified, but is not valid, the D\_packet\_number is included and the D\_result field is set to (**CAUSE=1h(rejected),DIAG=7h(Unknown request number)**);
- c) if no D\_packet\_number was specified ('cancel all'):
  - for those valid requests that have been cancelled, the packet number(s) are included in the D\_packet\_number\_list and the D\_result field is set to (**CAUSE=2h(Cancelled),DIAG=0h(No diagnostic available)**);
  - if no valid request can be cancelled (no pending requests), no D\_packet\_number\_list is included and the D\_result field is set to (**CAUSE=1h(rejected),DIAG=7h(Unknown request number)**);

If the D\_packet\_number was absent in the cancellation request, the DLF shall discard all the Uplink\_packet requests.

If the D\_packet\_number was present in the cancellation request, the DLF shall discard the Uplink\_packet requests specified in the D\_packet\_number field

The cancellation request may be for one aircraft packet, all aircraft packets or all the packets. The DLF discards the appropriate packets, and if the FFFFFFFh address is used then all packets for all aircraft are discarded.

The Local User should not send any SVC packets to the DLF.

### **3.3.6.3 Messages issued by DLF**

The DLF shall send an **Uplink\_packet\_ack** message to the Local User with the result field set to (**CAUSE=3h(Finished),DIAG=0h(No diagnostic available)**) when the interrogator has completed the uplink frame transmission.

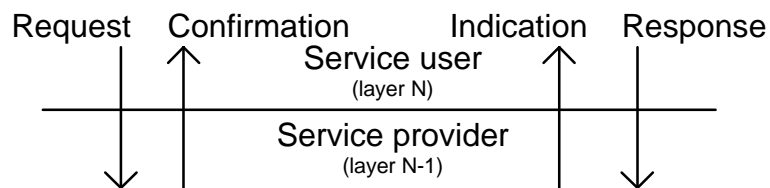
The DLF shall send an **Uplink\_packet\_ack** message to the GDLP with the D\_result field set to (**CAUSE=2h(Cancelled),DIAG=0h(No diagnostic available)**) for the packet(s) that have been cancelled.

# Appendix A

## GDLP/LU-DLF connection

The service primitives and the state tables are only used in order to specify formally the protocol. They do not constrain in any way the internal operation or design of an actual implementation. In particular, a layered architecture providing a service interface is no way required.

### 1. SERVICE PRIMITIVES



**Figure 2 - Service primitives**

The communication protocol supports four services. For each service, several primitives are available. The existing service primitives are summarised in Table 1.

Service	Association establishment	Association release	Association abort	Data transmission
Primitives	ASSOCIATE.req ASSOCIATE.ind ASSOCIATE.resp+ ASSOCIATE.resp- ASSOCIATE.conf+ ASSOCIATE.conf-	RELEASE.req RELEASE.ind RELEASE.resp+ RELEASE.resp- RELEASE.conf+ RELEASE.conf-	ABORT.req ABORT.ind	DATA.req DATA.ind

**Table 1: Service primitives**

NOTE: a "+" indicates a primitive with a positive confirmation (e.g. Associate\_resp with D\_result CAUSE equals to "Finished"), a "-" indicates a primitive with a negative confirmation (e.g. D\_Result CAUSE equals to "Rejected").

---

## 2. OPERATIONAL PARAMETERS

Name of constant	Default Value	Meaning
T1	1 s	Associate_req retransmission timer
T2	1 s	Keep_alive periodicity in the absence of traffic
T3	4 s	GDLP connection time out
T4	3 s	Release_req retransmission timer
R4	4	Number of transmissions of Release_req

