11. Marvelmind API

Marvelmind API library is used by Marvelmind Dashboard software and provides interface to user's software. API is coming as dynamic-link library (DLL) for MS Windows and shared library for Linux (x86 and ARM platforms). The API connects to the modem via USB (virtual serial port) and implements the communication protocol with modem.

In addition to the API library, the software package includes C example software, which was used for testing of the API and includes calls of all API functions.

The example can be used as a basis for developing of a user's software and for porting API library interface (file 'marvelmind_api.c') to other programming languages.

Tested on:

1. MS Windows 10; CPU: Intel Core i5
2. Ubuntu 20.04; CPU: Intel Core i5
3. Raspbian (2018-11-13-raspbian-stretch-full); Platform: Raspberry Pi 3 Model B+

11.1 Installation for Windows

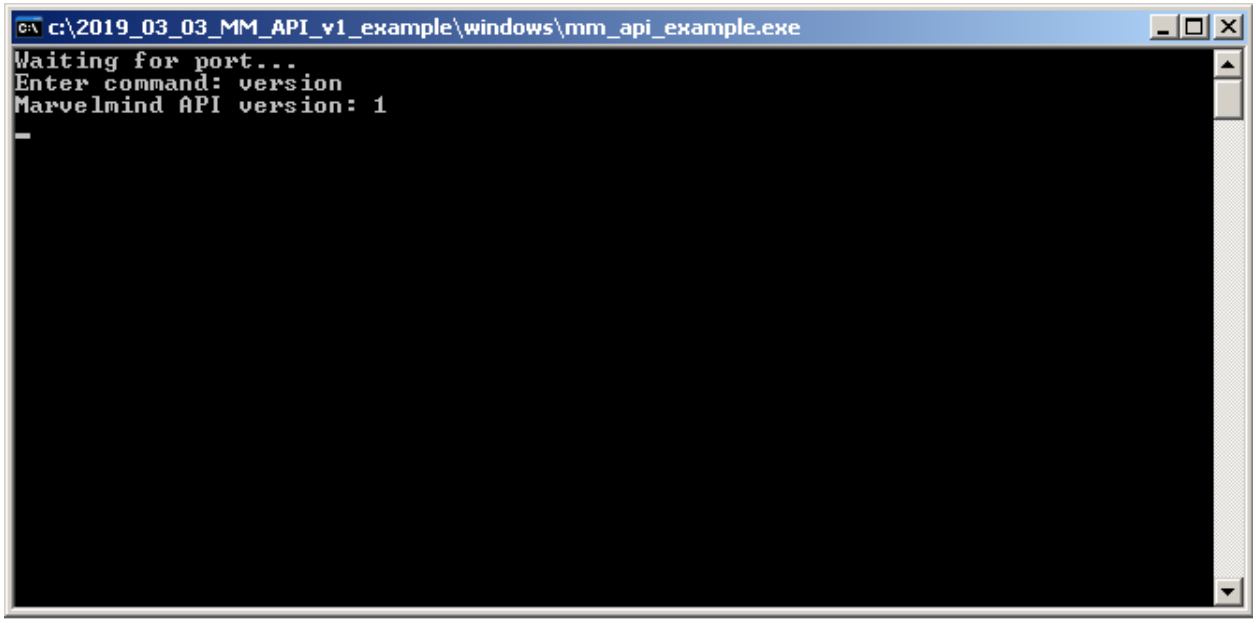
- Download Marvelmind API software package. Copy Dashboard API and example software to directory that you will use for the program. Beacons the Windows version of the example is coming with prebuilt executable file, you can immediately run ‘mm_api_example.exe’ from the ‘windows’ directory coming in API software package.

