HFDL

High Frequency Data Link

a.k.a. HF ACARS

What Is HFDL?

ARINC describes the system as follows: *"High Frequency Data Link (HFDL) is an ACARS communications medium used to exchange data such as Airline Operational Control (AOC) messages, Controller-Pilot Data Link Communication (CPDLC) messages and Automatic Dependent Surveillance (ADS) messages between aircraft end systems and corresponding ground-based HFDL ground stations. Using the unique propagation characteristics of high-frequency radio waves, the ground stations provide data link communications to properly equipped aircraft operating anywhere in the world. The result: pilots can always communicate with someone on the ground."*

HFDL is the HF part of the global air-ground communication system. ACARS (Aircraft Communications Addressing and Reporting System) is another well known part of the system that usually is associated with VHF. But ACARS messages are also sent via HFDL and Inmarsat satellites. VDL2 (VHF Digital Link 2) is a newer part of this system.

ARINC operates HFDL as GLOBALink through a network of stations around the globe. The system is specified in document ARINC 635. The service is known as HFDL (HF Data Link), GLOBALink, and HF ACARS.

HF Data Link is the connection between an aircraft and a ground station and/or two aircraft. 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.

HFDL is used for weather information and to send maintenance info. The pilot can receive METAR (Meteorological Aerodrome Reports) , TAF (Terminal Aerodrome Forecast), SIGMET (SIGnificant METeorological) and ATIS (Automatic Terminal Information Service) over ACARS and print the reports on the cockpit printer. Aircraft system status and engine data can be sent to be sent to the company's maintenance staff; and the pilot can send free text messages to ground stations or aircraft.

For more detailed (technical) information about HFDL we advise to read Airbus publication "Getting to grips with datalink" and ICAO publication "Draft Manual on HF Data Link".

http://www.cockpitseeker.com/wp-content/uploads/goodies/ac/a320/pdf/data/datalink.pdf

https://www.icao.int/safety/acp/inactive%20working%20groups%20library/amcp%205/item-1d.pdf

Decoding:
HFDL uses phase shift keying (PSK) at data rates of 300, 600, 1200 and 1800 bps. The rate used is dependent on the prevailing propagation conditions. HFDL is based on frequency division multiplexing (FDM) for access to ground station frequencies and time division multiplexing (TDM) within individual communication channels.

Each ground station transmits a frame called a "squitter" every 32 seconds. The squitter frame informs aircraft of the system status, provides a timing reference and provides protocol control. Each ground station has a time offset for its squitters. This allows aircraft to jump between ground stations finding the best one before logging on. When passing traffic, dedicated TDM time slots are used. This prevents two aircraft transmitting at the same time causing data collisions.

Most decoders show the following items. They can often be switched on and off.
PREAM   Preamble information
SPDU   Squitter Protocol Data Units
MPDU   Media Access Protocol Data Units
LPDU   Link Protocol Data Units
BDU   Basic Data Units (Segmented messages fragments)
HFNPDU   Network Data Units, this is probably the most interesting one
HEX   Displays received packets in Hexadecimal (Base 16) notation

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Decoders:
Many decoders can be used to decode HFDL, including PC-HFDL, HOKA Code-3000 and other versions, various Wavecom decoders, Sorcerer, Multi-PSK, Go2monitor, Go2decode, Krypto, and Sigmira.

Stations and frequencies:
In 2019 the network consists of the following stations.
San Francisco, CA, USA
Molokai, HWA, USA
Reykjavik, Iceland
Riverhead, New York, USA
Auckland, New Zealand
Hat Yai, Thailand
Shannon, Ireland
Johannesburg, South Africa
Barrow, Alaska, USA
Muan, South Korea
Albrook, Panama
Santa Cruz, Bolivia
Krasnoyarsk, Russia
Al Muharraq, Bahrain
Agana, Guam
Canarias, Spain

All stations are using a number of frequencies. The frequencies change every now and then. You can see the current stations and frequencies in the system table that is transmitted by the stations. The latest version of the table for the PC-HFDL decoder can be found on the UDXF website http://udxf.nl/modes.html

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Sample messages:

[HFNPDU PERFORMANCE]
17:17:48 UTC Flight ID = MAS3   LAT 34 56 1 N LON 64 13 13 E

[HF GROUND STATION CHANGE -> AL MUHARRAQ - BAHRAIN]

[HFNPDU PERFORMANCE]
17:17:54 UTC Flight ID = FDX39   LAT 50 7 33 N LON 59 13 7 E

HACARS mode: 2 Aircraft reg: .VT-IEK
Message label: SA Block id: 0 Msg. no: S74A Flight id: 6E0328
Message content:-
0EH171641VH
---[15/08/2013 17:18]
[HFNPDU ACARS FM AIR 6E0328 TO GND]
<SOH>2.VT-IEK<NAK>SA0<STX>S74A6E03280EH171641VH<ETX>`g<NUL>