**Table 2: Operational parameters**

### 3. STATE TABLES

State→ Input ↓	Disconnected	Wait for association confirm	Wait for association response	Connected
<b>ASSOCIATE.req</b>	S=wait for association confirm A=send Associate_req Restart T1	S=wait for association confirm A=none	S=wait for association response A=none	S=wait for association confirm A=send associate_req Restart T1 Stop T2 and T3
<b>Receive Associate_resp with D_result=finished</b>	S=Disconnected A=none	S=Connected A=ASSOCIATE.conf+ Stop T1 Restart T2 and T3	S=wait for association response A=none	S=connected A=none
<b>Receive Associate_resp with D_result=rejected</b>	S=Disconnected A=none	S=Disconnected A=ASSOCIATE.conf- Stop T1	S=wait for association response A=none	S=connected A=none
<b>Expiration of timer T1</b>	S=Disconnected A=none	S=wait for association confirm A=send associate_req Restart T1	S=wait for association response A=none	S=connected A=none
<b>ABORT.req</b>	S=Disconnected A=none	S=Disconnected A=Send Abort_req Stop T1	S=Disconnected A=Send Abort_req	S=Disconnected A=Send Abort_req Stop T2 and T3
<b>Receive Abort_req</b>	S=Disconnected A= none	S= Disconnected A=ABORT.ind Stop timer T1	S= Disconnected A=ABORT.ind	S=Disconnected A=ABORT.ind Stop timers T2 and T3
<b>Receive Associate_req</b>	S=wait for association response A=ASSOCIATE.ind	If machine is GDLP/LU, S=wait for association response, A=ASSOCIATE.ind Stop T1 If machine is DLF, S=wait for association confirm A=none	S=wait for association response A=none	S=wait for association response A=ASSOCIATE.ind Stop T2 and T3
<b>ASSOCIATE.resp+</b>	S=disconnected A=none	S=wait for association confirm A=none	S=connected A=Send Associate_resp with D_result=finished Restart T2 and T3	S=connected A=none
<b>ASSOCIATE.resp-</b>	S=disconnected A=none	S=wait for association confirm A=none	S=disconnected A=Send Associate_resp with D_result=rejected	S=connected A=none
<b>Inputs related to data transmission</b>	S=disconnected A=none	S=wait for association confirm A=none	S=wait for association response A=none	see Table 4
<b>Inputs related to data association release</b>	S=disconnected A=none	S=wait for association confirm A=none	S=wait for association response A=none	see Table 5

**Table 3: Connection state tables**

N.B.: A 'restart procedure' is implied in the above table. If an **Associate\_req** message is received while an association is already established, the existing association is cleared-down and either the new association is established by sending an **Associate\_resp** message with D\_Result=finished ( to restart), or the association is disconnected by sending an **Associate\_resp** message with D\_Result=rejected.

<b>State→ Input ↓</b>	<b>Connected</b>
<b>DATA.req</b>	S=connected A=send data message, restart T2
<b>Expiration of T2</b>	S=connected A=send Keep_alive, restart T2
<b>Receive data message</b>	S=connected A=DATA.ind, restart T3
<b>Receive Keep_alive</b>	S=connected A=restart T3
<b>Expiration of T3</b>	S=Disconnected A= send Abort_req, stop T2 and T3

**Table 4: Keep alive and data transmission state table**

<b>State→ Input ↓</b>	<b>No release undertaken</b>	<b>Wait for release confirm</b>	<b>Wait for release response</b>
<b>RELEASE.req</b>	S=wait for release confirm A=send Release_req Restart T4, set C4=0	S=wait for release confirm A=none	S=wait for release response A=none
<b>Receive Release_resp with D_result equal to finished</b>	S= no release undertaken A=none	S=disconnected A=release.conf+ Stop T2,T3and T4	S=wait for release response A=none
<b>Receive Release_resp with D_result equal to rejected</b>	S= no release undertaken A=none	S=wait for release confirm A=none	S=wait for release response A=none
<b>Expiration of timer T4</b>	S=no release undertaken, A=none	If counter C4=R4 S=disconnected A=ABORT.ind send ABORT_req, stop T2,T3, T4 If counter C4<R4, S=wait for release confirm A=send release_req, restart T4, increment counter C4	S=wait for release response A=none
<b>Receive Release_req</b>	S=wait for release response A=RELEASE.ind	S=wait for release confirm A=none	S=wait for release response A=none
<b>RELEASE.resp+</b>	S=no release undertaken, A=none	S=wait for release confirm A=none	S=Disconnected A=send Release_resp with D_result set to Finished Stop T2 and T3
<b>RELEASE.resp-</b>	S=no release undertaken, A=none	S=wait for release confirm A=none	S=no release undertaken, A=send Release_resp with D_result set to Rejected

**Table 5: Release state table**



# Appendix B

## Messages

Note: This appendix identifies the messages used between GDLP/LU and DLF.

