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Aeronautical Telecommunication Network Panel
Working Groups 1 and 2
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Status Report on HFDL Subnetwork SARPs

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The AMCP is developing the SARPs for the High Frequency Data Link (HFDL) subnetwork. This working paper reports of the status of the HFDL Standard and the anticipated performance of the HFDL subnetwork

Reference: AMCP: High Frequency Data Link Standards and Recommended Practices (SARPs) – Draft 3.0, 5 Sept. 1997

Attachment: "HFDL Subnetwork Layer," AMCP, 11 Sept. 1997

1. INTRODUCTION

The AMCP is tasked with developing SARPs for the High Frequency Data Link (HFDL) subnetwork. Working Group E of the AMCP has produced a draft version 3.0 of the HFDL SARPs. The AMCP is following the model of the ATN SARPs in that they have drafted a very brief core SARPs and Appendix material that together will specify the technical provisions for the HFDL subnetwork. The AMCP has not yet established a firm date for completion/approval of the HFDL SARPs, but there is some possibility they could have the validation completed by January 1998 and the SARPs ready for approval as early as April 1998. The AMSS SARPs were used as the model for preparing the HFDL draft SARPs. The HFDL SARPs are still under development at this time and have not been submitted to ATNP for their formal review or comment. Rather, this working paper is intended to give the members of the ATNP working groups an indication of the overall architecture and performance of the HFDL subnetwork.

2. DISCUSSION

A brief review of the draft HFDL SARPs materials from AMCP has been undertaken from the point of view of its use within the context of the ATN. While the HFDL draft SARPs are still being revised in many areas, it appears to be mature enough to allow an initial review of its anticipated characteristics.

2.1 PERFORMANCE

2.1.1 HFDL QoS

The draft HFDL core SARPs specify the QoS as *(please note the values below have yet to be validated and may be revised before the HFDL SARPs are approved by the AMCP)*:

a) "The undetected error rate for a Basic Data Unit (BDU), representing 1-53 octets of user data, shall not exceed 1×10^{-6}."

b) "Transit delays for BDUs of the Flight Safety Message priority and higher (Q11-Q14) shall not exceed the values shown in Table 2 for a HFDL BDU traversing the circuit segment between the HFDL aircraft station sub-system and the HFDL ground station subsystem."

Table 2. Transit Delay Requirements

Transit Delay Parameter	***Condition***	***Transit Delay***
Average Transit Delay		
To-Aircraft Direction	All Priorities	28 seconds
From-Aircraft Direction	All Priorities	56 seconds
95% Transit Delay		
To-Aircraft Direction	Q11 and Higher	51 seconds
	All Priorities	66 seconds
From-Aircraft Direction	Q11 and Higher	146 seconds
	All Priorities	252 seconds

2.1.2 ATSC TRAFFIC CLASS SUPPORTED BY HFDL SUBNETWORK

The ATSC traffic types, as currently defined in the ATN SARPs, are defined as the average of the uplink and downlink transit delays at 95% probability. Using the values applicable to flight safety communications in Table 2 (above) from the HFDL draft SARPs produces an averaged transit delay of 98.5 seconds at 95% probability. This corresponds to ATSC traffic class H.

2.2 HFDL ARCHITECTURE

The draft HFDL SARPs defines the subnetwork architecture as being composed of four subsystems:

a) the HFDL aircraft station subsystem (HAS)

b) the HFDL ground station subsystem (HGS)
c) the HFDL ground communications subsystem
e) the HFDL ground management subsystem

Please note that WG-E of AMCP is considering removal of the standards material on the HFDL ground communications subsystem from the SARPs because some members feel this is a local implementation matter.

The draft HFDL SARPs specify the use of ISO 8208 as the subnetwork access protocol . The attachment to this working paper is draft text for the HFDL subnetwork layer. The HFDL subnetwork layer within the HAS and the HGS are defined to contain the following functions:

a) HFDL subnetwork dependent (HFSND) functions;
b) subnetwork access (SNAc) functions; and
c) interworking (IW) function.

Both the HAS and the HGS contain DCE functions. The HAS also contains a connectivity notification function to generate and send the subnetwork join and leave events to the ATN routers. See the attachment to this working paper for more information.

The HFDL ground station management subsystem performs a set of functions to establish and maintain communication channels between the HGSs and each logged-on aircraft's HAS. The management system is responsible for managing the resources of the connected HGSs including management of the available HF channels.

Please note that the material on the HFDL subnetwork layer, as presented in the attachment to this working paper, is currently being revised by WG-E of AMCP and an updated version should be available shortly.

3. RECOMMENDATION

It is recommended that:

ATNP WG1 consider the role of HFDL for supporting overall system level requirement and be prepared to update the ATN core and SV-1 SARPs to reflect HFDL as a valid ICAO ATN mobile subnetwork as the AMCP matures the HFDL SARPs.

ATNP WG2 review the current draft materials from AMCP for the purpose of understanding the intended characteristics of HFDL as a subnetwork of the ATN. WG2 should be prepared to provide inputs to the AMCP on the draft HFDL SARPs when it becomes a more mature document.

ATTACHMENT

Excerpt from Draft HFDL SARPs

4.7 HFDL SUBNETWORK LAYER

4.7.1 General provisions

4.7.1.1 Architecture

4.7.1.1.1 The HFDL subnetwork layer (HFSNL) in the HFDL-Aircraft Station Subsystem and HFDL-Ground Station Subsystem shall provide connection-oriented packet data service by establishing subnetwork connections (SNCs) between subnetwork service (SNS) users. The HFSNL in the HFDL Aircraft Station Subsystem shall provide the additional connectivity notification service by sending connectivity notification event messages to the attached aeronautical telecommunication network (ATN) router. Both of the HFSNL in the HFDL Aircraft Station Subsystem and HFDL Ground Station Subsystem shall contain the following three functions:

a) HFDL subnetwork dependent (HFSND) function;

b) subnetwork access (SNAc) function; and

c) interworking (IW) function.

The HFDL Aircraft Station Subsystem shall contain the additional connectivity notification (CN) function. The HFSND function shall perform the HFSND protocol (HFSNDP) between each pair of HFDL Aircraft Station Subsystem and HFDL Ground Station Subsystem by exchanging subnetwork protocol data units (HFNPDUs). It shall perform the HFSNDP aircraft (HFSNDPA) function in the HFDL Aircraft Station Subsystem and the HFSNDP ground (HFSNDPG) function in the HFDL Ground Station Subsystem. The SNAc function shall perform the ISO 8208 protocol between the HFDL Aircraft Station Subsystem or HFDL Ground Station Subsystem and the attached routers by exchanging ISO 8208 packets. It shall perform the ISO 8208 DCE function in the HFDL Aircraft Station Subsystem and the HFDL Ground Station Subsystem. The CN function shall send connectivity notification event messages to the attached ATN router through the SNAc function. The IW function (IWF) shall provide the necessary harmonization functions between the HFSND, the SNAc and the CN functions. Figure 4-11 shows the HFSND, IW and SNAc functions and the ATN HFDL subnetwork protocol architecture.

4.7.1.1.2 The term DCE when used shall mean ISO 8208 DCE.

4.7.1.1.3 The HFSNL shall interface with the link layer and the HFDL Aircraft Station Subsystem/HFDL Ground Station Subsystem management.

4.7.1.2 Services

The HFSNL shall provide for the transparent transfer of octet aligned HFSNL user data and/or control information.

