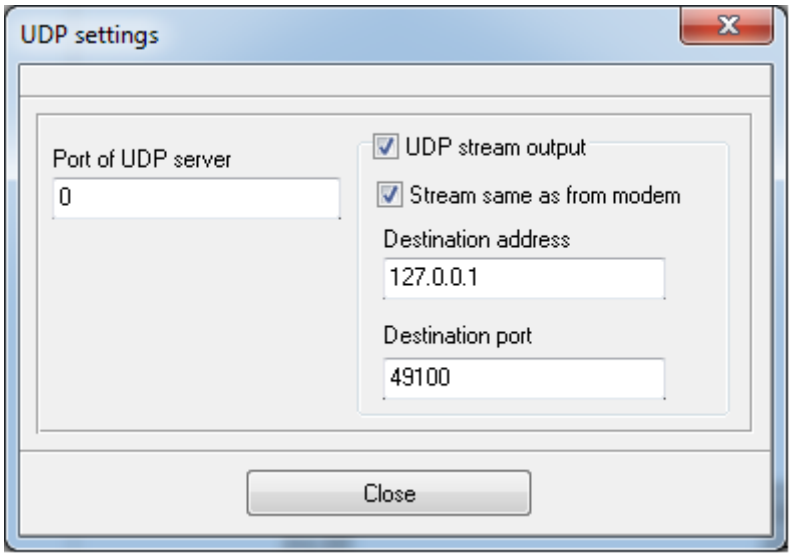
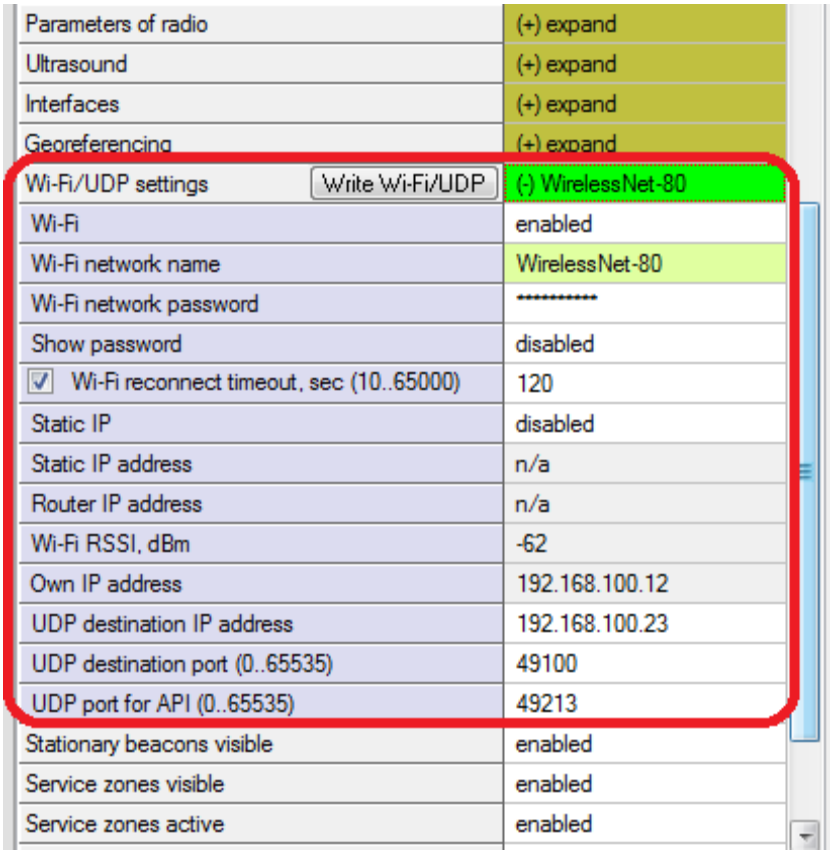
8. Protocols of communication via UDP (Wi-Fi)

Dashboard software can transmit data via UDP through network interfaces of the PC where the dashboard is running. Destination IP address/port can be adjusted via menu File/UDP settings:



Super-Modem has onboard Wi-Fi, and it is able to stream locations of mobile beacons and other data described below.

Configuration of WiFi network and UDP streaming is possible via Super-Modem settings in the dashboard:



8.1 Packet with hedgehog location

Supported hardware/software:

Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	not supported
Super-Modem:	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
Dashboard software:	supported

Please see the note about timestamps.