The ASTERIX format of each item is described in the Ref. 4.

All items shall be transmitted in FRN order within each message.

### 4. "LINK MANAGEMENT" MESSAGES

#### 4.1 "Connection procedures" messages

##### 4.1.1 Associate\_req GDLP/LU↔DLF

- D\_Source
- D\_Destination
- D\_message\_type value 00h
- D\_II\_code

D\_II\_code is only forwarded by the DLF.

##### 4.1.2 Associate\_resp GDLP/LU↔DLF

- D\_Source
- D\_Destination
- D\_message\_type value 01h
- D\_result
- D\_II\_code

D\_II\_code is only forwarded by the DLF.

#### 4.2 "Keep alive procedure" messages

##### 4.2.1 Keep\_alive GDLP/LU↔DLF

- D\_Source
- D\_Destination
- D\_message\_type value 05h

#### 4.3 "Disabling connection" messages

##### 4.3.1 Abort\_req GDLP/LU↔DLF

- D\_Source
- D\_Destination
- D\_message\_type value 04h
- D\_result

The use of the D\_result field in Abort\_req is optional.

- 4.3.2 Release\_req GDLP/LU↔DLF**
- D\_Source
  - D\_Destination
  - D\_message\_type value 02h
- 4.3.3 Release\_resp GDLP/LU↔DLF**
- D\_Source
  - D\_Destination
  - D\_message\_type value 03h
  - D\_result

## **4.4 "Routing information" messages**

### **4.4.1 Aircraft entry/exit messages**

- 4.4.2 Aircraft\_report DLF→GDLP/LU**
- D\_Source
  - D\_Destination
  - D\_message\_type value 10h
  - D\_Mode\_S\_address
  - D\_Data\_link\_status
  - D\_COM
  - D\_ECA
  - D\_Polar\_position
  - D\_Cartesian\_position
  - D\_identity
  - D\_mode\_A
  - D\_height
  - D\_speed
  - D\_heading
  - D\_CQF
  - D\_CQF\_method

The items D\_Polar\_position, D\_Cartesian\_position, D\_identity, D\_mode\_A, D\_height, D\_speed, D\_heading, D\_CQF and D\_CQF\_method are included here for completeness. These particular items are not sent by default, but may be sent upon request, through the Aircraft\_command message.

### **4.4.3 Air-Ground Link update message**

- 4.4.4 Aircraft\_command GDLP/LU→DLF**
- D\_Source
  - D\_Destination
  - D\_message\_type value 11h
  - D\_Mode\_S\_address
  - D\_Data\_link\_command
  - D\_Report\_request
  - D\_CQF\_method

D\_CQF\_method is optional.

- 4.4.5**      **II\_code\_change**      **DLF→GDLP/LU**
- D\_Source
  - D\_Destination
  - D\_message\_type      value 12h
  - D\_II\_code

---

## 5. "BROADCAST SERVICE" MESSAGES

### 5.1 Uplink broadcasts messages

#### 5.1.1 Uplink\_broadcast GDLP/LU→DLF

- D\_Source
- D\_Destination
- D\_message\_type value 30h
- D\_Broadcast\_number
- D\_Broadcast\_properties
- D\_Broadcast\_prefix
- D\_Broadcast

D\_Broadcast\_properties is optional.

#### 5.1.2 Uplink\_broadcast\_ack DLF→GDLP/LU

- D\_Source
- D\_Destination
- D\_message\_type value 32h
- D\_result
- D\_Broadcast\_number

D\_Broadcast\_number is optional.