11.2 Installation for Linux

- Download Marvelmind API software package. Copy Dashboard API to directory that you will use for the program. Note the Linux version is provided for two hardware platforms: **x86** (most of laptops based on Intel or AMD CPU) and **arm** (for example, single-board computers like Raspberry PI)
- Copy library **libdashapi.so** corresponding to your platform to the directory **/usr/local/lib** by executing command **sudo cp libdashapi.so /usr/local/lib** in terminal opened in directory with **libdashapi.so**. After that, execute **sudo ldconfig** in terminal.
- May be, you will need to give rights for your user to access serial port by adding him to **dialout** group:
  - Execute in terminal: **sudo adduser $USER dialout**
  - Add to the directory **/etc/udev/rules.d** file "**99-tty.rules**" with following content:
    #Marvelmind serial port rules
    KERNEL=="ttyACM0",GROUP="dialout",MODE="666"
- Build the example software – execute 'make all' in terminal opened in 'source' directory coming with the package
- Run the example by typing './mm_api_example' in terminal

11.3 Check connection to API

After running example software, press “space” button in terminal, type command ‘version’ and press enter. If the example software prints version of API, it can communicate with API library.



11.4 Marvelmind API library description

API is coming as dynamic-link library (DLL) for MS Windows and shared library for Linux (x86 and ARM platforms). The library includes set of functions for monitoring and controlling Marvelmind system via modem connected to USB port of the computer. This section of document contains description of all these functions.

To provide more compatibility with different programming languages, most of complex data structures are passing via untyped pointers to memory. Functions description include offset of every data field in the memory pool. In the file 'marvelmind_api.c' from the example software you can see implementation of moving data between memory pools and fields in C structures.

Types of parameters in the description are shown in C syntax. Here is description of the types:

Type	Size (bytes)	Description
bool	1	Boolean type. Zero means false, non-zero means true
uint8_t	1	Unsigned integer value, 0…255
int8_t	1	Signed integer value in two's complement format, -128…127
uint16_t	2	Unsigned integer value, 0…65535
int16_t	2	Signed integer value in two's complement format, -32768…32767
uint32_t	4	Unsigned integer value, 0…4294967295
int32_t	4	Signed integer value in two's complement format, -2147483648…2147483647
void *	4/8	Memory pointer (address in memory). 4 bytes for 32-bit platforms, 8 bytes for 64-bit platforms.

Each function description includes set of API versions where this function is available. New API versions will support more functions for new features in Marvelmind system. Now not all features available in Dashboard are available via API, so if you need more API functions please ask at info@marvelmind.com.

List of supported functions:

Function	API versions	License needed
Get version of Marvelmind API library	V1+	none
Get last error	V6+	none
Try to open serial port	V1+	none
Try to open serial port by given name	V2+	none
Try to open UDP port	V9+	none
Close serial port	V1+	none
Get version and CPU ID of Marvelmind device	V1+	none
Get list of devices	V1+	none
Wake device	V1+	none
Send device to sleep	V1+	none
Get telemetry data from beacon	V1+	none
Get latest location data	V1+	none
Get latest location data (with angle)	V3+	none
Set location of the beacon	V3+	MMSW0005
Set distance between beacons	V4+	MMSW0005
Get latest raw distances data	V1+	none
Get height of the hedgehog	V4+	none
Set height of the hedgehog	V4+	MMSW0005
Get height of stationary beacon in submap	V4+	none
Set height of stationary beacon in submap	V4+	MMSW0005
Get location update rate setting	V1+	none
Set location update rate setting	V1+	MMSW0005
Add submap	V1+	MMSW0005
Delete submap	V1+	MMSW0005
Freeze submap	V1+	MMSW0005
Unfreeze submap	V1+	MMSW0005
Get submap settings	V1+	none
Set submap settings	V1+	MMSW0005
Freese map	V4+	MMSW0005
Unfreeze map	V4+	MMSW0005
Get ultrasonic settings of the beacon	V1+	none
Set ultrasonic settings of the beacon	V1+	MMSW0005
Erase map	V1+	MMSW0005
Reset device to default settings	V1+	MMSW0005
Connect beacons to axes	V2+	MMSW0005
Read modem's configuration memory dump	V3+	MMSW0005
Write modem's configuration memory dump	V3+	MMSW0005
Get temperature of air setting from modem	V3+	none
Set temperature of air setting in modem	V3+	none
Software reset of the device	V3+	none
Get beacon real-time player settings	V6+	none
Set beacon real-time player settings	V6+	MMSW0005
Get georeferencing settings	V6+	none
Set georeferencing settings	V6+	MMSW0005
Get mode of updating positions	V6+	none
Set mode of updating positions	V6+	MMSW0005
Command to update positions	V6+	MMSW0005
Set geofencing alarm state for the beacon	V9+	MMSW0005