Format of the packet

Offset	Size	Type	Description	Value
0	1	uint8_t	Address of the beacon	
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0011
4	1	uint8_t	Data size (bytes)	N
5	4	uint32_t	Timestamp – time from running of dashboard/Super-Modem in milliseconds on the moment of receiving coordinates	
9	4	int32_t	Coordinate X of beacon, mm	
13	4	int32_t	Coordinate Y of beacon, mm	
17	4	int32_t	Coordinate Z 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…6: reserved (0) Bit 7: – 1 – out of geofencing zone	
22	1	uint8_t	Reserved (0)	
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…15: reserved (0)	
25	2	Reserved (0)		
27	M=N-22		Optional data fields – see the list	
27+M	2	Reserved (0)		

Note: for dashboard and Super-Modem versions before V6.290 the timestamp is in 1/64 sec units and timestamp units indicator (bit 1 of flags byte) is 0. For versions V6.290 and higher timestamp is in milliseconds and timestamp units indicator is 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	

8.1.1. Packet with hedgehog location with real-time timestamps (firmware v7.200+)

Supported hardware/software:

Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	not supported
Super-Modem:	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
Dashboard software:	supported

Please see the note about timestamps.

Format of the packet

Offset	Size	Type	Description	Value
0	1	uint8_t	Address of the beacon	
1	1	uint8_t	Type of packet	0x47
2	2	uint16_t	Code of data in packet	0x0081
4	1	uint8_t	Data size (bytes)	N
5	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.	
13	4	int32_t	Coordinate X of beacon, mm	
17	4	int32_t	Coordinate Y of beacon, mm	
21	4	int32_t	Coordinate Z 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…6: reserved (0) Bit 7: – 1 – out of geofencing zone	
26	1	uint8_t	Reserved (0)	
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…15: reserved (0)	
29	2	Reserved (0)		
31	M=N-26		Optional data fields – see the list	
31+M	2	Reserved (0)		

8.2. Packet with stationary beacons locations

Supported hardware/software:

Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	not supported
Super-Modem:	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
Dashboard software:	supported

Format of the packet

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	

Format of data structure for every of N beacons:

Offset	Size (bytes)	Type	Description
0	1	uint8_t	Address of the beacon
1	4	int32_t	Coordinate X of the beacon, mm
5	4	int32_t	Coordinate Y of the beacon, mm
9	4	int32_t	Coordinate Z of the beacon, mm
13	1	uint8_t	Reserved (0)

8.3. Packet with raw IMU data

Supported hardware/software:

Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	not supported
Super-Modem:	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
Dashboard software:	supported

Please see the note about timestamps.

Format of the packet

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of the beacon	
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	2	int16_t	Accelerometer, X axis, 1 mg/LSB	
7	2	int16_t	Accelerometer, Y axis, 1 mg/LSB	
9	2	int16_t	Accelerometer, Z axis, 1 mg/LSB	
11	2	int16_t	Gyroscope, X axis, 0.0175 dps/LSB	
13	2	int16_t	Gyroscope, Y axis, 0.0175 dps/LSB	
15	2	int16_t	Gyroscope, Z axis, 0.0175 dps/LSB	
17	2	int16_t	Compass, X axis, 1100 LSB/Gauss	
19	2	int16_t	Compass, Y axis, 1100 LSB/Gauss	
21	2	int16_t	Compass, Z axis, 980 LSB/Gauss	
23	1	uint8_t	Address of the beacon	
24	5	5 bytes	Reserved (0)	
29	4	uint32_t	Timestamp, ms	
33	8	8 bytes	reserved	

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

8.3.1. Packet with raw IMU data with real-time timestamps (firmware v7.200+)

Supported hardware/software:

Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	not supported
Super-Modem:	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
Dashboard software:	supported

Please see the note about timestamps.

Format of the packet

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of the beacon	
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	2	int16_t	Accelerometer, X axis, 1 mg/LSB	
7	2	int16_t	Accelerometer, Y axis, 1 mg/LSB	
9	2	int16_t	Accelerometer, Z axis, 1 mg/LSB	
11	2	int16_t	Gyroscope, X axis, 0.0175 dps/LSB	
13	2	int16_t	Gyroscope, Y axis, 0.0175 dps/LSB	
15	2	int16_t	Gyroscope, Z axis, 0.0175 dps/LSB	
17	2	int16_t	Compass, X axis, 1100 LSB/Gauss	
19	2	int16_t	Compass, Y axis, 1100 LSB/Gauss	
21	2	int16_t	Compass, Z axis, 980 LSB/Gauss	
23	1	uint8_t	Address of the beacon	
24	5	5 bytes	Reserved (0)	
29	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.	
37	8	8 bytes	reserved	

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

8.4. Packet with raw distances data

Supported hardware/software:

Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	not supported
Super-Modem:	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
Dashboard software:	supported

Please see the note about timestamps.

