

# HFDL monitoring

HFDL is a HF data link protocol, defined in ARINC spec 635-3.

It may be described as some sort of HF ACARS.

Transmissions on HF are in USB on a sub carrier of 1440 Hz with a symbol speed of 1800 baud.

Modulation is 2-PSK, 4-PSK or 8-PSK with effective bit rates of 300, 600, 1200 or 1800 bits/sec.

The HFDL service is operated by ARINC as **GLOBALink** service through a worldwide network of HF stations.

The PC-HFDL program is a Windows software to decode HF=DL data traffic and has been written by Charles Brain.

Besides the commercial version there is an unsupported free version to **download**.

Just feed the HF receiver speaker's output into the soundcard of a Windows PC running PC-HFDL.

The best monitoring results will be achieved with the following PC-HFDL settings:

PREAM ON - to control the audio frequency offset of the receiver

SPDU OFF - only needed temporarily ON to see the squitters of a new unknown ground station

MPDU ON - see the MPDU packets

LPDU ON - see the LPDUs within the MPDUs

BDU ON - see the BDUs

VERB ON - see more details, like aircraft log-on with their ICAO24 address

HFNPDU ON - see the routine position reports

HEX OFF - only needed for debugging purposes

So in short, with **all options 'ON' except SPDU and HEX**, the complete session can be seen: LOG-ON of the aircraft to the ground station giving its 24bit ICAO-ID, the assignment of the 1byte sequence ID number to the given ICAO-ID by the ground station referenced in all subsequent traffic, clear distinction of MPDU packets containing more than just one LPDU, and full traffic details.

# HF Frequency Table

Table of ground stations and frequencies of the ARINC GLOBALink HF DL service, Version 01D/29, 2006-05 :

Ground Station		Frequencies in kHz																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
01	San Francisco CA, USA	21934	17919	13276	11327	(10081)	8927	6559	5508	4672	(2947)										
02	Molokai, HI, HWA	21937	21928	17934	(17919)	(13324)	(13312)	(13276)	11348	11312	10081	8936	8912	(6565)	6559	(5514)	(5463)	(4687)	(3434)	(3019)	(2947)
03	Reykjavik, ISL	17985	15025	11184	8977	6712	5720	(3900)	(3116)												
04	Riverhead, NY, USA	(21934)	21931	(17952)	17934	(17919)	13276	11387	(11354)	11315	(10027)	8912	(8885)	8831	(6661)	(6652)	6646	(5652)	(5523)	3428	(3410)
05	Auckland, NZL	(21949)	(17916)	13351	(11327)	10084	(8921)	6535	5583	(3404)	(3016)										
06	Hat Yai, THA	21949	17928	13270	10066	8825	6535	(5655)	(4687)	(3470)											
07	Shannon, IRL	11384	10081	8942	(8843)	6532	5547	(3455)	(2998)												
08	Johannesburg, AFS	21949	13321	8834	4681	3016															
09	Barrow, AK, ALS	(21937)	(21928)	(17934)	(17919)	11354	(10093)	(10027)	8936	(8927)	6646	5544	(5538)	(5529)	(4687)	(4654)	(3497)	(3007)	(2992)	(2944)	
13	Santa Cruz, BOL	21997	(21988)	(21973)	(21946)	(17916)	13315	11318	8957	(6628)	(4660)	(3467)	(2983)								
14	Krasnoyarsk, RUS	(21990)	(17912)	13321	10087	(8886)	(6596)	(5622)	(4679)	(2905)	(2878)										
15	Al Muharraq, BHR	21982	17967	13354	11312	10075	8885	5544	(2986)												
16	Agana, GUM	(17934)	17919	13339	(13312)	(13276)	11306	(11288)	(8936)	8927	(8912)	(6661)	(6652)	(6634)	(6550)						
17	Telde, Gran Canaria, CNR	21955	17928	13303	11348	8948	6529	5589	2905												

Frequencies in (brackets): assigned but unknown if active.

The former ground stations 10 (Annapolis, MD), 11 (unknown), 12 (Anchorage, AK) are no longer in service.

