3. Protocols of communication via UART

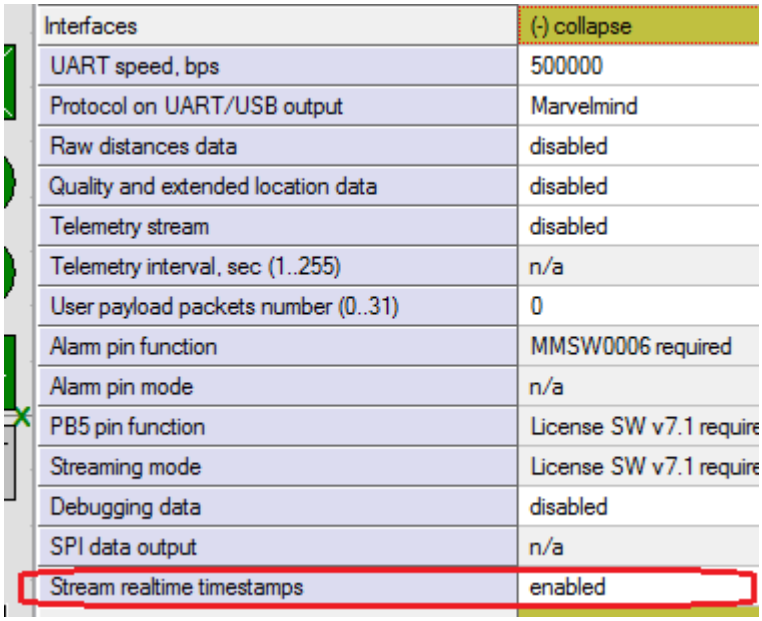
3.1 ‘Marvelmind’ protocol for streaming

All streaming packets have same general structure:

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Destination address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	See detail
4	1	uint8_t	Number of bytes of data transmitting	N
5	N	N bytes	Payload data according to code of data field	
5+N	2	uint16_t	CRC-16 (see appendix 1)	

Starting from software version v7.200 real-time timestamps are enabled by default. This means that packets 0x0081, 0x0083, 0x0084, 0x0085 are streamed out instead of packets 0x0011, 0x0003, 0x0004, 0x0005 correspondingly.

If you need an old streaming format with local timestamps for compatibility with older software, you can disable this option in the device settings in the dashboard:



3.1.1 Packet of hedgehog coordinates

This packet is transmitted every time new coordinates are measured or failed to measure.

3.1.1.1 Packet with mm resolution coordinates of mobile beacon and real-time timestamps (firmware V7.200+)

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported
Super-Modem:	supported
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

Please see the note about timestamps.

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Destination address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0081
4	1	uint8_t	Number of bytes of data transmitting	N
5	8	int64_t	Timestamp – Unix time - number of milliseconds from 1970.01.01 00:00:00. Time, synchronized by all devices with modem and dashboard.	
13	4	int32_t	Coordinate X of beacon, mm	
17	4	int32_t	Coordinate Y of beacon, mm	
21	4	int32_t	Coordinate Z, height of beacon, mm	
25	1	uint8_t	Byte of flags: Bit 0: 1 - coordinates unavailable. Data from fields X,Y,Z should not be used. Bit 1: timestamp units indicator (see note) Bit 2: 1 - user button is pushed (V5.23+) Bit 3: 1 - data are available for uploading to user device, see section 2 (V5.34+) Bit 4: 1 - want to download data from user device, see section 2 (V5.34+) Bit 5: 1 – second user button is pushed (V5.74+) Bit 6: 1 – data for another hedgehog (not same one that sending this packet) Bit 7: – 1 – out of geofencing zone	
26	1	uint8_t	Address of hedgehog	
27	2	uint16_t	Bit 0…11: orientation of hedgehogs pair in XY plane, decidegrees (0…3600) Bit 12: 1 – coordinates are given for center of beacons pair; 0 – coordinates for specified hedgehog Bit 13: 1 - orientation is not applicable Bit 14: 1 – no location data from slave mobile beacon. orientation can drift up to 1 degree / sec Bit 15: reserved (0)	

29	2	uint16_t	Time passed from ultrasound emission to current time, milliseconds (V5.88+)	
31	M=N-26		Optional data – see the list	
31+M	2	uint16_t	CRC-16 (see appendix 1)	

Optional data in mobile beacon location packet can include following structures:

- Speed data (7 bytes). Should be enabled in interfaces section of mobile beacon settings in the dashboard

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Code of data field = 1 means a vector of speed	**1**
1	2	int16_t	Speed along X, mm/sec	
3	2	int16_t	Speed along Y, mm/sec	
5	2	int16_t	Speed along Z, mm/sec	

3.1.1.2 Packet with cm resolution coordinates of mobile beacon

Obsolete packet, replaced by 0x0081. See details for the obsolete packet here.

3.1.1.3 Packet with mm resolution coordinates of mobile beacon

Obsolete packet, replaced by 0x0081. See details for the obsolete packet here.

3.1.2 Packet of stationary beacon's coordinates

This packet is transmitted when the map is frozen, and repeats every 10 sec.

3.1.2.1 Packet with mm resolution coordinates of stationary beacons, code of data 0x0012 (firmware V5.35+)

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported
Super-Modem:	supported
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0012
4	1	uint8_t	Number of bytes of data transmitting	1+N*14
5	1	uint8_t	Number of beacons in packet	N
6	1	N*14 bytes	Data for N beacons	
6+N*14	2	uint16_t	CRC-16 (see appendix 1)	

Format of data structure for every of N beacons:

Offset	Size (bytes)	Type	Description
0	1	uint8_t	Address of beacon
1	4	int32_t	Coordinate X of beacon, mm
5	4	int32_t	Coordinate Y of beacon, mm
9	4	int32_t	Coordinate Z, height of beacon, mm
13	1	uint8_t	Bit 0: 1 = location not applicable Bit 1…7: reserved

3.1.2.2 Packet with cm resolution coordinates of stationary beacons, code of data 0x0002.

Obsolete packet, replaced by 0x0012. See details for the obsolete packet here.

3.1.3 Packet of raw inertial sensors data

This packet is transmitted when new inertial sensors data available.

3.1.3.1 Packet of raw inertial sensors data with real-time timestamps, code of data 0x0083 (firmware V7.200+)

This packet is transmitted when new inertial sensors data available.

Supported hardware:

Super-Beacon:	supported, 100 Hz (if 'Raw inertial sensors data' enabled)
Industrial Super-Beacon:	supported, 100 Hz (if 'Raw inertial sensors data' enabled)
Modem HW5.1:	supported, system update rate (if 'IMU via modem' enabled)
Super-Modem:	supported, system update rate (if 'IMU via modem' enabled)
Mini-RX (Badge, Helmet, etc.):	supported, 100 Hz (if 'Raw inertial sensors data' enabled) with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported, 100 Hz (if 'Raw inertial sensors data' enabled)
Modem HW4.9:	supported, system update rate (if 'IMU via modem' enabled)
Beacon HW4.9:	supported, 100 Hz (if 'Raw inertial sensors data' enabled)
Beacon HW4.5:	supported, 100 Hz (if 'Raw inertial sensors data' enabled)

Please see the note about timestamps.