Format of the packet

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)	

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	Reserved (0)	

8.4.1. Packet with raw distances data with real-time timestamps (firmware v7.200+)

Supported hardware/software:

Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	not supported
Super-Modem:	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
Dashboard software:	supported

Please see the note about timestamps.

Format of the packet

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	32		Data packet (see lower)	

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.	
33	2	uint16_t	Time passed from ultrasound emission to current time, milliseconds (V5.89+)	
35	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	Reserved (0)	

8.5. Packet with IMU fusion data

Supported hardware/software:

Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	not supported
Super-Modem:	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
Dashboard software:	supported

Please see the note about timestamps.

Format of the packet

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of the beacon	
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	4	int32_t	Coordinate X of beacon (fusion), mm	
9	4	int32_t	Coordinate Y of beacon (fusion), mm	
13	4	int32_t	Coordinate Z of beacon (fusion), mm	
17	2	int16_t	W field of rotation quaternion	
19	2	int16_t	X field of rotation quaternion	
21	2	int16_t	Y field of rotation quaternion	
23	2	int16_t	Z field of rotation quaternion	
25	2	int16_t	Velocity X of beacon (fusion), mm/s	
27	2	int16_t	Velocity Y of beacon (fusion), mm/s	
29	2	int16_t	Velocity Z of beacon (fusion), mm/s	
31	2	int16_t	Acceleration X of beacon, mm/s^2	
33	2	int16_t	Acceleration Y of beacon, mm/s^2	
35	2	int16_t	Acceleration Z of beacon, mm/s^2	
37	1	uint8_t	Address of beacon	
38	1	1 byte	Reserved (0)	
39	4	uint32_t	Timestamp, ms	
43	4	4 bytes	Reserved (0)	

Note: Quaternion is normalized to 10000 value.

8.5.1. Packet with IMU fusion data with real-time timestamps (firmware v7.200+)

Supported hardware/software:

Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	not supported
Super-Modem:	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
Dashboard software:	supported

Please see the note about timestamps.

Format of the packet

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of the beacon	
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	4	int32_t	Coordinate X of beacon (fusion), mm	
9	4	int32_t	Coordinate Y of beacon (fusion), mm	
13	4	int32_t	Coordinate Z of beacon (fusion), mm	
17	2	int16_t	W field of rotation quaternion	
19	2	int16_t	X field of rotation quaternion	
21	2	int16_t	Y field of rotation quaternion	
23	2	int16_t	Z field of rotation quaternion	
25	2	int16_t	Velocity X of beacon (fusion), mm/s	
27	2	int16_t	Velocity Y of beacon (fusion), mm/s	
29	2	int16_t	Velocity Z of beacon (fusion), mm/s	
31	2	int16_t	Acceleration X of beacon, mm/s^2	
33	2	int16_t	Acceleration Y of beacon, mm/s^2	
35	2	int16_t	Acceleration Z of beacon, mm/s^2	
37	1	uint8_t	Address of beacon	
38	1	1 byte	Reserved (0)	
39	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	
47	4	4 bytes	Reserved (0)	

Note: Quaternion is normalized to 10000 value.

8.6. Packet with telemetry data

Supported hardware/software:

Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	not supported
Super-Modem:	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
Dashboard software:	supported

Format of the packet

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of the beacon	
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	2	uint16_t	Battery voltage, mV	
7	1	int8_t	RSSI, dBm	
8	13		Reserved (0)	

8.7. Packet with quality and extended location data

Supported hardware/software:

Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	not supported
Super-Modem:	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
Dashboard software:	supported

Format of the packet

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	
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	1	uint8_t	Device address	
6	1	uint8_t	Positioning quality, %	
7	1	uint8_t	0 = no geofencing zone alarm 1…255 - index of geofencing zone This field requires MMSW0005 license.	
8	13		Reserved (0)	

8.8. Packet with telemetry of all beacons

Supported hardware/software:

Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	not supported
Super-Modem:	supported (in SSM firmware)
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
Dashboard software:	on demand

