SwiftNav Binary Protocol

Protocol Specification v1.0

1 Message Structure

The Swift Binary Protocol is a fast, simple and minimal binary protocol for sending payloads to, from and between Swift-Nav devices. It is primarily used to send the binary representation of C structs with minimal overhead across serial links.

As of Version 1.0, the message consists of a 6 byte binary header section, a variable-sized payload field, and a 2 byte binary CRC value. SBP uses the CCITT CRC16 (XMODEM implementation) for error detection. It has no error correction and makes no delivery guarantees.

Name	Size	Description
`Preamble`	1	Denotes the start of frame transmission. Always 0x55.
`Message Type`	2	Identifies the payload contents.
`Sender`	2	A unique identifier of the sending hardware. Set to the 2 least significant bytes of the Piksi serial number.
`Length`	1	Length in bytes of the `Payload` field.
`Payload`	N	Binary data of the message.
`CRC`	2	Cyclic Redundancy Check of the packet's binary data from the Message Type up to the end of Payload (does not include the Preamble).
	$N+8$	

Table 1.0.1: Swift Binary Protocol message structure

2 Message Types

Messages are grouped into logical collections of packages.

Package	Message	Name	Size	Description
Acquisition	0x0015	MSG_ACQ_RESULT	13	
Observation	0x0045	MSG_OBS	$13N + 20$	MSG_OBS
	0x0044	MSG_BASE_POS	24	MSG_BASE_POS
Piksi	0x0010	MSG_PRINT	0	
	0x0018	MSG_UART_STATE	58	
Standard	0xFF00	MSG_STARTUP	4	System start-up message
	0xFFFF	MSG_HEARTBEAT	4	System heartbeat message
Tracking	0x0016	MSG_TRACKING_STATE	$6N + 6$	
	0x001A	MSG_EPHEMERIS	175	WGS84 satellite orbit ephemeris parameters

Table 2.0.2: Summary of message types

3 MSG_ACQ_RESULT 0x0015

Results of an attempted GPS signal acquisition. Contains the parameters of the point in the acquisition search space with the best signal-to-noise ratio.

Offset	Size	Format	Units	Name	Description
0	4	float		`snr`	SNR of best point.
4	4	float	chips	`cp`	Code phase.
8	4	float	hz	`cf`	Carrier frequency.
12	1	u8		`prn`	PRN identifier of the satellite signal for which acquisition was attempted.
	13				

Table 3.0.3: MSG_ACQ_RESULT 0x0015 message structure

4 MSG_OBS 0x0045

Offset	Size	Format	Units	Name	Description
0	4	u32	ms	`header.t.tow`	Milliseconds since start of GPS week
4	2	u16	week	`header.t.wn`	GPS week number
6	1	u8		`header.n_obs`	Total number of observations. First nibble is the size of the sequence (n), second nibble is the zero-indexed counter (ith packet of n)
$13N + 7$	4	u32	cm	`obs[N].P`	Pseudorange observation.
$13N + 11$	4	s32	cycles	`obs[N].L.i`	Carrier phase whole cycles.
$13N + 15$	1	u8	cycles / 255	`obs[N].L.f`	Carrier phase fractional part.
$13N + 16$	1	u8	dB Hz	`obs[N].cn0`	Carrier-to-Noise density
$13N + 17$	2	u16		`obs[N].lock`	Lock indicator. This value changes whenever a satellite signal has lost and regained lock, indicating that the carrier phase ambiguity may have changed. There is no significance to the value of the lock indicator.
$13N + 19$	1	u8		`obs[N].prn`	PRN identifier of the satellite signal
	$13N + 20$				

Table 4.0.4: MSG_OBS 0x0045 message structure

5 MSG_BASE_POS 0x0044

Offset	Size	Format	Units	Name	Description
0	8	double	deg	`lat`	Latitude
8	8	double	deg	`lon`	Longitude
16	8	double	m	`height`	Height
	24				

Table 5.0.5: MSG_BASE_POS 0x0044 message structure

6 MSG_PRINT 0x0010

Information and debugging information.

Offset	Size	Format	Units	Name	Description
	0				

Table 6.0.6: MSG_PRINT 0x0010 message structure

7 MSG_UART_STATE 0x0018

State of the UART channels.

