ForeFlight - GDL 90 Extended Specification

ForeFlight's extension of the GDL 90 protocol provides more inflight connectivity for third-party devices.

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Connectivity

ForeFlight expects data sent using UDP to port 4000 on the iOS device. Implementers are strongly advised to use UDP unicast to avoid significant packet loss, as iOS applications such as ForeFlight cannot reliably receive UDP broadcast messages, but perform much better with UDP unicast. See ForeFlight Broadcast below to learn how to discover ForeFlight's IP address to set as a UDP unicast target.

iOS has an MTU of 1500 bytes. It is strongly recommended to avoid fragmentation and to keep all packets (including headers) smaller than 1500 bytes.

ForeFlight determines that a device is connected if data is regularly received. Devices should regularly send either or both of the Heartbeat or Ownship Report messages to ensure that the device is consistently reported as Connected.

ForeFlight Broadcast

ForeFlight broadcasts a UDP message on port 63093 every 5 seconds when ForeFlight is running in the foreground. This message allows implementers to discover ForeFlight's IP address, which can be used as the target of UDP unicast messages. This is especially helpful when the implementer and the iOS device are on a shared infrastructure Wi-Fi network; otherwise, the implementer cannot identify connected clients' IP addresses.

This broadcast will be a JSON message, with at least these fields:

```
{

   "App":"ForeFlight",

   "GDL90":{

      "port":4000

   }

}
```

The GDL90 "port" field is currently 4000, but ForeFlight reserves the right to change this port number in the future as advanced configuration on networks where there are collisions on port 4000.

Implementors in certified avionics (or otherwise difficult-to-update software installations) are advised to consider allowing ForeFlight's broadcast port (port 63093) to be

modified via advanced configuration as well, in case of port collisions on certain networks.

Messages

The ForeFlight GDL90 Extension protocol defines messages based on the GDL90 protocol. Section 2.2 of the GDL90 specification describes the message structure and Section 3 outlines a set of standard messages. ForeFlight supports a subset of the standard messages and also extends the protocol with a pair of custom messages containing device ID and AHRS information.

Heartbeat Message

See GDL90 specification §3.1 for complete details. Only GPS validity bit is checked at this time.

Byte #	Name	Size	Value
1	Message ID	1	0_{10} = Heartbeat
2	Status Byte 1 Bit 7: GPS Pos Valid	1	1 = Position is available for ADS-B Tx Other bits are ignored
3	Status Byte 2	1	All bits ignored
4-5	Time Stamp	2	Ignored
6-7	Message Counts	2	Ignored

UAT Uplink

See GDL90 specification §3.3 for complete details.

Byte #	Name	Size	Value
1	Message ID	1	7_{10} = Uplink Data

Byte #	Name	Size	Value
2-4	Time of Reception	3	24-bit binary fraction Resolution = 80 nsec
5-436	Uplink Payload	432	UAT Uplink Packet. See §3.3.2 for details

Ownship Report

See GDL90 specification §3.4 for complete details. The position information in this message is used by ForeFlight to determine current position.

Byte #	Name	Size	Value
1	Message ID	1	10_{10} = Ownship Report
2-28	Ownship Report	27	Defined in §3.5.1

Notes:
Accuracy information is encoded by setting the NACp value.
Altitude is defined as ownship pressure altitude (referenced to 29.92 inches Hg). For unpressurized aircraft a barometer in the cabin is close enough for practical purposes, but in pressurized aircraft, care must be taken to set this field to 0xFFF (Invalid or Unavailable) if the device does not have access to outside pressure. Setting ownship pressure altitude incorrectly will result in incorrect calculation of relative traffic altitude.

Ownship Geometric Altitude

See GDL90 specification §3.8 for complete details. Note that the altitude may be interpreted as either relative to

the WGS-84 ellipsoid as spec'ed, or to the WGS-84 geoid (MSL). The ID message described below defines how this altitude will be interpreted.

Byte #	Name	Size	Value
1	Message ID	1	11_{10} = Ownship Geo Alt
2-3	Ownship Geo Altitude	2	Signed altitude in 5ft resolution. Byte 2 is the Most Significant Byte Altitude is interpreted as relative to the WGS84 ellipsoid unless Bit 0 of the ID Message Capabilities Mask is set, in which case it's treated as MSL.
4-5	Vertical Metrics	2	Vertical Warning Indicator (MSB of Byte 4) Vertical Figure of Merit (remaining 15 bits). 0x7FFF indicates VFOM not available 0x7EEE indicates VFOM is > 32766 meters Byte 4 is the most significant byte.

Traffic Report

See GDL90 specification §3.5 for complete details.

Byte #	Name	Size	Value
1	Message ID	1	20_{10} = Traffic Report
2-28	Traffic Report	27	Defined in §3.5.1

ID Message

For multibyte fields, the most significant byte should be sent first (Big Endian).

Byte #	Name	Size	Value
1	ForeFlight Message ID	1	0x65
2	ForeFlight Message sub-ID	1	0
3	Version	1	Must be 1
4-11	Device serial number	8	0xFFFFFFFFFFFFFFFF for invalid
12-19	Device name	8	8B UTF8 string.
20-35	Device long name	16	16B UTF8 string. Can be the same as Device name. Used when there is sufficient space for a longer string.
36-39	Capabilities mask	4	Bit 0 (LSB): Geometric altitude datum used in the GDL90 Ownship Geometric Altitudes message • 0: WGS-84 ellipsoid (as the GDL90 spec states) • 1: MSL Bits 1,2 (LSB): Internet Policy - how ForeFlight will access the

Byte #	Name	Size	Value
			internet while connected to a Wireless Device. • 0: Unrestricted • 1: Expensive (reduced bandwidth usage) • 2: Disallowed (will not attempt to access the internet) Bits 3-31: Reserved. Should be all 0's.

AHRS Message

For multibyte fields, the most significant byte should be sent first (Big Endian).
The AHRS message should be sent at 5Hz.

Byte #	Name	Size	Value
1	ForeFlight Message ID	1	0x65
2	AHRS Sub-Message D	1	0x01
3-4	Roll	2	Roll in units of 1/10 degree 0x7fff for invalid. Positive values indicate right wing down, negative values indicate right wing up. The message will be rejected if roll is outside of the

Byte #	Name	Size	Value
			range [-1800, 1800]
5-6	Pitch	2	Pitch in units of 1/10 degree 0x7fff for invalid. Positive values indicate nose up, negative values indicate nose down. The message will be rejected if pitch is outside of the range [-1800, 1800]
7-8	Heading	2	Most significant bit (bit 15) 0: True Heading 1: Magnetic Heading Bits 14-0: Heading in units of 1/10 degree Track should NOT be used here. 0xffff for invalid. The message will be rejected if heading is outside of the range [-3600,3600]
9-10	Indicated Airspeed	2	Value in Knots 0xffff for invalid.
11-12	True Airspeed	2	Value in Knots 0xffff for invalid.