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0083
4	1	uint8_t	Number of bytes of data transmitting	
5	36		Data packet (see lower)	
41	2	uint16_t	CRC-16 (see appendix 1)	

Format of data packet

Offset	Size (bytes)	Type	Description	Value
0	2	int16_t	Accelerometer, X axis, 1 mg/LSB	
2	2	int16_t	Accelerometer, Y axis, 1 mg/LSB	
4	2	int16_t	Accelerometer, Z axis, 1 mg/LSB	
6	2	int16_t	Gyroscope, X axis, 0.0175 dps/LSB	
8	2	int16_t	Gyroscope, Y axis, 0.0175 dps/LSB	
10	2	int16_t	Gyroscope, Z axis, 0.0175 dps/LSB	
12	2	int16_t	Compass, X axis, 1100 LSB/Gauss	
14	2	int16_t	Compass, Y axis, 1100 LSB/Gauss	
16	2	int16_t	Compass, Z axis, 980 LSB/Gauss	
18	1	uint8_t	Address of beacon	
19	5	5 bytes	Reserved (0)	
24	8	int64_t	Timestamp – Unix time - number of milliseconds from 1970.01.01 00:00:00. Time, synchronized by all devices with modem and dashboard.	
32	1	uint8_t	Flags: Bit 0: 1 = accelerometer data n/a Bit 1: 1 = Gyroscope data n/a Bit 2: 1 = Compass data n/a	

			Bit 3…7 – reserved (0)	
33	3	3 bytes	reserved	

Note: Compass data are available only for HW v4.9 beacons with IMU.

3.1.3.2 Packet of raw inertial sensors data, code of data 0x0003

Obsolete packet, replaced by 0x0083. See details for the obsolete packet here.

3.1.4 Packet of raw distances data

3.1.4.1 Packet of raw distances data with real-time timestamps, code of data 0x0084 (firmware V7.200+)

This packet is transmitted every time new coordinates are measured or failed to measure, after the packet with coordinates of mobile beacon.

Available only if “raw distances data” option is enabled in ‘Interfaces’ section of settings.

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported
Super-Modem:	supported
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

Please see the note about timestamps.

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0084
4	1	uint8_t	Number of bytes of data transmitting	
5	36		Data packet (see lower)	
41	2	uint16_t	CRC-16 (see appendix 1)	

Format of data packet

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of hedgehog	
1	6		Distance item 1	
7	6		Distance item 2	
13	6		Distance item 3	
19	6		Distance item 4	
25	8	int64_t	Timestamp – unix time of beacon ultrasound emission, number of milliseconds from 1970.01.01 00:00:00. Time, synchronized by all devices with modem and dashboard.	
29	2	uint16_t	Time passed from ultrasound emission to current time, milliseconds (V5.89+)	
31	1	uint8_t	reserved	

Format of distance item

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of beacon (0 if item not filled)	
1	4	uint32_t	Distance to the beacon, mm	

5	1	uint8_t	Bit 0: 1 = Distance not applicable Bit 1…7: Reserved (0)	

3.1.4.2 Packet of raw distances with candidates data with real-time timestamps, code of data 0x0094 (firmware V8.431+)

This packet is transmitted every time new coordinates are measured or failed to measure, after the packet with coordinates of mobile beacon.

Available only if “extra raw distances data” option is enabled in ‘Interfaces’ section of settings.

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	on demand
Super-Modem:	on demand
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported
Mini-TX-2:	on demand
Modem HW4.9:	not supported
Beacon HW4.9:	not supported
Beacon HW4.5:	not supported

Please see the note about timestamps.

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0094
4	1	uint8_t	Number of bytes of data transmitting	
5	80		Data packet (see lower)	
85	2	uint16_t	CRC-16 (see appendix 1)	

Format of data packet

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of hedgehog	
1	17		Distance item 1	
18	17		Distance item 2	
35	17		Distance item 3	
52	17		Distance item 4	
69	8	int64_t	Timestamp – unix time of beacon ultrasound emission, number of milliseconds from 1970.01.01 00:00:00. Time, synchronized by all devices with modem and dashboard.	
77	2	uint16_t	Time passed from ultrasound emission to current time, milliseconds (V5.89+)	
79	1	uint8_t	reserved	

Format of distance item

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of beacon (0 if item not filled)	
1	1	uint8_t	Number of distance candidates	
2	4	uint32_t	First candidate of distance to the beacon, mm	
6	1	uint8_t	Quality of first candidate, %	

7	4	uint32_t	Second candidate of distance to the beacon, mm	
11	1	uint8_t	Quality of second candidate, %	
12	4	uint32_t	Third candidate of distance to the beacon, mm	
16	1	uint8_t	Quality of third candidate, %	

3.1.4.3 Packet of raw distances data, code of data 0x0004

Obsolete packet, replaced by 0x0084. See details for the obsolete packet here.

3.1.5 Packet of processed IMU data

This packet is transmitted when new inertial sensors data available.

3.1.5.1 Packet of processed IMU data with real-time timestamps, code of data 0x0085 (firmware V7.200+)

This packet is transmitted when new inertial sensors data available.

Supported hardware:

Super-Beacon:	supported, 100 Hz (if 'Processed IMU data' enabled)
Industrial Super-Beacon:	supported, 100 Hz (if 'Processed IMU data' enabled)
Modem HW5.1:	supported, system update rate (if 'IMU via modem' enabled)
Super-Modem:	supported, system update rate (if 'IMU via modem' enabled)
Mini-RX (Badge, Helmet, etc.):	supported, 100 Hz (if 'Processed IMU data' enabled) with the UART cable for Mini-Rx
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported, 100 Hz (if 'Processed IMU data' enabled)
Modem HW4.9:	supported, system update rate (if 'IMU via modem' enabled)
Beacon HW4.9:	supported, 100 Hz (if 'Processed IMU data' enabled)
Beacon HW4.5:	supported, 100 Hz (if Processed IMU data' enabled)

Please see the note about timestamps.

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0085
4	1	uint8_t	Number of bytes of data transmitting	
5	46		Data packet (see lower)	
51	2	uint16_t	CRC-16 (see appendix 1)	

Format of data packet

Offset	Size (bytes)	Type	Description	Value
0	4	int32_t	Coordinate X of beacon (fusion), mm	
4	4	int32_t	Coordinate Y of beacon (fusion), mm	
8	4	int32_t	Coordinate Z of beacon (fusion), mm	
12	2	int16_t	W field of rotation quaternion (angles)	
14	2	int16_t	X field of rotation quaternion (angles)	
16	2	int16_t	Y field of rotation quaternion (angles)	
18	2	int16_t	Z field of rotation quaternion (angles)	
20	2	int16_t	Velocity X of beacon (fusion), mm/s	
22	2	int16_t	Velocity Y of beacon (fusion), mm/s	
24	2	int16_t	Velocity Z of beacon (fusion), mm/s	
26	2	int16_t	Acceleration X of beacon, mm/s^2	
28	2	int16_t	Acceleration Y of beacon, mm/s^2	
30	2	int16_t	Acceleration Z of beacon, mm/s^2	
32	1	uint8_t	Address of beacon	
33	1	1 byte	Reserved (0)	
34	8	int64_t	Timestamp – Unix time - number of milliseconds from 1970.01.01 00:00:00. Time, synchronized by all devices with modem and dashboard.	
42	1	uint8_t	Flags: Bit 0: 1 = Location data n/a	

			Bit 1: 1 = Quaternion data n/a Bit 2: 1 = Velocity data n/a Bit 3: 1 = Acceleration data n/a	
43	3	3 bytes	Reserved (0)	

Note: Quaternion is normalized to 10000 value.