4.7.2 Packet data performance

4.7.2.1 [BLANK]

4.7.2.1.1 [BLANK]

Note.- *The terms used with respect to packet data performance are based on the definitions in ISO 8348 (first edition). In applying these definitions to the HFDL subnetwork layer, the word “network” and its abbreviation “N” in ISO 8348 are replaced by the word “subnetwork” and its abbreviation “SN”, respectively, wherever they appear.*

4.7.2.1.2 [BLANK]

4.7.2.1.3 [BLANK].

4.7.2.2 Speed-of-service

Note. — Subnetwork performance depends on a number of factors, including the level of communication traffic. The performance values given here apply during peak busy hours.

4.7.2.2.1 *Connection establishment delay*

Note. — Connection establishment delay, as defined in ISO 8348, includes a component, attributable to the called subnetwork service user, which is the time between the SN-CONNECT indication and the SN-CONNECT response. This user component is due to actions outside the boundaries of the HFDL subnetwork and is therefore excluded from the HFDL specifications.

4.7.2.2.1.1 Connection establishment delay shall not exceed [70] seconds.

4.7.2.2.2 [BLANK]

4.7.2.2.2.1 [BLANK]

4.7.2.2.3 [BLANK]

4.7.2.2.4 *Connection release delay*

The connection release delay (95 percentile) shall not exceed [30] seconds.

4.7.2.3 [BLANK]

4.7.2.3.1 [BLANK]

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4.7.2.3.2.1 [BLANK]

4.7.2.3.2.2 [BLANK]

4.7.3 HFDL subnetwork-dependent protocol services and operations

4.7.3.1 General provisions

Since the functional differences between the HFSNDPA and HFSNDPG are minimal, their operations shall be described in terms of HFSNDPX where X shall stand for either A or G. Where differences do occur, the HFSNDPA and HFSNDPG functions shall be described individually.

4.7.3.2 HFDL subnetwork-dependent protocol entities

Note. — At least one pair of HFSNDPA and HFSNDPG entities exists between each pair of HFDL Aircraft Station Subsystem and HFDL Ground Station Subsystem. Figure 4-12 shows two pairs of HFSNDPA and HFSNDPG entities between two HFDL Aircraft Station Subsystems and a HFDL Ground Station Subsystem.

4.7.3.2.1 The HFSNDPX defined in this section shall pertain to each HFSNDPX entity.

4.7.3.3 Logical channels

Note. — The connections between HFSNDPAs and HFSNDPGs are established through logical channels. Up to 255 logical channels may be established between each pair of HFSNDPX entities. Each logical channel is identified by its own logical channel number (LCN) ranging from 1 through 255. LCN 0 is reserved.

4.7.3.3.1 For a new ground-to-air connection establishment, the HFSNDPG shall allocate a logical channel number in the range 1 to 127, by choosing the lowest numbered logical channel in the ready state in that range. For a new air-to-ground connection setup, the HFSNDPA shall allocate a logical channel number in the range 128 to 255, by choosing the highest numbered logical channel in the ready state in that range.

4.7.3.4 Operations

The HFSNDPX virtual call (VC) service shall proceed through three distinct phases:

a) connection establishment;

b) data transfer; and

c) connection release.

Note. — The HFSNDPX is specified in terms of locally originated, or remotely originated operations. Locally originated specifies the procedure at the HFSNDPX for handling operations originating from a local SNS user, while remotely originated specifies the procedure at the HFSNDPX for handling operations originating from a remote SNS user.

4.7.3.5 Connection establishment

Note. — Up to [128] octets of user data may be transferred during connection establishment.

4.7.3.5.1 The connection establishment procedure shall apply independently to each establishment request.

4.7.3.5.2 User data shall be transparently forwarded in both directions.

4.7.3.5.3 *Locally originated*

4.7.3.5.3.1 *Normal operation*

4.7.3.5.3.1.1 When the HFSNDPX receives a call request packet from the IWF, it shall allocate a logical channel which is in the ready state, forward the call request packet to the remote HFSNDPX by means of a connection request HFNPDU and place the logical channel into the IWF call request state.

4.7.3.5.3.1.2 If the call is accepted at the remote HFSNDPX, a connection confirm HFNPDU is received. The HFSNDPX shall then place the logical channel in the data transfer/flow control state (flow control ready/no remote or local interrupt pending) and forward a call connected packet to the IWF. The call connected packet shall use default values (if any) for the facilities which are not transmitted over the HFDL subnetwork, according to the HFNPDU to packet mapping rules defined in 4.7.3.16.

4.7.3.5.3.1.3 If the HFSNDPX does not receive either a connection confirm or connection released HFNPDU from the remote HFSNDPX before the timer (*see* tN1, Table 4-18) expires, it shall initiate a connection release procedure.

4.7.3.5.3.2 *Other operation*

If resources are not available, or a requested facility value is not allowed, then the originating HFSNDPX shall send a clear indication packet to the IWF.

4.7.3.5.4 *Remotely originated*

4.7.3.5.4.1 *Normal operation*

4.7.3.5.4.1.1 When the HFSNDPX receives a connection request HFNPDU from the remote HFSNDPX, it shall place the logical channel selected in the incoming call state. The HFSNDPX shall forward an incoming call packet to the IWF using default values for any facilities which are not transmitted over the HFDL subnetwork (see 4.7.3.16).

4.7.3.5.4.1.2 When the HFSNDPX receives a call accepted packet from the IWF, it shall forward a connection confirm HFNPDU to the remote HFSNDPX and place the logical channel in the data transfer/flow control state (flow control ready/no remote or local interrupt pending) when it receives from the interfacing link layer the information that the connection confirm HFNPDU has been processed.

4.7.3.5.4.2 *Other operation*

4.7.3.5.4.2.1 If the receiving HFSNDPX cannot support the request, then it shall transmit a connection released HFNPDU to the originating HFSNDPX.

4.7.3.5.4.2.2 If a selected facility value is not allowed, then the receiving HFSNDPX shall initiate a connection release procedure.

4.7.3.6 Connection release

Note. — A subnetwork connection may be released at any time by any party once the logical channel is in the data transfer, IWF call request, or incoming call states. The connection released HFNPDU may contain user data ([128] octets maximum) provided by the IWF.

4.7.3.6.1 User data shall be transparently forwarded in both directions.

4.7.3.6.2 The HFSNDPX shall guarantee in-sequence transmission between data/ interrupt HFNPDUs already forwarded to the link layer and a subsequently transmitted connection released or connection release complete HFNPDU.

4.7.3.6.3 *Locally originated*

4.7.3.6.3.1 When the HFSNDPX receives a clear request packet from the IWF, it shall place the logical channel in the local clear request state, generate a connection released HFNPDU, and forward it to the remote HFSNDPX. The only HFNPDUs it shall then accept, are a connection released HFNPDU or a connection release complete HFNPDU. It shall discard all other HFNPDUs. The HFSNDPX shall also consider the receipt of any packet other than a clear request packet as an error, and shall discard it.

4.7.3.6.3.2 When the HFSNDPX receives a connection release complete after the connection released has been successfully sent, it shall return the logical channel to the ready state. If the HFSNDPX receives a connection released HFNPDU from the remote HFSNDPX, it shall not expect to receive a connection release complete HFNPDU.

4.7.3.6.3.3 If the HFSNDPX does not receive a response from the remote HFSNDPX before the associated timer (*see* tN6, Table 4-18) expires, it shall return the logical channel to the ready state.

4.7.3.6.4 *Remotely originated*

When the HFSNDPX receives a connection released HFNPDU, it shall enter the remote clear request state, and forward a clear indication packet to the IWF. It shall also construct a connection release complete HFNPDU, send it to the remote HFSNDPX, and return the logical channel to the ready state.