Format of the packet

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address	0xff
1	1	uint8_t	Type of packet	0x48
2	2	uint16_t	Code of data in packet	0x2001
4	2	uint16_t	Number of bytes of data transmitting	
6	N*10		Telemetry for N beacon (see table below)	

Format of beacon telemetry item

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of the beacon	
1	2	uint16_t	Power voltage, mV	
3	1	int8_t	RSSI, dBm	
4	4	uint32_t	Time passed from last data update, sec	
8	2	uint16_t	Reserved (0)	

8.9. NMEA0183 protocol

Supported hardware/software:

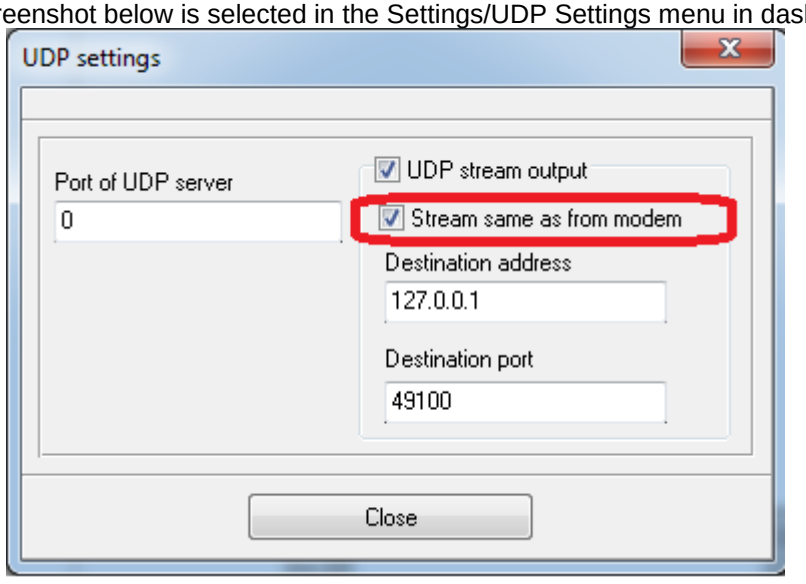
Super-Beacon:	not supported
Industrial Super-Beacon:	not supported
Modem HW5.1:	not supported
Super-Modem:	supported
Mini-RX (Badge, Helmet, etc.):	not supported
Mini-TX:	not supported
Mini-TX-2:	not supported
Modem HW4.9:	not supported
Beacon HW4.9:	not supported
Beacon HW4.5:	not supported
Dashboard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

Format of the packet

Offset	Size (bytes)	Type	Description	Value
0	N	N bytes	NMEA0183 message (see description here)	
N	1	uint8_t	Address of the mobile beacon	

Notes:

- Super-Modem streams NMEA0183 messages via UDP if NMEA0183 protocol is selected in interfaces section of settings for the Super-Modem in the dashboard
- Dashboard streams NMEA0183 messages if NMEA0183 protocol is selected in interfaces section of settings for the modem, and the option shown on the screenshot below is selected in the Settings/UDP Settings menu in dashboard:



9. Protocols of communication via CAN

Supported hardware:

Super-Beacon:	not supported
Industrial Super-Beacon:	supported
Modem HW5.1:	not supported
Super-Modem:	on demand
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

CAN hardware support can be installed in Super-Modem and Industrial Super-Beacon by request. If CAN is installed, RS-485 is not available.

Parameters of CAN:

Baudrate: **125 kbps.**

Frame format: **standard.**

9.1 ‘Marvelmind’ protocol of streaming

Packets described in corresponding chapter about UART streaming are transmitted also via CAN with CAN frame id **0x10**. Each CAN frame can contain from 1 to 8 bytes of data. Number of data bytes is specified in **DLC** field of CAN frame.

Data are transmitted as raw stream, so CAN frame can include end of one data packet and beginning of next packet. User should receive multiple CAN frames, place their data fields into some buffer and process by the same way as data received from UART.

9.2 NMEA0183 communication protocol

Packets described in corresponding chapter about UART streaming are transmitted also via CAN with CAN frame id **0x11**. Each CAN frame can contain from 1 to 8 bytes of data. Number of data bytes is specified in **DLC** field of CAN frame.

Data are transmitted as raw stream, so CAN frame can include end of one data packet and beginning of next packet. User should receive multiple CAN frames, place their data fields into some buffer and process by the