HACARS mode: 2 Aircraft reg: .VH-OQH
Message label: _• Block id: O [Uplink]

---[15/08/2013 17:18]
[HFNPDU ACARS FM GND TO AIR F8]
<SOH>2.VH-OQH8_<DEL>O<ETX>oq<NUL>
HACARS mode: 2 Aircraft reg: .VT-INQ
Message label: _• Block id: N [Uplink]

---[15/08/2013 17:18]
[HFNPDU ACARS FM GND TO AIR 10]
<SOH>2.VT-INQ0_<DEL>N<ETX>oH<NUL>
HACARS mode: 2 Aircraft reg: .F-HPJC
Message label: _• Block id: G [Uplink]

---[15/08/2013 17:18]
[HFNPDU ACARS FM GND TO AIR 1F]
<SOH>2.F-HPJC1_<DEL>G<ETX>
I<NUL>

[HFNPDU PERFORMANCE]
17:18:06 UTC Flight ID = UAE5   LAT 45 52 55 N LON 24 46 49 E

[HFNPDU PERFORMANCE]
17:18:14 UTC Flight ID = UAE720 LAT 19 12 9 N LON 52 12 23 E

HACARS mode: 2 Aircraft reg: .VT-IGX
Message label: 5U Block id: 8 Msg. no: M40A Flight id: 6E0106
Message content:-
01 WXRQ 0106/15 VOBL/VIDP .VT-IGX /TYP 1/STA VIDP/STA   /STA
---[15/08/2013 17:18]

[HFNPDU ACARS FM AIR 6E0106 TO GND]
<SOH>2.VT-IGX<NAK>5U8<STX>M40A6E0106 01 WXRQ   0106/15 VOBL/VIDP .VT-IGX
/TYP 1/STA VIDP/STA   /STA   <ETX>H<ACK><NUL>

HACARS mode: 2 Aircraft reg: .VT-INQ
Message label: 80 Block id: 1 Msg. no: M39A Flight id: 6E0103
Message content:-
3G01 INIT   0104/15 VOBL/VAPO .VT-INQ/001
---[15/08/2013 17:18]
[HFNPDU ACARS FM AIR 6E0103 TO GND]
<SOH>2.VT-INQ<NAK>801<STX>M39A6E01033G01 INIT   0104/15 VOBL/VAPO .VT-INQ/001   <ETX>Up<NUL>

HACARS mode: 2 Aircraft reg: .VT-IFR
Message label: Q0 Block id: 8 Msg. no: S89A Flight id: 6E0217

---[15/08/2013 17:18]
[HFNPDU ACARS FM AIR 6E0217 TO GND]
<SOH>2.VT-IFR<NAK>Q08<STX>S89A6E0217<ETX>Wa<NUL>

HACARS mode: 2 Aircraft reg: .SU-GCH
Message label: Q0 Block id: 4 Msg. no: S54A Flight id: MS0678

---[15/08/2013 17:18]
[HFNPDU ACARS FM AIR MS0678 TO GND]
<SOH>2.SU-GCH<NAK>Q04<STX>S54AMS0678<ETX>&o<NUL>

[HFNPDU PERFORMANCE]
17:18:50 UTC Flight ID = SIA317 LAT 33 29 25 N LON 68 25 32 E

[HFNPDU PERFORMANCE]
17:18:48 UTC Flight ID = SU1423 LAT 180 0 0 N LON 180 0 0 E

[HFNPDU PERFORMANCE]
17:18:58 UTC Flight ID = IGO198 LAT 21 34 13 N LON 73 7 40 E

HACARS mode: 2 Aircraft reg: .A6-ERD
Message label: H1 Block id: 8 Msg. no: F41A Flight id: EK0720
Message content:-
#M1BPOSN18595E052012,DUDRI,171653,330,TOKRA,175011,MUSAP,M35,09422,386/TS171653,08151385EE

---[15/08/2013 17:19]
[HFNPDU ACARS FM AIR UAE720 TO GND]
<SOH>2.A6-
ERD<NAK>H18<STX>F41AEK0720#M1BPOSN18595E052012,DUDRI,171653,330,TOKRA,175011,MUSAP,M35,09422,
386/TS171653,08151385EE<ETX><SUB>W<NUL>

HACARS mode: 2 Aircraft reg: .VT-IGX
Message label: RA Block id: J [Uplink]
Message content:-
QUDELOZ6E~1WX UPLINK~ - WX RESPONSE VIDP 151700Z 13005KT 2100 BR SCT030 BKN100 26/25 Q1004 NOSIG=
_ END

Sources / further information:

- ARINC   www.arinc.com
- Worldwide Utility News club (WUN) archive
- Utility DXers Forum (UDXF)   www.udxf.nl
- Wikipedia
- PC-ALE manual
- AMCP/5-DP/1 Manual on the implementation of HFDL
  http://legacy.icao.int/anb/panels/acp/meetings/amcp5/item-1e.pdf