4.7.3.6.5 *HFSNDPX originated*

If the HFSNDPX entity needs to disconnect a connection, it shall place the logical channel in the local clear request state, send a clear indication packet to the IWF and transmit a connection released HFNPDU to the remote HFSNDPX. It expects to receive as a response from the remote HFSNDPX a connection release complete HFNPDU or connection released HFNPDU, and shall return the logical channel to the ready state when the expected response is received or timing supervision expires (*see* tN6, Table 4-20).

4.7.3.7 Data transfer

4.7.3.7.1 The data transfer procedure shall apply independently to each logical channel which is in the data transfer/flow control state.

4.7.3.7.2 *Data transfer procedure*

4.7.3.7.2.1 Data shall be forwarded transparently and in sequence between the SNS users.

4.7.3.7.2.2 An M-bit HFNPDU sequence shall consist of a sequence of one or more data HFNPDUs. Each data HFNPDU except the last one, shall contain the maximum [503] octets of user data and its M-bit shall be set to 1. The user data field of the last HFNPDU which belongs to the sequence may have less than the maximum length and shall have its M-bit set to 0.

4.7.3.7.2.3 *Locally originated*

4.7.3.7.2.3.1 An M-bit packet sequence received from the IWF shall be forwarded as an M-bit HFNPDU sequence to the remote HFSNDPX.

4.7.3.7.2.3.2 Upon receipt from the IWF of one or more data packets belonging to one M-bit packet sequence, the HFSNDPX shall generate one or more data HFNPDUs, using the M-bit to indicate a following data HFNPDU of the same sequence of data HFNPDUs and shall forward them to the remote HFSNDPX.

Note. — The number of data HFNPDUs needed in the sequence depends on the amount of user data in the data packets which belong to the M-bit packet sequence.

4.7.3.7.2.3.3 The HFSNDPX shall also assign an HFNPDU number to each data HFNPDU. HFNPDU numbers shall be consecutive over a given connection. The sequence numbering of data HFNPDUs shall be performed modulo 256 and the HFNPDU numbers shall cycle through the entire range from 0 through 255. The first data HFNPDU to be transmitted over the HFDL link, when the logical channel has just entered the flow control ready state, shall have an HFNPDU number equal to 0.

4.7.3.7.2.4 *Remotely originated*

4.7.3.7.2.4.1 An M-bit HFNPDU sequence received from the remote HFSNDPX shall be forwarded as an M-bit packet sequence to the IWF.

4.7.3.7.2.4.2 Upon receipt of an M-bit HFNPDU sequence, the HFSNDPX shall generate an M-bit packet sequence, using the M-bit to indicate a following packet of the same sequence as required and forward it to the IWF.

Note. — The number of data packets needed in the M-bit packet sequence depends on the amount of user data in the M-bit HFNPDU sequence and the packet size.

4.7.3.7.2.4.3 If a data HFNPDU is received which contains less than the maximum size and with M-bit = 1, then the HFSNDPX shall initiate a reset procedure (*see* 4.7.3.8.2.1).

4.7.3.7.3 *Flow control*

4.7.3.7.3.1 Flow control shall be provided within the HFSNDPX to prevent the overflow of data buffers.

4.7.3.7.3.2 To interrupt the flow of data, the receiving HFSNDPX shall generate a flow control HFNPDU with its flow control reason field set to suspend and transmit it to the remote HFSNDPX. The HFNPDU number in the flow control (suspend) HFNPDU shall be set to the HFNPDU number of the last received and accepted data HFNPDU. If there are any out-of-sequence data HFNPDUs in the HFSNDPG, the HFNPDU number in the flow control HFNPDU with its reason field set to suspend shall be set to the HFNPDU number of the HFNPDU received and accepted before the out-of-sequence HFNPDU. When subsequently the receiving SNDPX is able to resume the data transfer, it shall transmit a flow control HFNPDU with its flow control reason field set to resume.

4.7.3.7.3.3 When the HFSNDPX receives a flow control HFNPDU with its flow control field set to suspend, it shall stop transmitting data HFNPDUs on the indicated logical channel. If the HFNPDU number in the flow control (suspend) HFNPDU is other than that of the last data HFNPDU transmitted and the data HFNPDU with HFNPDU number equal to the HFNPDU number in the flow control (suspend) HFNPDU plus one modulo 256 is no longer in the data buffer, the HFSNDPX shall initiate a reset of the logical channel. When the HFSNDPX receives a flow control HFNPDU with its control field set to resume, it shall restart transmitting data HFNPDUs on the indicated logical channel. The first (re)transmitted data HFNPDU shall have its HFNPDU number equal to the HFNPDU number of the previously received flow control HFNPDU (suspend) plus one modulo 256, unless a reset procedure has been invoked.

4.7.3.7.3.4 If the receiving HFSNDPX is not able to resume data transfer before the associated timer (*see* tN7 in Table 4-18 and Table 4-20) expires, it shall initiate a reset of the logical channel.

4.7.3.7.4 *Expedited data transfer*

Note. — The expedited data transfer allows an HFSNDPX to transmit user data contained in an interrupt packet to the remote HFSNDPX, bypassing any flow control that may have been applied by subnetwork layer entities.

4.7.3.7.4.1 The expedited data transfer procedure shall apply independently to each logical channel which is in the data transfer state and shall not be initiated when a release or reset procedure is in process.

4.7.3.7.4.2 Only one interrupt HFNPDU at a time, with a maximum user data length of [32] octets, shall be permitted in each direction.

4.7.3.7.4.3 *Locally originated*

4.7.3.7.4.3.1 When the originating HFSNDPX receives an interrupt packet from the IWF and provided there is no pre-existing interrupt HFNPDU awaiting interrupt confirm HFNPDU, the HFSNDPX shall then generate an interrupt HFNPDU and forward it to the remote HFSNDPX, and await an interrupt confirm HFNPDU; otherwise, the HFSNDPX shall discard the interrupt packet.

4.7.3.7.4.3.2 Upon receipt of an interrupt confirm HFNPDU, the HFSNDPX shall generate an interrupt confirmation packet and forward it to the IWF.

4.7.3.7.4.3.3 If the HFSNDPX does not receive the interrupt confirm HFNPDU before the associated timer (*see* tN4 in Table 4-18 and Table 4-20) expires, it shall initiate a reset of the logical channel.

4.7.3.7.4.4 *Remotely originated*

4.7.3.7.4.4.1 When the HFSNDPX receives an interrupt HFNPDU, it shall forward an interrupt packet to the IWF.

4.7.3.7.4.4.2 When the HFSNDPX receives an interrupt confirmation packet from the IWF, it shall construct an interrupt confirm HFNPDU, and send it to the remote SSNPDX.

4.7.3.8 *Connection reset*

4.7.3.8.1 When the HFSNDPX detects an error in the HFSNDPX operation for which its action is to reset the virtual circuit (*see* Table 4-24), then it shall place the logical channel into the local reset state, carry out the reset procedure and transmit a reset HFNPDU to the remote HFSNDPX.

Note. — The cause and diagnostic codes indicate whether the reset should be carried out within the HFDL subnetwork alone or should be extended to the IWF.

4.7.3.8.2 *Reset action*

During the reset process, the following actions shall be taken by the HFSNDPX with respect to its data transfer operation:

a) the HFNPDUs which have not yet been passed to the link layer shall be discarded;

b) the HFNPDUs that have been received prior to receiving/transmitting a reset HFNPDU but which do not constitute an M-bit HFNPDU sequence shall be flushed from the reassembly area;

c) the expected (data) HFNPDU number shall be reset to 0 and subsequently transmitted data HFNPDUs shall be numbered starting from 0; and

d) any outstanding interrupt HFNPDU to or from the remote HFSNDPX remains unconfirmed and tN4 is stopped.