3.1.5.2 Packet of processed IMU data, code of data 0x0005

Obsolete packet, replaced by 0x0085. See details for the obsolete packet here.

3.1.6 Packet of telemetry data (code of data 0x0006)

This packet is transmitted after location update, if the option “Telemetry stream” is enabled in ‘Interfaces’ section of settings.

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported (firmware V7.000+)
Super-Modem:	supported (firmware V7.000+)
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	not supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0006
4	1	uint8_t	Number of bytes of data transmitting	
5	16		Data packet (see lower)	
21	2	uint16_t	CRC-16 (see appendix 1)	

Format of data packet

Offset	Size (bytes)	Type	Description	Value
0	2	uint16_t	Battery voltage, mV	
2	1	int8_t	RSSI, dBm	
3	1	uint8_t	Address of the beacon	
4	12		Reserved (0)	

3.1.7 Packet of quality and extended location data (code of data 0x0007)

This packet is transmitted after location update, if the option “Quality and extended location data” is enabled in ‘Interfaces’ section of settings.

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported
Super-Modem:	supported
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	supported (only quality field)
Beacon HW4.9:	supported (only quality field)
Beacon HW4.5:	supported (only quality field)

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0007
4	1	uint8_t	Number of bytes of data transmitting	
5	16		Data packet (see lower)	
21	2	uint16_t	CRC-16 (see appendix 1)	

Format of data packet

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Device address	
1	1	uint8_t	Positioning quality, %	
2	1	uint8_t	0 = no geofencing zone alarm 1…255 - index of geofencing zone This field requires MMSW0005 license.	
3	13		Reserved (0)	

3.1.8 Packet of free time available for polling requests

This packet is transmitted after location update as last of the sequence of streaming packets. This packet contains time to next streaming packet. During this time, PC or another device can send polling requests using API without conflicting with streaming.

Supported hardware:

Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	supported
Super-Modem:	not supported
Mini-RX (Badge, Helmet, etc.):	not supported
Mini-TX:	not supported
Mini-TX-2:	not supported
Modem HW4.9:	not supported
Beacon HW4.9:	not supported
Beacon HW4.5:	not supported

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x000a
4	1	uint8_t	Number of bytes of data transmitting	
5	16		Data packet (see lower)	
21	2	uint16_t	CRC-16 (see appendix 1)	

Format of data packet

Offset	Size (bytes)	Type	Description	Value
0	4	uint32_t	Time to next streaming packet. Bus will be free for this time and can be used for sending request via API	
4	4	uint3_t	Reserved (0)	

3.1.9 Retired features

Here described obsolete packets, used in old version of software and replaced by default by other packets.

3.1.9.1 Packet with cm resolution coordinates of mobile beacon

Obsolete packet. Replaced by 0x0081.

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported
Super-Modem:	supported
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Destination address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0001
4	1	uint8_t	Number of bytes of data transmitting	0x10
5	4	uint32_t	Timestamp – internal time of beacon ultrasound emission, in milliseconds from the moment of the latest wakeup event. See note.	
9	2	int16_t	Coordinate X of beacon, cm	
11	2	int16_t	Coordinate Y of beacon, cm	
13	2	int16_t	Coordinate Z, height of beacon, cm	
15	1	uint8_t	Byte of flags: Bit 0: 1 - coordinates unavailable. Data from fields X, Y, Z should not be used. Bit 1: timestamp units indicator (see note) Bit 2: 1 - user button is pushed (V5.23+) Bit 3: 1 - data are available for uploading to user device, see section 2 (V5.34+) Bit 4: 1 - want to download data from user device, see section 2 (V5.34+) Bit 5: 1 – second user button is pushed (V5.74+) Bit 6: 1 – data for another hedgehog (not same one that sending this packet) Bit 7: – reserved (0)	
16	1	uint8_t	Address of hedgehog	
17	2	uint16_t	Bit 0…11: orientation of hedgehogs pair in XY plane, decidegrees (0…3600) Bit 12: 1 – coordinates are given for center of beacons pair; 0 – coordinates for specified beacon Bit 13: 1 - orientation is not applicable Bit 14: 1 – no location data from slave mobile beacon. orientation can drift up to 1 degree / sec Bit 15: reserved	
19	2	uint16_t	Time passed from ultrasound emission to current time, milliseconds (V5.88+)	

21	2	uint16_t	CRC-16 (see appendix 1)	

3.1.9.2 Packet with mm resolution coordinates of mobile beacon

Obsolete packet. Replaced by 0x0081.

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported
Super-Modem:	supported
Mini-Rx (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

Please see the note about timestamps.

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Destination address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0011
4	1	uint8_t	Number of bytes of data transmitting	N
5	4	uint32_t	Timestamp – internal time of beacon ultrasound emission, in milliseconds from the moment of the latest wakeup event. See note.	
9	4	int32_t	Coordinate X of beacon, mm	
13	4	int32_t	Coordinate Y of beacon, mm	
17	4	int32_t	Coordinate Z, height of beacon, mm	
21	1	uint8_t	Byte of flags: Bit 0: 1 - coordinates unavailable. Data from fields X,Y,Z should not be used. Bit 1: timestamp units indicator (see note) Bit 2: 1 - user button is pushed (V5.23+) Bit 3: 1 - data are available for uploading to user device, see section 2 (V5.34+) Bit 4: 1 - want to download data from user device, see section 2 (V5.34+) Bit 5: 1 – second user button is pushed (V5.74+) Bit 6: 1 – data for another hedgehog (not same one that sending this packet) Bit 7: – 1 – out of geofencing zone	
22	1	uint8_t	Address of hedgehog	
23	2	uint16_t	Bit 0…11: orientation of hedgehogs pair in XY plane, decidegrees (0…3600) Bit 12: 1 – coordinates are given for center of beacons pair; 0 – coordinates for specified hedgehog Bit 13: 1 - orientation is not applicable Bit 14…15: reserved (0)	
25	2	uint16_t	Time passed from ultrasound emission to current time, milliseconds (V5.88+)	
27	M= N-22		Optional data – see the list	
27+M	2	uint16_t	CRC-16 (see appendix 1)	

Note: for firmware versions before V5.20 timestamp is in 1/64 sec units and timestamp units indicator (bit 1 of flags byte) is 0. For versions 5.20 and higher timestamp is in milliseconds and timestamp units indicator is 1.

3.1.9.3 Packet with cm resolution coordinates of stationary beacons, code of data 0x0002.

Obsolete packet. Replaced by 0x0012.

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported
Super-Modem:	supported
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0002
4	1	uint8_t	Number of bytes of data transmitting	1+N*8
5	1	uint8_t	Number of beacons in packet	N
6	1	N*8 bytes	Data for N beacons	
6+N*8	2	uint16_t	CRC-16 (see appendix 1)	

Format of data structure for every of N beacons:

Offset	Size (bytes)	Type	Description
0	1	uint8_t	Address of beacon
1	2	int16_t	Coordinate X of beacon, cm
3	2	int16_t	Coordinate Y of beacon, cm
5	2	int16_t	Coordinate Z, height of beacon, cm
7	1	uint8_t	Reserved (0)

3.1.9.4 Packet of raw inertial sensors data, code of data 0x0003

Obsolete packet. Replaced by 0x0083.