		MMSW0006
Send generic user payload data	V9+	MMSW0005
Get generic user payload data	V9+	MMSW0005
Send command for manual distances measurement	V9+	MMSW0011
Get streaming data from modem	V9+	none
Check if the device type is modem	V1+	none
Check if the device type is stationary beacon	V1+	none
Check if the device type is hedgehog	V1+	none

11.4.1.1 Get version of Marvelmind API library

Reads version of the API library. Required to ensure the needed functions are available in this version of library.

Function name: **mm_api_version**
Declaration in C: bool mm_api_version(void *pdata);
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
void *	Pointer to data to be filled

Structure of data returned via pointer.

Type	Description
uint32_t	Version of API library

11.4.1.2 Get last error

Reads status of last operation with API library to differ causes of the error.

Function name: **mm_get_last_error**
Declaration in C: bool mm_get_last_error(void *pdata);
Available for API versions: V6+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
void *	Pointer to data to be filled

Structure of data returned via pointer.

Type	Description
uint32_t	Status of last operation: 0: operation successfully executed 1: communication error 2: error opening serial port 3: license is required

11.4.1.3 Open serial port

Opens port where Marvelmind device (modem or beacon) is connected via USB (virtual serial port). You don't need to specify serial port name, because the API searching all serial ports and checks whether it corresponds to Marvelmind device or no.

Function name: **mm_open_port**
Declaration in C: bool mm_open_port ();
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, port is opened false – error in execution

Parameters: none

11.4.1.4 Open serial port by given name

Opens port where Marvelmind device (modem or beacon) is connected via USB (virtual serial port). Function tries to open port with specified name.

Function name: **mm_open_port_by_name**
Declaration in C: bool mm_open_port_by_name(void *pdata);
Available for API versions: V2+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, port is opened false – error in execution

Parameters:

Type	Description
void *	Pointer to serial port name – sequence of ASCII characters terminated by zero (ASCIIZ)

10.4.4.1. Open UDP port

Allows to establish communication with Super-Modem via UDP instead USB.

Function name: **mm_open_port_udp**
Declaration in C: bool mm_open_port_udp(void *pdata);
Available for API versions: V9+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, UDP port is opened false – error in execution

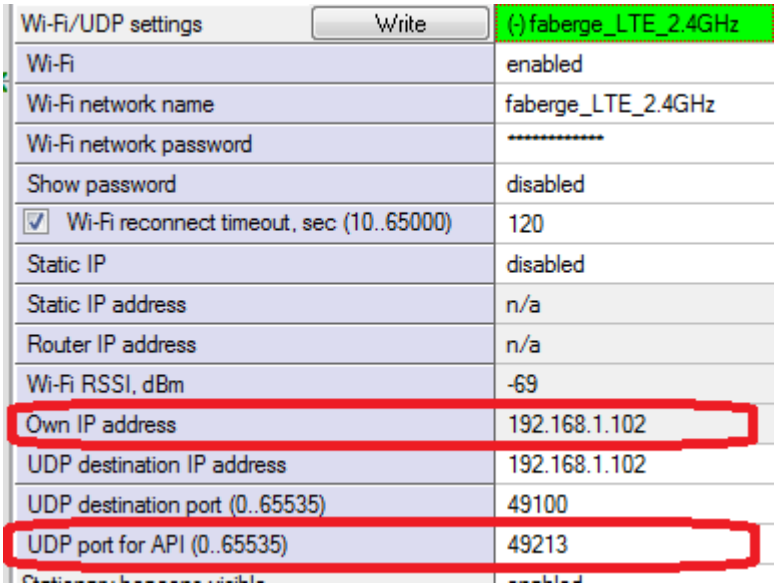
Parameters:

Type	Description
void *	Pointer to the structure of UDP settings (see below)

Structure of data by the pointer:

Type	Description
uint16_t	UDP port to connect
uint16_t	Timeout of communication, ms
uint16_t	reserved
Up to 255 bytes	IP address– sequence of ASCII characters terminated by zero (ASCIIZ)

IP address and UDP port should correspond to the settings of the Super-Modem (see screenshot below).