4.7.3.8.3 *Reset procedures*

4.7.3.8.3.1 The reset procedures shall apply only to logical channels that are in the data transfer state.

4.7.3.8.3.2 The HFSNDPX shall guarantee in sequence transmission between data/interrupt HFNPDUs already forwarded to the link layer and a subsequently transmitted reset or reset confirm HFNPDU.

4.7.3.8.3.3 *Locally/HFSNDPX originated*

4.7.3.8.3.3.1 When the originating HFSNDPX receives a reset request packet from the IWF or when it has detected an error for which its action is to reset the SVC, it shall place the logical channel into the local reset state, execute the reset action, transmit a reset HFNPDU to the remote HFSNDPX, and start a timer tN3 (*see* Table 4-18). If required by the error procedures in 4.7.3.9, the HFSNDPX shall forward a reset indication packet to the IWF.

4.7.3.8.3.3.2 Upon receipt of the reset confirm HFNPDU from the remote HFSNDPX, it shall return the logical channel to the data transfer/flow control state.

4.7.3.8.3.3.3 If the HFSNDPX does not receive a response from the HFSNDPX before the associated timer (*see* tN3 in Table 4-18) expires, it shall initiate a connection release procedure.

4.7.3.8.3.4 *Remotely originated*

4.7.3.8.3.4.1 When the HFSNDPX receives a reset HFNPDU, it shall place the logical channel into the remote reset state, execute the reset action and transmit a reset indication packet to the IWF as required (*see* Table 4-24).

4.7.3.8.3.4.2 The HFSNDPX shall transmit a reset confirm HFNPDU to its remote HFSNDPX and shall return the logical channel to the data transfer state when it has received from the link layer the information that the reset confirm HFNPDU has been successfully transmitted.

4.7.3.8.3.5 *Simultaneous reset*

If the HFSNDPX sends a reset HFNPDU and subsequently receives a reset HFNPDU it shall:

a) not send a reset confirm HFNPDU; and

b) not expect to receive a reset confirm HFNPDU.

4.7.3.9 Error procedures

Note. — Errors which are recognized by the HFSNDPX may be the result of the following events:

- *channel degradation or loss of synchronization*
- *HFDL Aircraft Station Subsystem log-off*
- *a HFDL Ground Station Subsystem-to-HFDL Ground Station Subsystem handover*
- *link congestion*
- *an uncorrected transmission error*
- *a remote HFSNDPX protocol error*
- *a protocol error in the IWF/HFSNDPX interface procedure*

4.7.3.9.1 When an error as noted in Tables 4-22 to 4-24 is detected, the HFSNDPX shall initiate either reset or release of the relevant connection.

4.7.3.9.2 Errors shall be notified to the IWF by means of cause and diagnostic parameters within the relevant packet. Errors shall be notified to the remote HFSNDPX by using the corresponding fields of the HFNPDUs, i.e. reset or release cause and diagnostic code.

4.7.3.9.3 The coding of the cause fields which are generated by the HFSNDPX and passed to the remote HFSNDPX shall be as defined in Table 4-16.

4.7.3.9.4 The coding of the corresponding HFSNDPX generated diagnostic code field shall be as defined in Table 4-17.

4.7.3.9.5 *Log-on/log-off*

Note. — The procedures for log-on and log-off are covered in 4.7.6.

4.7.3.9.6 *Originating HFSNDPX error recovery*

4.7.3.9.6.1 Transmission error resulting from the loss or delay of HFNPDUs shall be detected either by time-out when a response is expected or by the fail LIDU reported by the link layer.

4.7.3.9.6.2 The actions the HFSNDPX follows upon time-out shall be as summarized in Table 4-18.

4.7.3.9.6.3 The actions the HFSNDPX shall follow when it is informed by the link layer that the transmission of an HFNPDU has failed shall be as summarized in Table 4-19. Receipt of a fail (data/interrupt) LIDU while the relevant LCN is either in local/remote reset state or local/remote clear request state, shall not cause the HFSND sub-layer entity to generate a (further) connection reset.

4.7.3.9.7 *Protocol error*

Note. — Two types of protocol error may occur at the HFSNDPX. These are:

a) a syntactical error which occurs when a received HFNPDU does not conform to the format specifications over the HFDL subnetwork; and

b) a logical error which occurs when the HFSNDPX receives from its peer entity an HFNPDU that is not an acceptable input to the current state of the logical channel.

4.7.3.9.7.1 When the HFSNDPX detects a protocol error, it shall respond as indicated in Tables 4-21 to 4-24. These tables are depicted for each logical channel state.

4.7.3.9.8 *Out-of-sequence data HFNPDU procedure*

4.7.3.9.8.1 The HFSNDPX shall process received data HFNPDUs in proper sequence, according to HFNPDU number to construct data packets to be forwarded to the IWF. The HFSNDPX shall discard duplicate HFNPDUs.

Note. — The receiving link layer at the HFDL Ground Station Subsystem may deliver HFNPDUs to the HFSNDPG in altered sequence. The HFSNDPG assembles data HFNPDUs in proper sequence before forwarding them to the IWF.

4.7.3.9.8.2 *HFSNDPG actions for out-of-sequence data HFNPDUs*

A data HFNPDU shall be defined as out of sequence if and only if its HFNPDU number does not immediately follow the HFNPDU number of the last received data HFNPDU that has been used in creating the last data packet.

Note. HFNPDU numbers are incremented modulo 256. Thus, HFNPDU number 0 follows HFNPDU number 255.

4.7.3.9.8.2.1 If an out-of-sequence data HFNPDU is not a duplicate, the HFSNDPG shall store the out-of-sequence data HFNPDU. If no more storage is available, the HFSNDPG shall place the logical channel in the reset state and extend the reset to the IWF.

4.7.3.9.8.2.2 Stored data HFNPDUs shall be processed to create data packets whenever this can be done without creating an out-of-sequence condition. Data packets shall be forwarded to the IWF as soon as possible.

4.7.3.9.8.3 *HFSNDPA actions for out-of-sequence HFNPDUs*

If a data HFNPDU is received which is not a duplicate but has an HFNPDU number not immediately following the HFNPDU number of the data HFNPDU last received, the HFSNDPA shall initiate a reset of the connection.

4.7.3.10 HFNPDU formats

4.7.3.10.1 *General HFNPDU format*

4.7.3.10.1.1 An HFNPDU shall consist of at least two octets. Octet 1 shall contain the D- and M-bits and the HFNPDU type identifier field. Octet 2 shall contain the logical channel number field; depending on the particular HFNPDU type, additional octets may be required. The general HFNPDU format shall be as defined in Figure 4-13.

4.7.3.10.1.2 The D- and M-bits shall be bits 7 and 8, respectively, in octet 1.

4.7.3.10.1.3 The M-bit shall be used in an M-bit HFNPDU sequence consisting of a sequence of data HFNPDUs; it shall be set to 0 in all other HFNPDUs.

Note. — The D-bit is not used.

4.7.3.10.1.4 The HFNPDU type identifier field shall be bits 1-6 in octet 1. The coding of the HFNPDU type identifier field shall be as defined in Table 4-15.

4.7.3.10.1.5 Octet 2 shall contain the logical channel number field.

Note. — In the following sections, fields are defined in the order they may appear in the relevant HFNPDU.