#### 5.1.3 Cancel\_uplink\_broadcast GDLP/LU→DLF

- D\_Source
- D\_Destination
- D\_message\_type value 31h
- D\_Broadcast\_number

D\_Broadcast\_number is optional. If absent, the cancellation shall be applied to all active (or outstanding) uplink broadcasts.

### 5.2 Downlink broadcasts messages

#### 5.2.1 Downlink\_broadcast DLF→GDLP/LU

- D\_Source
- D\_Destination
- D\_message\_type value 34h
- D\_Mode\_S\_address
- D\_Time
- D\_Broadcast

## 6. "GICB SERVICE" MESSAGES

### 6.1.1 GICB\_extraction GDLP/LU→DLF

- D\_Source
- D\_Destination
- D\_message\_type value 40h
- D\_Mode\_S\_address
- D\_GICB\_periodicity
- D\_GICB\_properties
- D\_GICB\_number
- D\_BDS\_code
- D\_Time

D\_GICB\_periodicity, D\_GICB\_properties and D\_Time are optional

### 6.1.2 GICB\_extraction\_ack DLF→GDLP/LU

- D\_Source
- D\_Destination
- D\_message\_type value 42h
- D\_result
- D\_Mode\_S\_address
- D\_GICB\_number

D\_GICB\_number is optional and is not included for the case when no D\_GICB\_number was included in the Cancel\_GICB\_extraction request **and** no pending GICB requests exist.

### 6.1.3 Cancel\_GICB\_extraction GDLP/LU→DLF

- D\_Source
- D\_Destination
- D\_message\_type value 41h
- D\_Mode\_S\_address
- D\_GICB\_number

D\_GICB\_number is optional. If absent, the cancellation shall be applied to all the current active GICB requests for the aircraft identified by D\_Mode\_S\_address

### 6.1.4 GICB\_response DLF→GDLP/LU

- D\_Source
- D\_Destination
- D\_message\_type value 43h
- D\_result
- D\_Mode\_S\_address
- D\_GICB\_number
- D\_BDS\_code
- D\_GICB\_extracted
- D\_Time

D\_GICB\_extracted is optional : present in the case of successful extraction; absent in the case of extraction failure'

## 7. "DOWNLINK PACKET DATA FLOW" MESSAGES

### 7.1 Downlink packet message

#### 7.1.1 Downlink\_packet DLF→GDLP/LU

- D\_Source
- D\_Destination
- D\_message\_type value 23h
- D\_Result
- D\_Mode\_S\_address
- D\_Mode\_S\_packet

D\_Result is optional to indicate the presence of an invalid LV field.

---

## 8. "UPLINK PACKET DATA FLOW" MESSAGES

### 8.1 Flow control messages

#### 8.1.1 Data\_XON DLF→GDLP/LU

- D\_Source
- D\_Destination
- D\_message\_type value 26h
- D\_Mode\_S\_address\_list

#### 8.1.2 Data\_XOFF DLF→GDLP/LU

- D\_Source
- D\_Destination
- D\_message\_type value 27h
- D\_Mode\_S\_address\_list

### 8.2 Uplink Packet messages

#### 8.2.1 Uplink\_packet GDLP/LU→DLF

- D\_Source
- D\_Destination
- D\_message\_type value 20h
- D\_Mode\_S\_address
- D\_Packet\_number
- D\_Packet\_properties
- D\_Mode\_S\_packet

#### 8.2.2 Uplink\_packet\_ack DLF→GDLP/LU

- D\_Source
- D\_Destination
- D\_message\_type value 22h
- D\_result
- D\_Mode\_S\_address
- D\_Packet\_number\_list

D\_Packet\_number\_list is optional and is not included for the case when no D\_Packet\_number was included in the Cancel\_uplink\_packet request **and** no pending packets exist.

#### 8.2.3 Cancel\_uplink\_packet LU/GDLP→DLF

- D\_Source
- D\_Destination
- D\_message\_type value 21h
- D\_Mode\_S\_address
- D\_Packet\_number

D\_Packet\_number is optional. If absent, the cancellation shall be applied to all active Mode S uplink packet requests for the aircraft identified by D\_Mode\_S\_address.