Supported hardware:

Super-Beacon:	supported, 100 Hz (if 'Raw inertial sensors data' enabled)
Industrial Super-Beacon:	supported, 100 Hz (if 'Raw inertial sensors data' enabled)
Modem HW5.1:	supported, system update rate (if 'IMU via modem' enabled)
Super-Modem:	supported, system update rate (if 'IMU via modem' enabled)
Mini-RX (Badge, Helmet, etc.):	supported, 100 Hz (if 'Raw inertial sensors data' enabled) with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported, 100 Hz (if 'Raw inertial sensors data' enabled)
Modem HW4.9:	supported, system update rate (if 'IMU via modem' enabled)
Beacon HW4.9:	supported, 100 Hz (if 'Raw inertial sensors data' enabled)
Beacon HW4.5:	supported, 100 Hz (if 'Raw inertial sensors data' enabled)

Please see the note about timestamps.

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0003
4	1	uint8_t	Number of bytes of data transmitting	
5	32		Data packet (see lower)	
37	2	uint16_t	CRC-16 (see appendix 1)	

Format of data packet

Offset	Size (bytes)	Type	Description	Value
0	2	int16_t	Accelerometer, X axis, 1 mg/LSB	
2	2	int16_t	Accelerometer, Y axis, 1 mg/LSB	
4	2	int16_t	Accelerometer, Z axis, 1 mg/LSB	
6	2	int16_t	Gyroscope, X axis, 0.0175 dps/LSB	
8	2	int16_t	Gyroscope, Y axis, 0.0175 dps/LSB	
10	2	int16_t	Gyroscope, Z axis, 0.0175 dps/LSB	
12	2	int16_t	Compass, X axis, 1100 LSB/Gauss	
14	2	int16_t	Compass, Y axis, 1100 LSB/Gauss	
16	2	int16_t	Compass, Z axis, 980 LSB/Gauss	
18	1	uint8_t	Address of beacon	
19	5	5 bytes	Reserved (0)	
24	4	uint32_t	Timestamp, ms	
28	1	uint8_t	Flags: Bit 0: 1 = accelerometer data n/a Bit 1: 1 = Gyroscope data n/a Bit 2: 1 = Compass data n/a Bit 3…7 – reserved (0)	
29	3	3 bytes	reserved	

Note: Compass data are available only for HW v4.9 beacons with IMU.

3.1.9.5 Packet of raw distances data, code of data 0x0004

Obsolete packet. Replaced by 0x0084.

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported
Super-Modem:	supported
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

Please see the note about timestamps.

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0004
4	1	uint8_t	Number of bytes of data transmitting	
5	32		Data packet (see lower)	
37	2	uint16_t	CRC-16 (see appendix 1)	

Format of data packet

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of hedgehog	
1	6		Distance item 1	
7	6		Distance item 2	
13	6		Distance item 3	
19	6		Distance item 4	
25	4	uint32_t	Timestamp – internal time of beacon ultrasound emission, in milliseconds from the moment of the latest wakeup event (V5.89+).	
29	2	uint16_t	Time passed from ultrasound emission to current time, milliseconds (V5.89+)	
31	1	uint8_t	reserved	

Format of distance item

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of beacon (0 if item not filled)	
1	4	uint32_t	Distance to the beacon, mm	
5	1	uint8_t	Bit 0: 1 = Distance not applicable Bit 1…7: Reserved (0)	

3.1.9.6 Packet of processed IMU data, code of data 0x0005

Obsolete packet. Replaced by 0x0085.

Supported hardware:

Super-Beacon:	supported angles, 100 Hz (if 'Processed IMU data' enabled)
Industrial Super-Beacon:	supported angles, 100 Hz (if 'Processed IMU data' enabled)
Modem HW5.1:	supported, system update rate (if 'IMU via modem' enabled)
Super-Modem:	supported, system update rate (if 'IMU via modem' enabled)
Mini-RX (Badge, etc.):	supported angles, 100 Hz (if 'Processed IMU data' enabled) with the UART cable for Mini-Rx
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported angles, 100 Hz (if 'Processed IMU data' enabled)
Modem HW4.9:	supported, system update rate (if 'IMU via modem' enabled)
Beacon HW4.9:	supported, 100 Hz (if 'Processed IMU data' enabled)
Beacon HW4.5:	supported, 100 Hz (if Processed IMU data' enabled)

Please see the note about timestamps.

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	0xff
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0005
4	1	uint8_t	Number of bytes of data transmitting	
5	42		Data packet (see lower)	
47	2	uint16_t	CRC-16 (see appendix 1)	

Format of data packet

Offset	Size (bytes)	Type	Description	Value
0	4	int32_t	Coordinate X of beacon (fusion), mm	
4	4	int32_t	Coordinate Y of beacon (fusion), mm	
8	4	int32_t	Coordinate Z of beacon (fusion), mm	
12	2	int16_t	W field of rotation quaternion (angles)	
14	2	int16_t	X field of rotation quaternion (angles)	
16	2	int16_t	Y field of rotation quaternion (angles)	
18	2	int16_t	Z field of rotation quaternion (angles)	
20	2	int16_t	Velocity X of beacon (fusion), mm/s	
22	2	int16_t	Velocity Y of beacon (fusion), mm/s	
24	2	int16_t	Velocity Z of beacon (fusion), mm/s	
26	2	int16_t	Acceleration X of beacon, mm/s^2	
28	2	int16_t	Acceleration Y of beacon, mm/s^2	
30	2	int16_t	Acceleration Z of beacon, mm/s^2	
32	1	uint8_t	Address of beacon	
33	1	1 byte	Reserved (0)	
34	4	uint32_t	Timestamp, ms	
38	1	uint8_t	Flags: Bit 0: 1 = Location data n/a Bit 1: 1 = Quaternion data n/a Bit 2: 1 = Velocity data n/a Bit 3: 1 = Acceleration data n/a Bit 4…7 – reserved (0)	
39	3	3 bytes	Reserved (0)	

Note: Quaternion is normalized to 10000 value

3.2 Protocol of reading/writing data from/to user device

3.2.1 Sending data from user device

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported
Super-Modem:	supported
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	not supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

If the user device needs to transmit data via Marvelmind system, it should send following frame:

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Destination address	0x00
1	1	uint8_t	Type of packet	0x49
2	2	uint16_t	Code of data in packet	0x0200
4	1	uint8_t	Number of bytes of data transmitting	N
5	N	N bytes	Payload data	
5+N	2	uint16_t	CRC-16 (see appendix 1)	

The data will be transmitted via radio to the modem by the parts of the size defined as ‘User payload data size’ in ‘Interfaces’ section of dashboard settings for hedgehog. The rate of sending these parts is equal to update rate of hedgehog. Buffer size in hedgehog is 128 bytes. Take this in attention to avoid overflow the buffer.

3.2.2 Writing data to user device

This packet is transmitted from Marvelmind device (modem or mobile beacon) to user device.