4.7.3.10.2 *Connection request HFNPDU*

4.7.3.10.2.1 The format of connection request HFNPDU shall be as defined in Figure 4-14.

4.7.3.10.2.2 *HFNPDU type identifier field*

4.7.3.10.2.2.1 Bits 1, 2, 3 and 6 shall be the following indicator bits:

a) bit 1, facilities field present;

b) bit 2, called NSAP address present;

c) bit 3, calling NSAP address present; and

d) bit 6, fast select with restriction on response.

4.7.3.10.2.2.2 Bits 1, 2 and 3 shall be set to 1 if the corresponding fields are present in the connection request HFNPDU; otherwise, they shall be set to 0. Bit 6 shall be set to 1 if fast select with restriction on response applies; otherwise, it shall be set to 0.

4.7.3.10.2.3 *DTE address length field*

Octet 3 shall consist of the calling- and called-DTE address length fields. Bits 8 to 5 shall specify the length of the calling-DTE address in semi-octets. Bits 4 to 1 shall specify the length of the called-DTE address in semi-octets. Each address-length field shall be binary coded, where bit 5 or 1 shall be the low-order bit of the indicator.

4.7.3.10.2.4 *Calling- and called-DTE fields*

4.7.3.10.2.4.1 When indicated by the DTE addresses length field, the octets following the DTE addresses length field shall contain the called-DTE address followed by the calling-DTE address.

4.7.3.10.2.4.2 Each digit of an address shall be coded in a semi-octet in binary-coded decimal, where bit 5 or bit 1 shall be the low-order bit of the digit.

4.7.3.10.2.4.3 Starting from the high-order digit, a DTE address shall be coded in consecutive octets, with two digits per octet. In each octet, the higher-order digit shall be coded in bits 8 to 5. When the total number of digits in the called- plus calling-DTE fields is odd, the combined fields shall be rounded up to an integral number of octets by inserting zeros in bits 4 to 1 of the last octet of the combined fields.

4.7.3.10.2.5 *Called- and calling-NSAP address fields*

When indicated by the called- and calling-NSAP address present indicator bits, the octets following the calling- and called-DTE fields shall contain the called-NSAP address field, then the calling-NSAP address field.

4.7.3.10.2.6 *Facility field length field*

When indicated by the facilities field present indicator bit, the next octet shall contain the length of the facilities field in octets. The facility field length field shall be binary-coded, where bit 1 shall be the low-order bit of the field.

4.7.3.10.2.7 *Facilities field*

When indicated by the facilities field present indicator bit, the octets following the facility field length field shall contain the codes and parameters for the facilities.

4.7.3.10.2.8 *Call user data field*

The next octets shall be used to carry the call user data, if any. If fast select facility is not used, not more than [16] octets of data shall be present. If fast select facility is used, not more than [128] octets of data shall be present.

4.7.3.10.3 *Connection confirm HFNPDU*

4.7.3.10.3.1 The format of the connection confirm HFNPDU shall be as specified in Figure 4-15.

4.7.3.10.3.2 *HFNPDU type identifier field*

4.7.3.10.3.2.1 Bits 1 and 2 shall be the following indicator bits:

a) bit 1: facilities field present; and

b) bit 2: NSAP address present.

4.7.3.10.3.2.2 These bits shall be set to 1 if the corresponding fields are present; otherwise, they shall be set to 0.

4.7.3.10.3.3 *Called-NSAP address field*

When indicated by the NSAP address present indicator bit, the octets following the logical channel number field shall consist of the called-NSAP address.

4.7.3.10.3.4 *Facility length field*

When indicated by the facilities field present indicator bit, the next octet shall contain the length of the facilities field in octets. The facility length indicator shall be binary-coded, where bit 1 shall be the low-order bit of the field.

4.7.3.10.3.5 *Facilities field*

When indicated by the facilities field present indicator bit, the octets following the facilities field shall contain the codes and parameters for the facilities.

4.7.3.10.3.6 *Called user data field*

The next octets shall be used to carry the called user data, if any. If fast select facility is used, not more than [128] octets of data shall be present.

4.7.3.10.4 *Connection released HFNPDU*

4.7.3.10.4.1 The connection released HFNPDU format shall be as defined in Figure 4-16.

4.7.3.10.4.2 *HFNPDU type identifier field*

4.7.3.10.4.2.1 Bit 2 shall be the NSAP address present indicator bit.

4.7.3.10.4.2.2 This bit shall be set to 1 if the called-NSAP address field is present; otherwise, it shall be set to 0.

4.7.3.10.4.3 *Called-NSAP address field*

This field shall have the same coding as 4.7.3.10.3.3.

4.7.3.10.4.4 *Clearing cause field*

4.7.3.10.4.4.1 The next octet shall be the clearing cause field. It shall contain the clearing cause for the release of the connection.

4.7.3.10.4.4.2 The coding of the clearing cause which may be generated by the HFSNDPX shall be as given in Table 4-16.

4.7.3.10.4.5 *Diagnostic code field*

The octet following the clearing cause field shall be the diagnostic code field. It shall contain additional information on the reason for the release of the connection. The coding of the diagnostic code field shall be dependent on the clearing cause as in Table 4-16. The diagnostic code field codings when connection release has been initiated by the HFSNDPX shall be as defined in Table 4-17.

4.7.3.10.4.6 *Clear user data field*

The field following the diagnostic code field shall be the user data field. If present, this field shall contain not more than [128] octets of user data.

4.7.3.10.5 *Connection release complete HFNPDU*

The connection release complete HFNPDU format shall be as defined in Figure 4-17.

4.7.3.10.6 *Data HFNPDU*

4.7.3.10.6.1 The data HFNPDU format shall be as defined in Figure 4-18.

4.7.3.10.6.2 *M-bit*

The M-bit shall be set to 1 if the HFNPDU is not the last in an M-bit sequence of data HFNPDUs; otherwise, it shall be set to 0.

4.7.3.10.6.3 *HFNPDU number field*

Octet 3 shall contain the 8-bit HFNPDU number.

4.7.3.10.6.4 *User data field*

The field following the HFNPDU number field shall contain the user data. This field shall contain up to a maximum of [503] octets.

4.7.3.10.7 *Interrupt data HFNPDU*

4.7.3.10.7.1 The interrupt data HFNPDU format shall be as defined in Figure 4-19.

4.7.3.10.7.2 *Interrupt user data field*

The field following the logical channel number field shall be the interrupt user data field. This field shall contain up to a maximum of [32] octets.

4.7.3.10.8 *Interrupt confirm HFNPDU*

The interrupt confirm HFNPDU format shall be as defined in Figure 4-20.

4.7.3.10.9 *Reset HFNPDU*

4.7.3.10.9.1 The reset HFNPDU format shall be as defined in Figure 4-21.

4.7.3.10.9.2 *Resetting cause*

Octet 3 shall be the resetting cause field and shall contain the reason for the reset. When the reset has been initiated by the HFSNDPX, the coding of the resetting cause field in a reset HFNPDU shall be as given in Table 4-16.

4.7.3.10.9.3 *Diagnostic code*

4.7.3.10.9.3.1 Octet 4 shall be the diagnostic code field and shall contain additional information on the reason for the reset. The coding of the diagnostic code field shall be dependent on the resetting cause as given in Table 4-16. The diagnostic code field codings when the reset has been initiated by the HFSNDPX shall be as defined in Table 4-17.

4.7.3.10.9.3.2 If the resetting cause field indicates “IWF originated”, the diagnostic code field shall have been passed unchanged from the IWF as a result of its having initiated a resetting procedure.

4.7.3.10.10 *Reset confirm HFNPDU*

The reset confirm HFNPDU format shall be as defined in Figure 4-22.