## Here is a HFDL traffic example

The following traffic session example has been captured one day in 2003 on 8942 kHz, starting at 1640UTC. It shows parts of the communication between just one aircraft and the ground station. Other traffic of other aircrafts snipped and ignored.

```
[MPDU AIR CRC PASS]
Nr LPDUs = 1 Ground station ID SHANNON - IRELAND SYNCHED
Aircraft ID LOG-ON
Slots Requested medium = 0 Low = 0
Max Bit rate 1200 bps U(R) = 0 UR(R)vect = 0
[LPDU LOG ON DLS REQUEST] ICAO AID 9F0002
[HFNPDU FREQUENCY DATA]
16:38:44 UTC Flight ID = SU0203 LAT 60 18 49 N LON 24 56 52 E
```

Along comes an aircraft with **ICAO-ID 9F0002** (bitreversed in that old version of the PC-HFDL program, is 4000F9 in real life) initiating a LOG-ON to ground station SHANNON (7) and giving a first HFNPDU position data record identifying this aircraft as AEROFLOT flight **SU0203**. [MPDU AIR] indicates that this MPDU packet is from the aircraft to the groundstation.

```
[MPDU GND CRC PASS]
Ground station ID SHANNON - IRELAND SYNCHED
NR AIR CALLS 1
AIR CALL 0 = LOG-ON
LPDUS = 1
Max Bit rate 1200 bps
[LPDU LOG ON CONFIRM] ICAO AID 9F0002 ID 86
TXW = 0 D(R) = 0 D(R)vect = 0
```

The ground station SHANNON (7) accepts the LOG-ON request and assigns a sequence ID number of **86**. This 8bit-number will be the communications ID for all subsequent traffic with this airframe on this frequency. The previous aircraft got 85, and the next aircraft logging on will get sequence number 87. Since it is a 1byte-number counting from 0x01 to 0xFD, there can't be more than 253 aircrafts being served on one channel concurrently. [MPDU GND] indicates that this MPDU packet is from the groundstation to the aircraft.

```
[MPDU AIR CRC PASS]
Nr LPDUs = 1 Ground station ID SHANNON - IRELAND SYNCHED
Aircraft ID 86
Slots Requested medium = 0 Low = 0
Max Bit rate 1800 bps U(R) = 0 UR(R)vect = 0
[LPDU UNNUMBERED ACKED DATA]
[HFNPDU ACARS AID ]
  2.VP-BWA Q00 S84ASU0204 B
```

The aircraft with ID=86 sends an ACARS message, showing its callsign as being **VP-BWA**.

So, if we wouldn't already have looked up the ICAO-ID 4000F9 (bitreversed "9F0002") shown in the first LOG-ON packet, we at least now know for sure what airframe this is: AFL/Aeroflot VP-BWA, Airbus A319-111 2052.

Interestingly, although the first HFNPDU report seen at LOG ON time identified the flight as being SU0203, within this ACARS message it now says it is flight **SU0204**. The ground station obviously does not care at all, it once identified the aircraft according to its unique 24bit ICAO-ID and simply passes on whatever information is contained within the messages, so we don't know yet which of the 2 flight numbers is the correct one.

```
[MPDU GND CRC PASS]
Ground station ID SHANNON - IRELAND SYNCHED
NR AIR CALLS 2
AIR CALL 0 = 86
LPDUS = 1
Max Bit rate 1200 bps
AIR CALL 1 = 87
LPDUS = 1
Max Bit rate 1200 bps
[LPDU UNNUMBERED DATA]
[HFNPDU ACARS GND STN]
  2.VP-BWA4_P 0+
[LPDU UNNUMBERED DATA]
[HFNPDU ACARS GND STN]
  2.VP-BWD1_ B B?
```

More communication follows. This is a MPDU from the ground station addressing 2 aircraft at this time, in the 1st LPDU sending an ACARS message to aircraft ID=86 which again is confirmed from the message content to be VP-BWA, and in the 2nd LPDU sending to another airframe with ID=87 with callsign VP-BWD.

```
[MPDU GND CRC PASS]
Ground station ID SHANNON - IRELAND SYNCHED
NR AIR CALLS 2
AIR CALL 0 = LOG-ON
LPDUS = 1
Max Bit rate 600 bps
AIR CALL 1 = 86
LPDUS = 1
Max Bit rate 1800 bps
[LPDU LOG ON CONFIRM] ICAO AID B60E3C ID 89
TXW = 0 D(R) = 0 D(R)vect = 0
[LPDU UNNUMBERED DATA]
[HFNPDU ACARS GND STN]
  2.VP-BWA8_ T ,7
```