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Destination address	0xff
1	1	uint8_t	Type of packet	0x4a
2	2	uint16_t	Code of data in packet	0x0200... 0x02ff
4	1	uint8_t	Number of bytes of data transmitting	N
5	N	N bytes	Payload data	
5+N	2	uint16_t	CRC-16 (see appendix 1)	

For this command the codes of data from 0x200 to 0x2ff are reserved.

If the user device successfully processed the request, it should send a response in following format:

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of hedgehog (can get from 0x0001 or 0x0011 packet of streaming)	
1	1	uint8_t	Type of packet	0x4a
2	2	uint16_t	Code of data in packet	0x0200... 0x02ff
4	2	uint16_t	CRC-16 (see appendix 1)	

If the user device failed to process the request, it sends response in following format:

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of hedgehog (get from 0x0001 packet of streaming)	
1	1	uint8_t	Type of packet	0xca
2	2	uint16_t	Code of requested data	0x0200... 0x02ff
4	1	uint8_t	Code of error (see note)	1
5	2	uint16_t	CRC-16 (see appendix 1)	

In the following sections described the specific data writing requests.

Note: If user device could not process request from hedgehog, it should send reply with one of following error codes:

1 - unknown field "type of packet" in request
2 - unknown field "code of data" in request
3 - incorrect payload data in request
6 - device is busy and cannot retrieve requested data now

3.2.2.1 Request of writing the movement path

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	on demand
Super-Modem:	on demand
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	not supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

This packet contains one command of elementary movement. The Marvelmind device sends one after another all commands for elementary movements in the path.

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Destination address	0xff
1	1	uint8_t	Type of packet	0x4a
2	2	uint16_t	Code of data in packet	0x201
4	1	uint8_t	Number of bytes of data transmitting	0x0c
5	12	12 bytes	Payload data	
17	2	uint16_t	CRC-16 (see appendix 1)	

Format of payload data:

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Type of elementary movement: 0 - move forward 1 - move backward 2 - rotate right (clockwise) 3 - rotate left (counterclockwise) 4 - pause 5 - repeat program from start 6 - move to specified point 7 - setup speed	
1	1	uint8_t	Index of this elementary movement (0 is the first)	
2	1	uint8_t	Total number of elementary movements	
3	2	int16_t	Parameter of movement: Types 0; 1 - distance of movement, cm Types 2; 3 - angle of rotation, degrees Type 4: time of pause, ms Type 6: X target coordinate, cm Type 7: speed, %	
5	2	int16_t	Parameter of movement: Type 6: Y target coordinate, cm	
7	2	int16_t	Parameter of movement: Type 6: Z target coordinate, cm	
9	3	3 bytes	Reserved (0)	

3.2.2.2 Request of writing zones

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	on demand
Super-Modem:	on demand
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	not supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

This packet contains one item of sequence of zones list. The Marvelmind device sends one after another all commands for zones list.

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Destination address	0xff
1	1	uint8_t	Type of packet	0x4a
2	2	uint16_t	Code of data in packet	0x202
4	1	uint8_t	Number of bytes of data transmitting	0x25
5	37	37 bytes	Payload data	
42	2	uint16_t	CRC-16 (see appendix 1)	

Format of payload data:

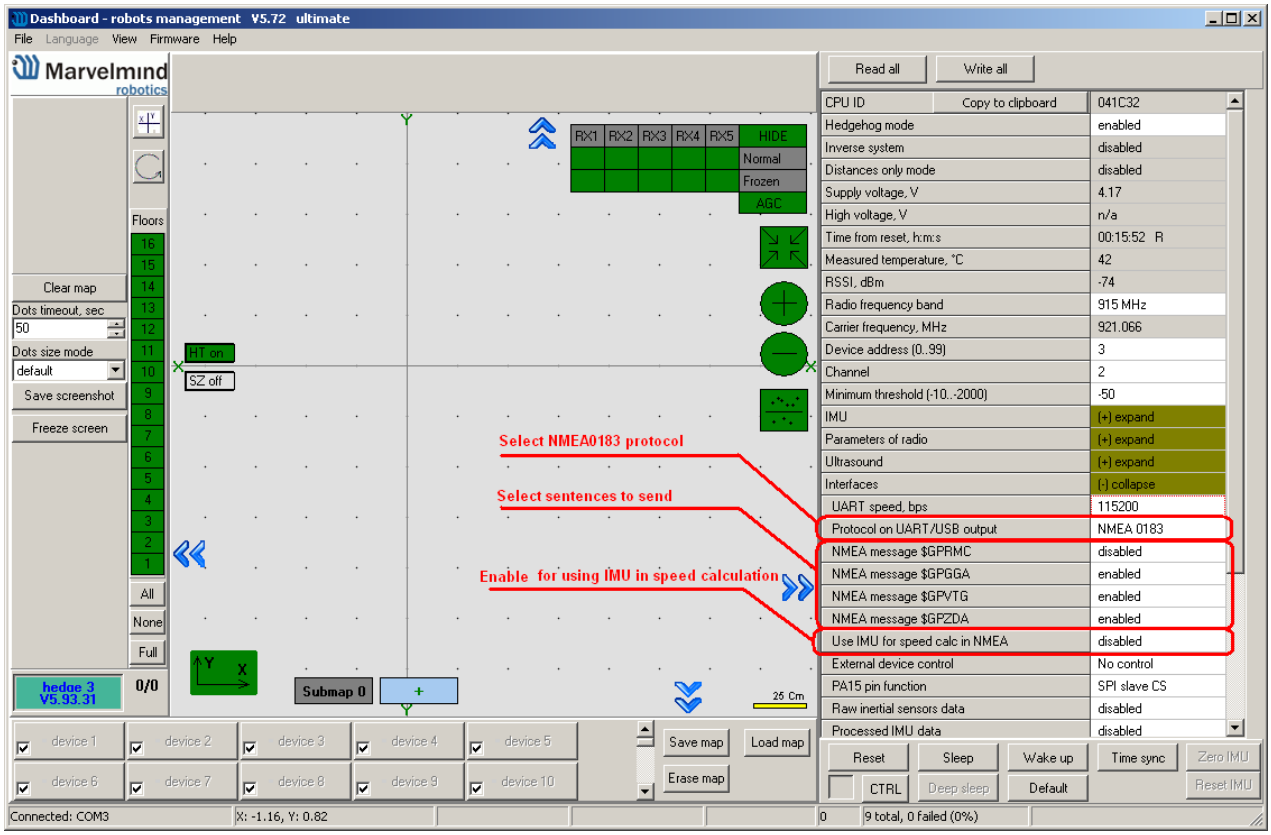
Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Index of the zone	
1	1	uint8_t	Number of points in zone polygon (N)	
2	1	uint8_t	Index of first point in this packet: M=0…N-1	
3	1	uint8_t	Flags: Bit 0: 1 = no service zone Bit 1: 1= no driving zone Bit 2: 1= inverted zone Bit 3: 1= active zone Bit 4…7: reserved (0)	
4	1	uint8_t	Number of zones	
5	32	4x8 bytes	Up to 4 points of zone polygon (see below)	

Format of payload data:

Offset	Size (bytes)	Type	Description	Value
0	4	int32_t	X coordinate of the point, mm	
4	4	int32_t	Y coordinate of the point, mm	

3.3 NMEA0183 communication protocol

Mobile beacon can output some of the NMEA0183 sentences via UART and USB (virtual UART) interfaces. NMEA protocol should be enabled in the device with dashboard as shown on following screenshot:



The device sends all enabled messages every time it receives updated position.