11.4.1.5 Close serial port

Closes port, if it was previously opened by **mm_open_port** function.
Function name: **mm_close_port**
Declaration in C: bool mm_close_port ();
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, port is closed false – error in execution

Parameters: none

11.4.1.6 Get version and CPU ID of Marvelmind device

Reads version and CPU ID. Version includes information about firmware version and type of device hardware. CPU ID is the unique ID of the device item.

Function name: **mm_get_device_version_and_id**
Declaration in C: bool mm_get_device_version_and_id (uint8_t address, void *pdata);
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, version and CPU ID data retrieved false – error in execution

Parameters:

Type	Description
uint8_t	Address of Marvelmind device (1…254)
void *	Pointer to data to be filled

Structure of data returned via pointer:

Type	Description
uint8_t	Major version of firmware (example: “6”, for version V6.07a)
uint8_t	Minor version of firmware (example: “7”, for version V6.07a)
uint8_t	Second minor version of firmware (example: “1”, for version V6.07a)
uint8_t	Device type ID (see appendix).
uint8_t	Firmware options (TBD).
uint32_t	CPU ID. Printing this value as hexadecimal gives CPU ID in form shown in dashboard and on the stickers on devices.

11.4.1.7 Get list of devices

Reads list of Marvelmind devices known to modem. The list includes list of all devices connected by radio to modem's network, including sleeping devices.

Function name: **mm_get_devices_list**
Declaration in C: bool mm_get_devices_list (void *pdata);
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, list of devices is retrieved false – error in execution

Parameters:

Type	Description
void *	Pointer to data to be filled

Structure of data returned via pointer:

Type	Description
uint8_t	Number of following devices in the list (N)
N*9 bytes	Sequence of N devices structures, described in next table

Structure of each device in the list:

Type	Description
uint8_t	Address of device
bool	true = duplicated address - more than 1 device with same address was found false = not duplicated address
bool	true = device is sleeping false = device not sleeping
uint8_t	Major version of firmware (example: "6", for version V6.07a)
uint8_t	Minor version of firmware (example: "7", for version V6.07a)
uint8_t	Second minor version of firmware (example: "1", for version V6.07a)
uint8_t	Device type ID (see appendix).
uint8_t	Firmware options (TBD).
uint8_t	Flags: Bit 0: 1 – device connection complete – device has confirmed connection 0 – waiting for confirmation from device (like 'Connecting…' in dashboard). Bit 1…7 - TBD

11.4.1.8 Wake device

Sends command to wake specified device. If wake command was sent and such device is existing, the device will connect to modem in several seconds and will appear in devices list.

Function name: **mm_wake_device**
Declaration in C: bool mm_wake_device (uint8_t address);
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, wake command was sent false – error in execution

Parameters:

Type	Description
uint8_t	1…254 - address of Marvelmind device to wake 0 – wake all devices

11.4.1.9 Send device to sleep

Send to sleep existing device.

Function name: **mm_send_to_sleep_device**
Declaration in C: bool mm_send_to_sleep_device (uint8_t address);
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, sleep command was sent false – error in execution

Parameters:

Type	Description
uint8_t	1…254 - address of Marvelmind device to sleep 0 – send to sleep all devices

11.4.1.10 Get telemetry data from beacon

Reads telemetry data of Marvelmind beacon.

Function name: **mm_get_beacon_telemetry**
Declaration in C: bool mm_get_beacon_telemetry (uint8_t address, void *pdata);
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, telemetry is retrieved false – error in execution

Parameters:

Type	Description
uint8_t	Address of Marvelmind beacon (1…254)
void *	Pointer to data to be filled

Structure of data returned via pointer:

Type	Description
uint32_t	Working time of the beacon, seconds (time from reset or waking up).
int8_t	RSSI, dBm – radio signal strength
int8_t	Measured temperature, °C
uint16_t	Supply voltage, mV
16 bytes	Reserved (0)

11.4.1.11 Get latest location data

Reads latest updated coordinates pack from modem. Also reads user payload data if available.