4.7.3.10.11 *Flow control (suspend) HFNPDU*

4.7.3.10.11.1 The flow control (suspend) HFNPDU format shall be as defined in Figure 4-23.

4.7.3.10.11.2 *Flow control reason field*

Octet 3 shall contain the flow control reason field. This field shall be set to 11001001 (suspend).

4.7.3.10.11.3 *HFNPDU number field*

Octet 4 shall contain the 8-bit HFNPDU number of the last in-sequence received and accepted data HFNPDU.

4.7.3.10.12 *Flow control (resume) HFNPDU*

4.7.3.10.12.1 The flow control (resume) HFNPDU format shall be as defined in Figure 4-24.

4.7.3.10.12.2 *Flow control field*

Octet 3 shall contain the flow control reason field. This field shall be set to 11001011 (resume) to resume transmission from the peer.

4.7.3.10.13 *Connection request/confirm HFNPDU facilities field*

4.7.3.10.13.1 The facilities field shall be present only when the facility field present indicator bit is set to one in the connection request, and connection confirm HFNPDUs.

4.7.3.10.13.2 The facilities field shall contain one facility element for each facility or group of facilities requested. The first octet of each facility element shall be the facility code field, which shall indicate the code for the facility or facilities requested. The remaining octets of a facility element shall contain the facility parameter field.

4.7.3.10.13.3 *Recommended facilities*

Recommendation. *The following facilities should be supported by the HFSNDPX:*

a) [BLANK]

b) [BLANK]

c) fast select; and.

d) expedited data negotiation.

4.7.3.10.13.4 *[BLANK]*

4.7.3.10.13.5 *[BLANK*

4.7.3.10.13.6 *Fast select facility format*

The fast select facility format shall be as defined in Figure 4-27.

4.7.3.10.13.7 *Expedited data negotiation*

The expedited data negotiation facility format shall be as defined in Figure 4-28.

4.7.3.10.14 *Diagnostic codes*

When connection release/reset is initiated by the HFSNDPX, the coding of the diagnostic code field in the connection released and reset HFNPDUs shall be as defined in Table 4-17.

4.7.3.11 Timer values

The timer values shall be as defined in Table 4-20.

4.7.3.12 State diagrams

State diagrams for the following states shall be given below:

a) The state diagram for connection establishment/release of a logical channel shall be as defined in Figure 4-29.

b) The state diagram for reset and flow control states within the data transfer state shall be as defined in Figure 4-30.

4.7.3.13 State tables

4.7.3.13.1 Action taken in any state of the HFSNDPX shall be given by Tables 4-21 to 4-24.

4.7.3.13.2 The following conventions shall be used in the state tables:

a) action taken, which could be:

- normal, as defined in 4.7.3.5 to 4.7.3.8;

- discard the received HFNPDU and take no subsequent action as a result of receiving that HFNPDU;

- error, as defined in the table;

b) - the diagnostic code contained in the diagnostic code field of the appropriate HFNPDU (connection released, or reset) issued upon the detection of the indicated error.

4.7.3.14 HFDL subnetwork dependent to link layer interface functions

4.7.3.14.1 The interface functions to the link layer shall include the following:

a) generation and reception of link interface data units (LIDUs);

b) routing of received HFNPDUs according to connection;

c) selection of further HFNPDUs for transmission according to a cyclic order of selecting among the logical channels at a given Q number and giving precedence to interrupt HFNPDUs over data HFNPDUs of the same Q number; and

d) routing of local acknowledgement (success/fail) for RLS transmission status indication LIDUs.

4.7.3.14.2 The LIDUs passed between the HFSNDPX and the link layer shall include the LIDUs defined in Table 4-25.

4.7.3.15 Packet to HFNPDU mapping rules

4.7.3.15.1 The rules for mapping the ISO 8208 packet fields into the corresponding fields in HFNPDU shall be as specified in this section.

4.7.3.15.2 *DTE addresses*

4.7.3.15.2.1 The called-DTE address and the calling-DTE address fields in the ISO 8208 call request packet shall be directly mapped into the called-DTE address and the calling-DTE address fields in the connection request HFNPDU.

4.7.3.15.2.2 The calling and called DTE addresses in the ISO 8208 call accepted packet shall not be transmitted across the HFDL link.

4.7.3.15.3 *NSAP address*

4.7.3.15.3.1 The called address extension and the calling address extension parameter fields in the ISO 8208 call request packet shall be directly mapped into the called NSAP address and the calling NSAP address fields in the connection request HFNPDU.

4.7.3.15.3.2 If the called address extension parameter in either the ISO 8208 call accepted packet or clear request packet is equal to the called NSAP address of the corresponding connection request HFNPDU, then the called address extension shall not be transmitted across the HFDL link; otherwise, it shall be directly mapped into the relevant HFNPDU.

4.7.3.15.4 *Subnetwork connection priority*

4.7.3.15.4.1 The target value for the priority of data on a connection in the ISO 8208 call request packet shall be mapped to the LIDU Q number passed to the link layer as defined in Table 4-26. This value shall be used as long as the connection setup procedure HFDL Aircraft Station Subsystem not been completed.

4.7.3.15.4.2 The selected value for the priority of data on a connection in the ISO 8208 call accepted packet shall be mapped to the LIDU Q number passed to the link layer as defined in Table 4-26. This value shall be used for the remainder of the SNC.

4.7.3.15.4.3 If an invalid priority value is provided in the call request or call accepted packet, the HFSNDPX shall reject the call. The diagnostic code in the clear indication packet shall be set to “connection rejection □ requested quality of service not available □ (permanent condition)”.

4.7.3.15.4.4 If priority of data on a connection is not indicated in the call request packet, a default value (SNC priority = 0) shall be used.

4.7.3.15.5 [BLANK]

4.7.3.15.5.1 [BLANK]

4.7.3.15.5.2 [BLANK]

4.7.3.15.6 *Transit delay*

4.7.3.15.6.1 [BLANK]

4.7.3.15.6.2 *[BLANK]*

4.7.3.15.6.2.1 [BLANK]

4.7.3.15.6.3 *[BLANK]*

4.7.3.15.7 *Fast select*

The fast select facility shall be treated as follows:

a) a call request packet without the fast select facility shall be mapped to a connection request with no restriction on response HFNPDU with the fast select (use not permitted) facility;

b) a call request packet with the fast select facility indicating fast select requested with no restriction on response shall be mapped to a connection request with no restriction on response HFNPDU without the fast select (use not permitted) facility; and

c) a call request packet with the fast select facility indicating fast select request with restriction on response shall be mapped to a connection request with restriction on response HFNPDU without the fast select (use not permitted) facility.

4.7.3.15.8 *Expedited data negotiation*

The expedited data negotiation facility in the call request or call accepted packet shall not be mapped to the corresponding connection request or connection confirm HFNPDU unless the facility parameter is set to “no use of expedited data”.

4.7.3.15.9 *Cause and diagnostic codes*

4.7.3.15.9.1 Clearing cause, resetting cause and diagnostic code fields shall be transferred without modification from the packets to the corresponding HFNPDUs.

4.7.3.15.9.2 If the HFSNDPX has initiated the clear or reset procedure, then the clearing cause, the resetting cause and the diagnostic code fields shall be set as defined in Tables 4-16 and 4-17.

4.7.3.15.10 *Data*

4.7.3.15.10.1 If the user data field in the data packets of an M-bit packet sequence is less than the default data HFNPDU maximum user data field length, then these fields shall be concatenated to form an M-bit HFNPDU sequence.

4.7.3.15.10.2 If the user data field in the data packets of an M-bit packet sequence is greater than the default data HFNPDU maximum user data field length, then these fields shall be segmented to form an M-bit HFNPDU sequence.