To get NMEA data from mobile beacon (hedgehog), it shall be connected to an external device (robot, copter, AGV, etc.) via any of the following interfaces:

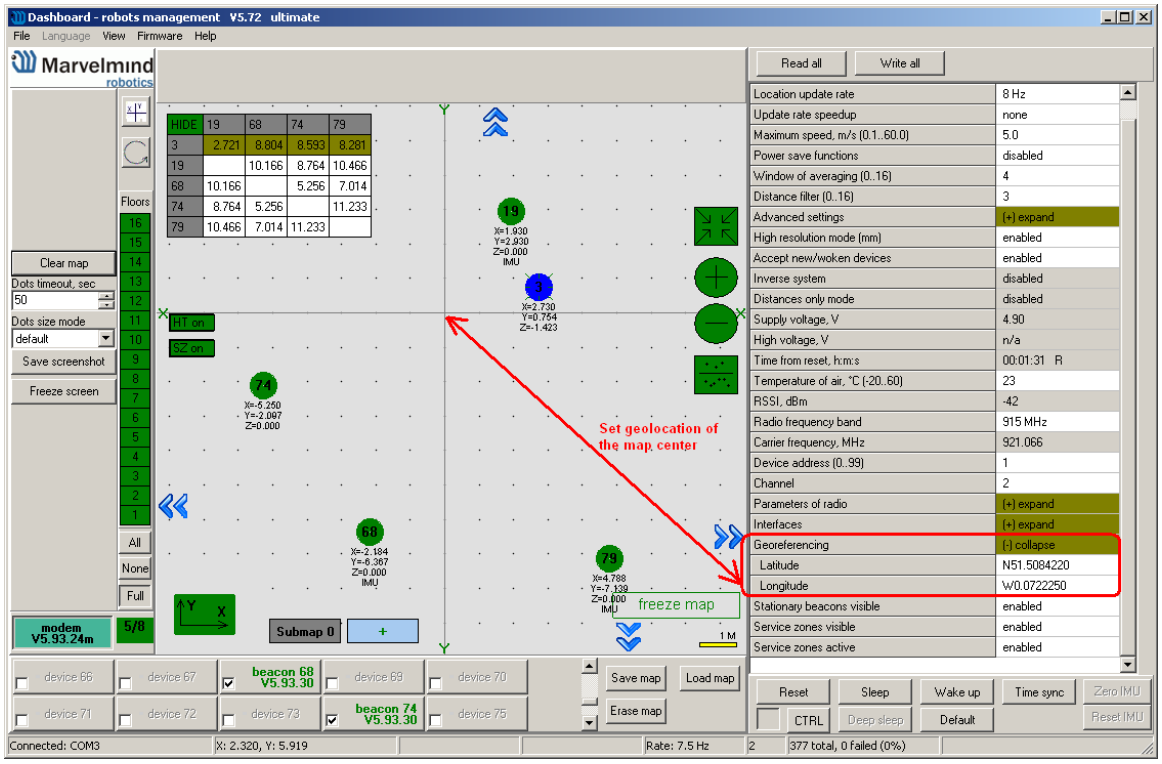
1. Connect to USB-host as an USB device of CDC class (virtual COM port in Windows, ttyUSB or ttyACM in Linux). In the Windows, it requires driver - the same driver as for modem. In Linux, the driver in most cases is not required, since the required driver is integrated into Linux kernel. Because real RS-232 is not used in the interface, parameters of serial port opened on the host (baudrate, number of bits, parity, etc) may be any.
2. Connect to UART on a hedgehog – 2 wires soldering to pins required. See the picture of beacon interface below. To have the location data out, it is sufficient to connect only 2 wires: GND and USART2_TX. Logic level of UART transmitter is CMOS 3.3V. Default baudrate is 500 kbps, it is configurable from the Dashboard (see parameter “UART speed, bps” on above picture) from following list: 4.8, 9.6, 19.2, 38.4, 57.6, 115.2, 500 kbps. Format of data: 8 bit, no parity, 1 stop bit.

3.3.1 General agreements for coordinates translation

Marvelmind system measures position in form of rectangular Cartesian system coordinates (X, Y, Z), where Z in most cases is the height. For translation to GPS coordinates following agreements are used:

- Z axis is directed up, Z coordinate means altitude above sea level;
- Y axis is directed to north, so Y is latitude;
- X axis is directed to east, so X is longitude;
- point (X= 0, Y= 0) has GPS coordinates according to georeference point (by default: 0 ° North, 0 °' West);

Georeference coordinates can be set as shown on the screenshot:

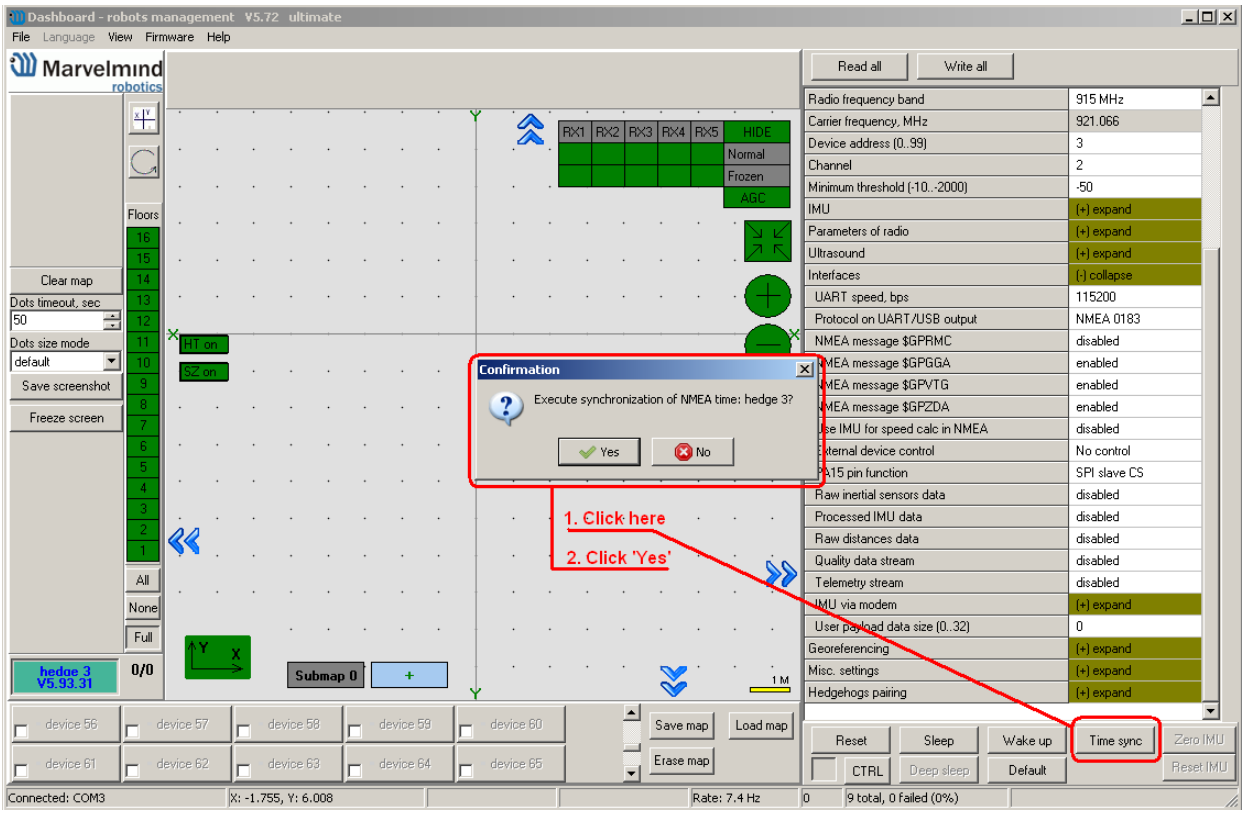


GPS coordinates are calculated according to specified georeference point and WGS-84 Earth model.
More, detailed,
Lat= Lat_ref + y*9.013373
where
Lat - latitude, microdegrees
Lat_ref - georeference latitude, microdegrees
y - y coordinates in Marvelmind system, meters

Long= Long_ref + x*8.98315/cos(Lat_ref/1000000)
Long - longitude, microdegrees
Long_ref - georeference longitude, microdegrees
Lat_ref - georeference latitude, microdegrees
x - x coordinates in Marvelmind system, meters

3.3.2 General agreements for time

After power on, mobile beacon counts time starting from 2016.08.01 00:00:00. User can synchronize time with computer clock as shown on following screenshot.



3.3.3 Description of “NMEA0183” messages implementation

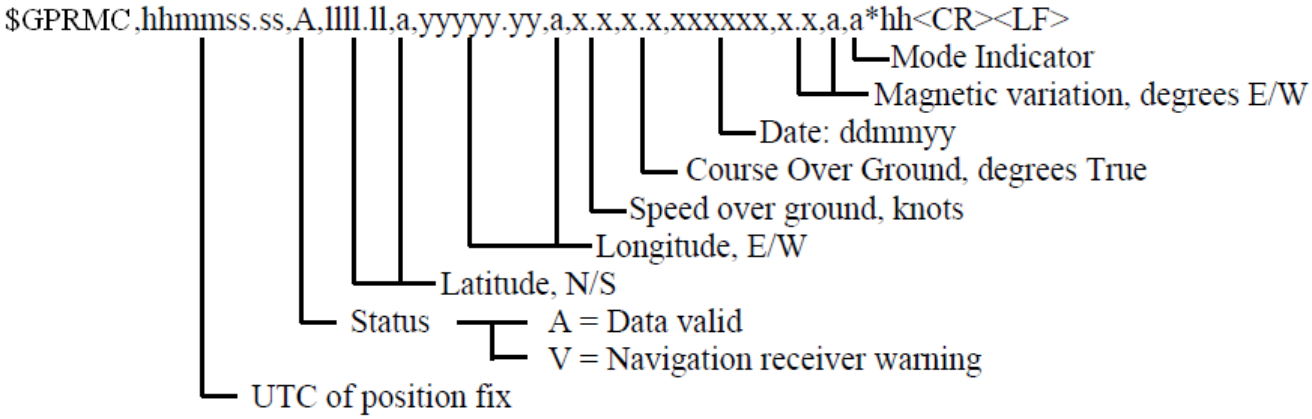
NMEA 0183 messages are ASCII coded text frames, consist of several parts, separated by commas, and terminated by end of line. Before end of line, every message is finished by ‘*’ symbol, followed by two symbols of checksum, calculated according to NMEA 0183 standard. Each part of NMEA 0183 message represents certain parameter.
Below is description of all supported messages and parameter fields.
Messages format is taken from NMEA 0183 standard version 3.01, January 1, 2002.

1. $GPRMC -Recommended Minimum Specific GNSS Data

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported (starting from SW V7.000)
Super-Modem:	supported (starting from SW V7.000)
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	not supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

General format from NMEA 0183 standard:



Description of fields implementation:

1.1. ‘$GPRMC’ – designation of message type

1.2. ‘hhmmss.ss’ – UTC position fix

According to general agreements, time is counted from default 2016.01.01 or synchronized with computer clock.

1.3. 'A' – status

‘A’ value is sent if last position update was successful
‘V’ value is sent if any error occurred in last position update

1.4. 'llll.llllll,a' – latitude, N/S

According to general agreements (see above), latitude corresponds to the Y coordinate relative to georeference location. Latitude is presented with 6 digits of decimal-fraction of minutes, which gives resolution not more than 2 mm,

1.5. 'yyyyy.yyyyyy,a' – longitude, E/W

According to general agreements (see above), longitude corresponds to the X coordinate relative to georeference location Longitude is presented with 6 digits of decimal-fraction of minutes, which gives resolution not more than 2 mm.

1.6. 'x.x' – speed over ground, knots

Marvelmind system measures the coordinates; the speed is calculated from dynamics of coordinates with applying of some filtering. Optionally, it can use IMU fusion for speed calculation.

1.7. 'xxxxxx' - date: ddmmyy

According to general agreements, time is counted from default 2016.01.01 or synchronized with computer clock.

1.8. 'x.x,a' - magnetic variation

This parameter value is always a null field.

1.9. 'a' - mode indicator

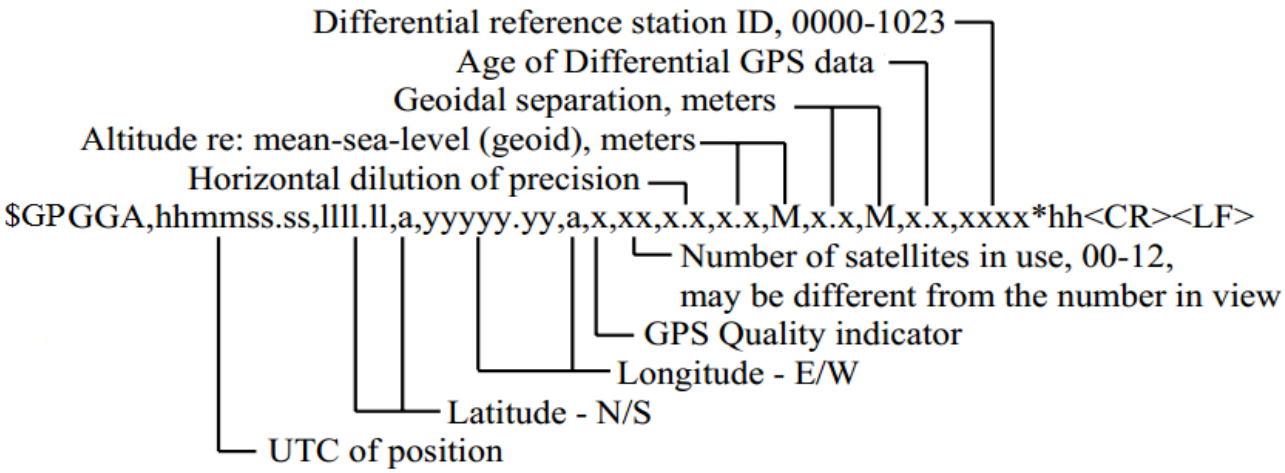
'A' value (autonomous mode) is sent if last position update was successful
'N' value (data not valid) is sent if any error occurred in last position update

2. $GPGGA -Global Positioning System Fix Data

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported (starting from SW V7.000)
Super-Modem:	supported (starting from SW V7.000)
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable for Mini-Rx
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported
Modem HW4.9:	not supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

General format from NMEA 0183 standard:



Description of fields implementation:

2.1. '$GPGGA' – designation of message type

2.2. 'hhmmss.ss' – UTC position fix

According to general agreements, time is counted from default 2016.01.01 or synchronized with computer clock.