Offset	Size	Format	Units	Name	Description
0	4	float	kB/s	uart_a.tx_throughput	UART transmit throughput.
4	4	float	kB/s	uart_a.rx_throughput	UART receive throughput.
8	2	u16		uart_a.crc_error_count	UART CRC error count.
10	2	u16		uart_a.io_error_count	UART IO error count.
12	1	u8	Utilization % /255	uart_a.tx_buffer_level	UART transmit usage percentage.
13	1	u8	Utilization % /255	uart_a.rx_buffer_level	UART receive usage percentage.
14	4	float	kB/s	uart_b.tx_throughput	UART transmit throughput.
18	4	float	kB/s	uart_b.rx_throughput	UART receive throughput.
22	2	u16		uart_b.crc_error_count	UART CRC error count.
24	2	u16		uart_b.io_error_count	UART IO error count.
26	1	u8	Utilization % /255	uart_b.tx_buffer_level	UART transmit usage percentage.
27	1	u8	Utilization % /255	uart_b.rx_buffer_level	UART receive usage percentage.
28	4	float	kB/s	uart_ftdi.tx_throughput	UART transmit throughput.
32	4	float	kB/s	uart_ftdi.rx_throughput	UART receive throughput.
36	2	u16		uart_ftdi.crc_error_count	UART CRC error count.
38	2	u16		uart_ftdi.io_error_count	UART IO error count.
40	1	u8	Utilization % /255	uart_ftdi.tx_buffer_level	UART transmit usage percentage.
41	1	u8	Utilization % /255	uart_ftdi.rx_buffer_level	UART receive usage percentage.
42	4	s32	ms	latency.avg	Average latency.
46	4	s32	ms	latency.lmin	Minimum latency.
50	4	s32	ms	latency.lmax	Maximum latency.
54	4	s32	ms	latency.current	Smoothed estimate of the current latency.
	58				

Table 7.0.7: MSG_UART_STATE 0x0018 message structure

8 MSG_STARTUP 0xFF00

The system start-up message is sent once on system start-up. It is intended to be used to notify the host or other attached devices that the system has started and is now ready to respond to commands or configuration requests.

Offset	Size	Format	Units	Name	Description
0	4	u32		`reserved`	Reserved
	4				

Table 8.0.8: MSG_STARTUP 0xFF00 message structure

9 MSG_HEARTBEAT 0xFFFF

The heartbeat message is sent periodically to inform the host or other attached devices that the system is running. It is intended to be used to monitor for system malfunctions and also contains status flags that indicate to the host the status of the system and if it is operating correctly.

The system error flag is used to indicate that an error has occurred in the system. To determine the source of the error the remaining error flags should be inspected.

Offset	Size	Format	Units	Name	Description
0	4	u32		`flags`	Status flags
	4				

Table 9.0.9: MSG_HEARTBEAT 0xFFFF message structure

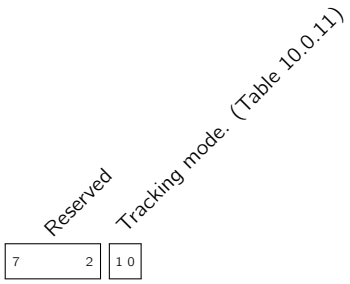
Field 9.0.1: Status flags (`flags`)

10 MSG_TRACKING_STATE 0x0016

Tracking channel states

Offset	Size	Format	Units	Name	Description
$6N+0$	1	u8		`states[N].state`	Status of tracking channel.
$6N+1$	1	u8		`states[N].prn`	PRN being tracked.
$6N+2$	4	float	dB Hz	`states[N].cn0`	Carrier-to-noise density
	$6N+6$				

Table 10.0.10: MSG_TRACKING_STATE 0x0016 message structure



Field 10.0.2: Status of tracking channel. (`state`)

Value	Description
0	Disabled

Table 10.0.11: Tracking mode. values (`state[0:1]`)

11 MSG_EPHEMERIS 0x001A

WGS84 satellite orbit ephemeris parameters

Offset	Size	Format	Units	Name	Description
0	8	double	s	tgd	Group delay differential between L1 and L2 (?)
8	8	double	m	crs	Amplitude of the sine harmonic correction term to the orbit radius
16	8	double	m	crc	Amplitude of the cosine harmonic correction term to the orbit radius
24	8	double	rad	cuc	Amplitude of the cosine harmonic correction term to the argument of latitude
32	8	double	rad	cus	Amplitude of the sine harmonic correction term to the argument of latitude
40	8	double	rad	cic	Amplitude of the cosine harmonic correction term to the angle of inclination
48	8	double	rad	cis	Amplitude of the sine harmonic correction term to the angle of inclination
56	8	double	rad/s	dn	Mean motion difference
64	8	double	radians	m0	Mean anomaly at reference time
72	8	double		ecc	Eccentricity of satellite orbit
80	8	double	m^(1/2)	sqrta	Square root of the semi-major axis of orbit
88	8	double	rad	omega0	Longitude of ascending node of orbit plane at weekly epoch
96	8	double	rad/s	omegadot	Rate of right ascension
104	8	double	rad	w	Argument of perigee
112	8	double	rad	inc	Inclination
120	8	double	rad/s	inc_dot	Inclination first derivative
128	8	double	s	af0	Polynomial clock correction coefficient (clock bias)
136	8	double	s/s	af1	Polynomial clock correction coefficient (clock drift)
144	8	double	s/s^2	af2	Polynomial clock correction coefficient (rate of clock drift)
152	8	double	s	toe_tow	Time of week
160	2	u16	week	toe_wn	Week number
162	8	double	s	toc_tow	Clock reference time of week
170	2	u16	week	toc_wn	Clock reference week number
172	1	u8		valid	Is valid?
173	1	u8		healthy	Satellite is healthy?
174	1	u8		prn	PRN being tracked
	175				

Table 11.0.12: MSG_EPHEMERIS 0x001A message structure