4.7.3.16 HFNPDU to packet mapping rules

4.7.3.16.1 This section shall specify the rules for mapping the HFNPDU fields into the corresponding fields in ISO 8208 packet.

4.7.3.16.2 *DTE address*

4.7.3.16.2.1 The called DTE address and the calling DTE address fields in the connection request HFNPDU shall be directly mapped into the called DTE address and the calling DTE address fields in the incoming call packet.

4.7.3.16.2.2 Both the calling and called DTE address fields shall be regenerated when forwarding a call connected packet, if they were present in the corresponding call request packet.

4.7.3.16.3 *NSAP address*

4.7.3.16.3.1 The called NSAP address and the calling NSAP address fields in the connection request HFNPDU shall be directly mapped into the called address extension and calling address extension parameter fields in the incoming call packet.

4.7.3.16.3.2 The called NSAP address field in the connection confirm or connection released HFNPDU shall be mapped into the called address extension field in the call connected or clear indication packet.

4.7.3.16.4 *Priority*

The Q number associated with the connection request and connection confirm HFNPDUs shall be mapped into the target and selected values of the priority of data on a connection field in the priority facility in the ISO 8208 incoming call and call connected packets.

4.7.3.16.5 *[BLANK]*

4.7.3.16.5.1 *[BLANK]*

4.7.3.16.5.2 *[BLANK]*

4.7.3.16.6 *[BLANK]*

4.7.3.16.6.1 *[BLANK*

4.7.3.16.6.2 *[BLANK]*

4.7.3.16.6.2.1 [BLANK]

4.7.3.16.6.2.2 [BLANK]

4.7.3.16.6.3 *[BLANK]*

4.7.3.16.6.3.1 [BLANK]

4.7.3.16.6.3.2 [BLANK]

4.7.3.16.7 *Fast select*

The fast select facility shall be treated as follows:

a) a connection request with no restriction on response HFNPDU with the fast select (use not permitted) facility shall be mapped into an incoming call packet without the fast select facility;

b) a connection request with no restriction on response HFNPDU without the fast select (use not permitted) facility shall be mapped into an incoming call packet with the fast select facility with the “no restriction on response” parameter;

c) a connection request with restriction on response HFNPDU without the fast select (use not permitted) facility shall be mapped into an incoming call packet with the fast select facility with the “restriction on response” parameter.

4.7.3.16.8 *Expedited data negotiation*

If the expedited data negotiation facility is not present in the connection request or connection confirm HFNPDU, this facility with its parameter set to “use of expedited data” shall be added to the corresponding incoming call or call connected packet; otherwise, this facility shall be mapped to the corresponding packet.

4.7.3.16.9 *Cause and diagnostic codes*

Clearing cause, resetting cause and diagnostic code fields shall be transferred without modification from the HFNPDUs to the corresponding packets.

4.7.3.16.10 *Data*

4.7.3.16.10.1 If the user data field in the data HFNPDUs of an M-bit HFNPDU sequence is less than the default data packet maximum user data field length, then these fields shall be concatenated to form an M-bit packet sequence.

4.7.3.16.10.2 If the user data field in the data HFNPDUs of an M-bit HFNPDU sequence is greater than the default data packet maximum user data field length, then these fields shall be segmented to form an M-bit packet sequence.

4.7.3.17 Capacity

The HFSNDPA shall support at least eight simultaneous, independent logical channels.

4.7.4 ISO 8208 DCE protocol operations

4.7.4.1 General provisions

4.7.4.1.1 The protocol between the ISO 8208 DCE and the ISO 8208 DTE shall comply with the ISO 8208 second edition.

4.7.4.1.2 *Packet layer entity*

Note. — Within the ISO 8208 DCE there may be more than one DCE/DTE interface, e.g. a HFDL Ground Station Subsystem may be connected to more than one ground ATN router. One such entity exists in the DCE for each DCE/DTE interface. Deciding which entity to use to reach a particular destination is a function performed external to the protocol described here. The protocol defined in 4.7.4 pertains to each packet layer entity in the DCE.

4.7.4.2 Conformance requirements

4.7.4.2.1 *Supported services and capabilities*

The following services and capabilities shall be supported:

a) virtual call service;

b) a user data field of up to 128 octets in data packets; and

c) expedited data delivery, i.e. the use of interrupt packets with a user data field of up to 32 octets.

4.7.4.2.2 *Supported facilities*

The following facilities shall be supported:

a) calling address extension and called address extension; and

b) priority.

Note. — The target and lowest acceptable values for the priority to gain a connection and keep a connection, and the lowest acceptable value for data on a connection, need not be supported.

4.7.4.2.3 *Recommended facilities*

Recommendation. *The following facilities should be supported:*

a) [BLANK]

b) [BLANK]

c) fast select;

d) fast select acceptance.

4.7.4.3 Operations

4.7.4.3.1 *External interactions*

Note. — The initiation of certain DCE procedures is directed by elements outside the ISO 8208 DCE. Likewise, the occurrence of certain ISO 8208 DCE events are to be reported appropriately. These external interactions include:

a) requesting of the link layer, transmission of outgoing packets;

b) receiving, from the link layer, incoming packets;

c) accepting requests from the IWF to initiate certain ISO 8208 protocol procedures including:

1) originate a virtual call,

2) accept a virtual call,

3) terminate a virtual call,

4) transfer data and interrupt information, and

5) re-initialize a logical channel.

d) reporting to the IWF the occurrence of certain ISO 8208 protocol events including:

1) receipt of an incoming request to set up a virtual call,

2) receipt of the acceptance of a virtual call setup,

3) *termination of a virtual call,*

4) *receipt of data and interrupt information, and*

5) *re-initialization of a logical channel.*

4.7.4.3.1.1 The ISO 8208 DCE shall accept all ISO 8208 packets from the ISO 8208 DTE without failure.

4.7.4.3.2 *Logical channels*

Note. — Each virtual call and permanent virtual circuit is assigned a logical channel identifier which is a number in the range from 1 through 4 095. For each virtual call, a logical channel identifier is assigned during the call setup phase from a range of previously agreed-upon logical channel identifiers. For each permanent virtual circuit, a logical channel identifier is assigned in agreement with the DTE. A DCE's use of logical channels is agreed upon for a period of time with the DTE.

4.7.4.3.3 *State transitions*

4.7.4.3.3.1 The specifications and definitions in ISO 8208 shall apply for format definitions, diagnostic and cause codes, facility registration protocols (if used), and flow control on the ISO 8208 interface.

Note 1. — The ISO 8208 DCE is defined as a state machine. An ISO 8208 packet received from the DTE can cause state transitions, as can a packet received from IWF. The next state transition (if any) that occurs when the DCE receives a packet from the DTE is specified by Tables 4-29 to 4-34. These tables are organized according to the hierarchy in Figure 4-31.

Note 2. — Upon receiving a packet, the action is classified as normal or erroneous under the entry "A =". The resulting state is shown under the entry, "S =".

4.7.4.3.3.2 If a state transition is specified, the action taken shall be as specified in Tables 4-29 to 4-34.

4.7.4.3.4 *Disposition of packets*

When a packet is received from the DTE, the expressions in parentheses in Tables 4-29 to 4-34 specify whether the packet shall be forwarded or not forwarded to the IWF. If no remark in parentheses is listed or listed as not forwarded, then the packet shall be discarded. The ISO 8208 DCE shall either forward or not forward a packet from the IWF to the DTE in a manner that is compatible with ISO 8208.