2.3. 'llll.llllll,a' – latitude, N/S

According to general agreements (see above), latitude corresponds to the Y coordinate relative to georeference location. Latitude is presented with 6 digits of decimal-fraction of minutes, which gives resolution not more than 2 mm

2.4. 'yyyyy.yyyyyy,a' – longitude, E/W

According to general agreements (see above), longitude corresponds to the X coordinate relative to georeference location. Longitude is presented with 6 digits of decimal-fraction of minutes, which gives resolution not more than 2 mm

2.5. 'x' – GPS quality indicator

'1' (GPS SPS Mode, fix valid) value is sent if last position update was successful

'0' (Fix not available or invalid) value is sent if any error occurred in last position update

2.6. 'xx' – number of satellites in use
Always '08' in current implementation.

2.7. 'x.x' – horizontal dilution of precision
Always '1.2' in current implementation.

2.8. 'x.x, M' – altitude re: mean-sea-level (geoid), meters
This corresponds to the Z coordinate according to general agreements.

2.9. 'x.x, M' – geoidal separation, meters
Always '0.0, M' value is transmitted.

2.10. 'x.x' – age of differential GPS data
This parameter value is always a null field, DGPS is not used.

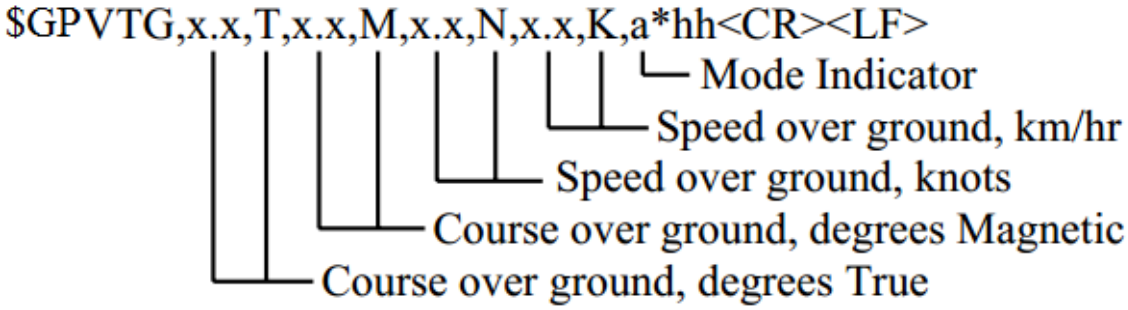
2.11. 'xxxx' – differential reference station ID
This parameter value is always a null field.

3. $GPVTG -Course Over Ground and Ground Speed

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported (starting from SW V7.000)
Super-Modem:	supported (starting from SW V7.000)
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable for Mini-Rx
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported
Modem HW4.9:	not supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

General format from NMEA 0183 standard:



Description of fields implementation:

3.1. '$GPVTG' – designation of message type

3.2 . 'x.x, T' – course over ground, degrees True
According to NMEA standard, the course is the angle between vector of speed and direction to the north. As shown in general agreements above, the Y axis is taken as direction to north.

3.3. 'x.x, M' – course over ground, degrees Magnetic
In current implementation, magnetic course is same as true course.

3.4. 'x.x, N' – speed over ground, knots
Marvelmind system measures the coordinates; the speed is calculated from dynamics of coordinates with applying of some filtering. Optionally, it can use IMU fusion for speed calculation.

3.5. 'x.x, K' – speed over ground, km/hr
It is the same speed in another units

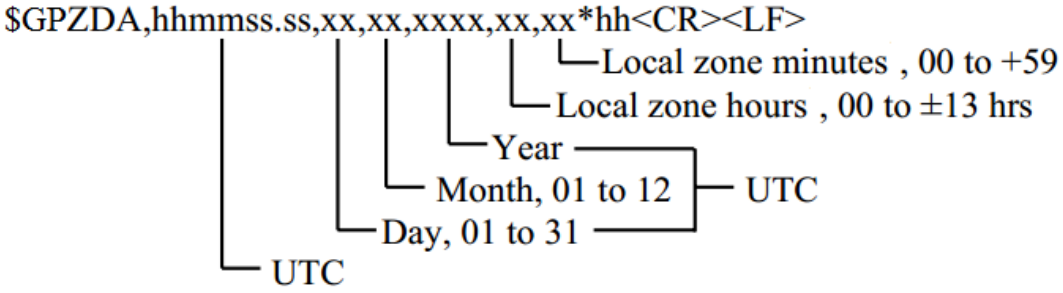
3.6. 'a' – mode indicator
'A' value (autonomous mode) is sent if last position update was successful
'N' value (data not valid) is sent if any error occurred in last position update

4. $GPZDA –Time & Date

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported (starting from SW V7.000)
Super-Modem:	supported (starting from SW V7.000)
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported in the current HW version
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	not supported
Beacon HW4.9:	supported
Beacon HW4.5:	supported

General format from NMEA 0183 standard:



According to general agreements, time is counted from default 2016.01.01 or synchronized with computer clock.

Description of fields implementation:

4.1. '$GPZDA' – designation of message type

4.1. ‘hhmmss.ss’ – UTC

Time (hours, minutes, seconds).

4.2. ‘xx’ – day, 01 to 31

Day.

4.3. ‘xx’ – month, 01 to 12

Month.

4.4. ‘xxxx’ – year

Year.

4.4. ‘xx – local zone hours

Local zone is always “00” hours.

4.5. ‘xx – local zone minutes

Local zone is always “00” minutes.

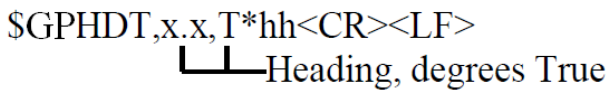
5. $GPHDT – Heading

Supported hardware:

Super-Beacon:	supported
Industrial Super-Beacon:	supported
Modem HW5.1:	supported (starting from SW V7.000)
Super-Modem:	supported (starting from SW V7.000)
Mini-RX (Badge, Helmet, etc.):	supported with the UART cable
Mini-TX:	not supported
Mini-TX-2:	supported with the UART cable
Modem HW4.9:	not supported
Beacon HW4.9:	not supported
Beacon HW4.5:	not supported

Note you need MMSW0002 license to enable streaming of this packet.

General format from NMEA 0183 standard:



5.1. '$GPHDT' – designation of message type

5.2. 'x.x, T' – heading, degrees True

This is a heading angle calculated by using paired beacons or paired microphones feature with fusion with the gyroscope.

3.3.4 Examples of NMEA data receiving

On the next screenshot is example of data, received from mobile beacon, connected via USB (virtual COM port) to the OpenCPN software, running on the computer under MS Windows.