Now sending another MPDU from the ground station addressing 2 aircraft at the same time, in the 1st LPDU confirming a LOG-ON to another airframe with ICAO-ID B60E3C (= 3C706D unreversed) assigning the sequence ID number 89 and in the 2nd LPDU sending an ACARS message to aircraft ID=86 which again is confirmed from the message content to be VP-BWA.

```
[MPDU AIR CRC PASS]
Nr LPDUs = 1 Ground station ID SHANNON - IRELAND SYNCHED
Aircraft ID 86
Slots Requested medium = 0 Low = 0
Max Bit rate 1800 bps U(R) = 0 UR(R)vect = 0
[LPDU UNNUMBERED ACKED DATA]
[HFNPDU ACARS AID ]
  2.VP-BWA QR6 M17ASU0204UUUEEFHK1456 h?
```

Another ACARS message from the aircraft, announcing flight SU0204 from UUEE/Moskva to EFHK/Helsinki with an arrival time of 1456, which seems to be odd and old, as the first LOGON-packet of this session was received at around 1640 UTC.

```
[MPDU AIR CRC PASS]
Nr LPDUs = 1 Ground station ID SHANNON - IRELAND SYNCHED
Aircraft ID 86
Slots Requested medium = 0 Low = 0
Max Bit rate 1800 bps U(R) = 0 UR(R)vect = 0
[LPDU UNNUMBERED ACKED DATA]
[HFNPDU ACARS AID ]
 2.VP-BWA QP8 M19ASU0204EFHKUUEE1629 238      Sk
```

Someone on board apparently has corrected some input data in the ACARS box: while still propagating a flight number of SU0204, the flight now has "turned around" to be from EFHK/Helsinki to UUEE/Moskva, with a time of 1629 now (take off time?). So obviously a previous flight was SU0203 UUEE->EFHK a few hours ago and this now actually seems to be the return flight SU0204 EFHK->UUEE

```
[MPDU AIR CRC PASS]
Nr LPDUs = 1 Ground station ID SHANNON - IRELAND SYNCHED
Aircraft ID 86
Slots Requested medium = 0 Low = 0
Max Bit rate 1200 bps U(R) = 0 UR(R)vect = 0
[LPDU UNNUMBERED DATA]
[HFNPDU PERFORMANCE]
16:38:40 UTC Flight ID = SU0203 LAT 60 18 56 N LON 24 57 8 E
```

However, the HFDL box still sends old data: another HFNPDU for old flight number SU0203 with an old time stamp and old position data.

```
[MPDU AIR CRC PASS]
Nr LPDUs = 1 Ground station ID SHANNON - IRELAND SYNCHED
Aircraft ID 86
Slots Requested medium = 0 Low = 0
Max Bit rate 1200 bps U(R) = 0 UR(R)vect = 0
[LPDU UNNUMBERED DATA]
[HFNPDU PERFORMANCE]
17:06:32 UTC Flight ID = SU0204 LAT 59 38 4 N LON 30 49 10 E
```

Ah, someone on board now has also fixed the data in the HFDL box: a new actual HFNPDU for "new" flight number SU0204 with an updated time stamp and recent position (the aircraft made a "jump" of 6 degrees to the east since 1638 UTC).

```
[MPDU AIR CRC PASS]
Nr LPDUs = 1 Ground station ID SHANNON - IRELAND SYNCHED
Aircraft ID 86
Slots Requested medium = 0 Low = 0
Max Bit rate 1800 bps U(R) = 0 UR(R) vect = 0
[LPDU UNNUMBERED ACKED DATA]
[HFNPDU ACARS AID SU0204]
2.VP-BWA 132 M22ASU0204CONN GATE REQ /AIR ID SU,/DEST UUEE,/ETA 1801
```

Another ACARS message from the aircraft. This flight now indeed seems to be heading to UUEE/Moskva, giving a new arrival time of 1801 UTC now.

A lot can be seen from this session example:

The LOG-ON sequence can be studied in detail.

And we now know, that there is no absolute truth in the transmitted data -- the quality of the data depends on the operating situation.

The HFDL ground station does not care about the content of the messages.

The ACARS and HFDL boxes on board may be tied together to exchange messages, however the flight ID data of these boxes are to be set independently.

#### **Abbreviations:**

BDU - Basic Data Unit

HFNPDU - High Frequency Network Protocol Data Unit

LPDU - Link Protocol Data Unit

MPDU - Media access Protocol Data Unit

SPDU - Squitter Protocol Data Unit

#### **More information:**

A short article about the [ICAO 24 bit aircraft addresses](#) and their use in PC-HFDL.

A list of [aircraft on HFDL](#).

A list of [ICAO 24 bit address allocations](#) to states.

An interactive online service to [convert an ICAO 24 bit address](#) between binary - octal - hex, bit-reverse it and look it up in the list of aircraft.

Document URL : <http://www.kloth.net/radio/hfdl-monitoring.php>

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