4.7.4.3.5 *Diagnostic and cause codes*

For certain conditions, Tables 4-29 to 4-34 indicate a diagnostic code that shall be included in the packet generated when entering the state indicated. The term, "D =", shall define the diagnostic code. When "A = DIAG", the action taken shall be to generate an ISO 8208 diagnostic packet and transfer it to the DTE; the diagnostic code indicated shall define the entry in the diagnostic field of the packet. In the cause field of any packet type, bit 8 of the cause field shall always be set to 0, indicating that the condition was recognized by the ISO 8208 interface.

Note. — The state Tables 4-29 to 4-34 are defined so that the HFSNDPX and ISO 8208 DCE functions can operate simultaneously. While asynchronous operation is a suitable implementation strategy, it is not a requirement for the HFSNDPX and ISO 8208 DCE operations.

4.7.4.3.6 *DCE timer*

Note. — Under certain circumstances, the DTE must respond to a packet issued from the DCE within a given time.

4.7.4.3.6.1 Table 4-35 covers these circumstances and the action that the DCE shall initiate upon the expiration of that time.

4.7.4.4 Capacity

The HFDL Aircraft Station Subsystem DCE shall support at least eight simultaneous, independent logical channels.

4.7.4.5 VC pre-emption

A logical channel of the lowest priority and the associated virtual call shall be cleared as necessary to accept a request for higher priority service.

Note. — Logical channels and virtual calls have a priority level of 0 unless the ISO 8208 priority facility was invoked during call set up.

4.7.5 Interworking function

4.7.5.1 HFSNDPX/IWF interface

4.7.5.1.1 The ISO 8208 packets exchanged between the IWF and the HFSNDPX shall be as defined in Table 4-36.

4.7.5.1.2 *Incoming call packet handling*

The IWF shall forward the incoming call packet with the expedited data negotiation facility and "use of expedited data" parameter to the appropriate ISO 8208 DCE entity.

Note. — If the facility parameter is "no use of expedited data", the IWF forwards the incoming call packet with or without this facility.

4.7.5.1.3 *Call connected packet handling*

If the parameter of the expedited data negotiation facility is set to "use of expedited data" in the call connected packet, the IWF shall forward this facility and its parameter with the packet to the appropriate ISO 8208 DCE entity. For each virtual call, the IWF shall associate the HFSNDPX logical channel with the corresponding ISO 8208 DCE logical channel.

Note. — If the expedited data negotiation facility parameter is set to "no use of expedited data", the IWF forwards the call connected packet with or without this facility.

4.7.5.1.4 *Clear indication packet handling*

4.7.5.1.4.1 The IWF shall disassociate the HFSNDPX logical channel with the corresponding ISO 8208 DCE logical channel and forward the packet to the ISO 8208 DCE entity.

4.7.5.1.5 *Data, interrupt, interrupt confirmation and reset indication packet handling*

4.7.5.1.5.1 Data, interrupt, interrupt confirmation and reset indication packets shall be forwarded to the appropriate ISO 8208 DCE entity based on the logical channel association established after the completion of a connection establishment.

4.7.5.2 ISO 8208 DCE/IWF interface

4.7.5.2.1 The ISO 8208 packets exchanged between the IWF and the ISO 8208 DCE shall be as defined in Table 4-37.

4.7.5.2.2 *Call request packet handling*

If the call request packet does not contain the expedited data negotiation facility, the IWF shall add this facility with its parameter set to “no use of expedited data” to the packet and shall forward it to the appropriate HFSNDPX entity; otherwise, the IWF shall forward the call request packet with this facility and parameter. If the optional called DTE address is invalid, then the IWF shall return a clear indication packet to the ISO 8208 DCE entity.

4.7.5.2.3 *Call accepted packet handling*

If the call accepted packet does not contain the expedited data negotiation facility, the IWF shall add this facility with its parameter set to “no use of expedited data” to the packet and shall forward it to the appropriate HFSNDPX entity; otherwise, the IWF shall forward the call accepted packet with this facility and parameter. For each virtual call, the IWF shall associate the ISO 8208 DCE logical channel with the corresponding HFSNDPX logical channel.

4.7.5.2.4 *Clear request packet handling*

The IWF shall disassociate the ISO 8208 DCE logical channel with the corresponding HFSNDPX logical channel and forward the packet to the HFSNDPX entity.

4.7.5.2.5 *Data, interrupt, interrupt confirmation and reset request packet handling*

Data, interrupt, interrupt confirmation and reset request packets shall be forwarded to the appropriate HFSNDPX entity based on the logical channel association established after the completion of a connection establishment.

4.7.5.3 IWF/CN interface

The IWF shall forward the connectivity notification event messages to the appropriate ISO 8208 DCE logical channel.

4.7.5.4 ISO 8208 logical channel and HFSNDPX logical channel association

Note.— ISO 8208 DCE logical channel identifier and the HFSNDPX logical channel number of an SNC need not be identical.

4.7.5.5 Data transfer procedures

4.7.5.5.1 *Flow control*

Flow control shall be applied between the HFSNDPX and the ISO 8208 DCE to prevent storage overflow.

4.7.5.6 Cause and diagnostic code

4.7.5.6.1 The IWF shall replace the cause “local procedure error” in ISO 8208 packets received from the DCE, by the cause “remote procedure error” before forwarding them to the HFSNDPX. The IWF shall replace the cause “local link error” in an HFNPDU received from the HFSNDPX by the cause “network congestion” before forwarding them to the DCE. All other causes shall be transferred without modification.

4.7.5.6.2 Diagnostic codes shall be transferred without modification.

4.7.6 Management interface

4.7.6.1 HFDL Aircraft Station Subsystem management interface

4.7.6.1.1 The changes in log-on status conveyed from the HFDL Aircraft Station Subsystem management to the HFSNL shall be as defined in 4.9.2.1.1.

4.7.6.1.2 [When the HFDL Aircraft Station Subsystem either logs-off or otherwise terminates communication with a HFDL Ground Station Subsystem, the HFDL Aircraft Station Subsystem HFSNL shall clear all connections with this HFDL Ground Station Subsystem.]

4.7.6.1.3 *Connectivity notification event*

4.7.6.1.3.1 The CN function shall be performed by the CN entity.

4.7.6.1.3.2 *Log-on to a HFDL Ground Station Subsystem*

When the HFDL Aircraft Station Subsystem logs-on to a HFDL Ground Station Subsystem, the HFDL Aircraft Station Subsystem shall send a join event message to the attached ATN router on the aircraft. This message shall include sufficient information for the attached ATN router to determine the address(es) of the DTE(s) attached to the HFDL Ground Station Subsystem.

Note. — The attached ATN router, on receiving the join event message, will have sufficient information to establish the SVCs.

4.7.6.1.3.3 *Log-off from a HFDL Ground Station Subsystem*

[When the HFDL Aircraft Station Subsystem logs-off from a HFDL Ground Station Subsystem, the CN shall forward to the IWF a leave event message indicating HFDL Aircraft Station Subsystem log-off from the HFDL Ground Station Subsystem.]

4.7.6.2 HFDL Ground Station Subsystem management interface

4.7.6.2.1 The changes in log-on status conveyed from the HFDL Ground Station Subsystem management to the HFSNL shall be as defined in 4.10.3.2.

4.7.6.2.2 When the HFDL Aircraft Station Subsystem logs-off from the HFDL Ground Station Subsystem, the HFSNL shall clear all connections associated with the HFDL Aircraft Station Subsystem, and shall release all resources associated with these SNCs. In addition, the HFDL Ground Station Subsystem shall provide to the attached ATN ground routers a leave event indication referencing the 24-bit ICAO aircraft identifier.