Function name: **mm_get_last_locations**
Declaration in C: bool mm_get_last_locations(void *pdata);
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, location data was retrieved false – error in execution

Parameters:

Type	Description
void *	Pointer to data to be filled

Structure of data returned via pointer:

Type	Description
18*6 bytes	6 18-byte data structures of last updated coordinates, see table below
bool	true – new raw distances are available to read
5 bytes	TBD
uint8_t	User payload data size (M)
M bytes	User payload data

Structure of each location data item:

Type	Description
uint8_t	Address of device (1…254) 0 - this data item is not filled
uint8_t	Head index (TBD)
int32_t	X coordinate, mm
int32_t	Y coordinate, mm
int32_t	Z coordinate, mm
uint8_t	Status flags (TBD)
uint8_t	Quality of positioning, 0…100%
uint8_t	TBD
uint8_t	TBD

11.4.1.12 Get latest location data (with angle)

Reads latest updated coordinates pack from modem (with angle for paired beacons). Also reads user payload data if available.

Function name: **mm_get_last_locations2**
Declaration in C: bool mm_get_last_locations2(void *pdata);
Available for API versions: V3+
License required: none

Returned value:

Type	Description
bool	true – function successfully executed, location data was retrieved false – error in execution

Parameters:

Type	Description
void *	Pointer to data to be filled

Structure of data returned via pointer:

Type	Description
20*6 bytes	6 20-byte data structures of last updated coordinates, see table below
bool	true – new raw distances are available to read
5 bytes	TBD
uint8_t	User payload data size (M)
M bytes	User payload data

Structure of each location data item:

Type	Description
uint8_t	Address of device (1…254) 0 - this data item is not filled
uint8_t	Head index (TBD)
int32_t	X coordinate, mm
int32_t	Y coordinate, mm
int32_t	Z coordinate, mm
uint8_t	Status flags (TBD)
uint8_t	Quality of positioning, 0…100%
uint8_t	TBD
uint8_t	TBD
uint16_t	Bit 0…11 – angle of rotation in 1/10 degree (if paired beacons feature is enabled) Bit 12 – 1 = angle not available Bit 13…15 - reserved

11.4.1.13 Set location of the beacon

Manual setup of location of the specified beacon.

Function name: **mm_set_beacon_location**
Declaration in C: bool mm_set_beacon_location (uint8_t address, void *pdata);
Available for API versions: V3+
License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, location is updated false – error in execution

Parameters:

Type	Description
uint8_t	Address of the beacon
void *	Pointer to buffer with location data

Structure of data by pointer (should be filled before function call):

Type	Description
int32_t	New X coordinate of the beacon, mm
int32_t	New Y coordinate of the beacon, mm
int32_t	New Z coordinate of the beacon, mm

11.4.1.14 Set distance between beacons

Manual setup of distance between beacons.

Function name: **mm_set_beacons_distance**
Declaration in C: bool mm_set_beacons_distance (void *pdata);
Available for API versions: V4+
License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, distance is written false – error in execution

Parameters:

Type	Description
void *	Pointer to buffer with distance data

Structure of data by pointer (should be filled before function call):

Type	Description
uint8_t	Address of first beacon
uint8_t	Address of second beacon
int32_t	Distance between beacons, mm

11.4.1.15 Get latest raw distances data

Reads latest updated raw distances pack from modem.

Function name: **mm_get_last_distances**
Declaration in C: bool mm_get_last_distances(void *pdata);
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, raw distances data was retrieved false – error in execution

Parameters:

Type	Description
void *	Pointer to data to be filled

Structure of data returned via pointer:

Type	Description
uint8_t	Number of raw distances data items (N). Maximum number of raw distances per request is 16: N<=16
9*N bytes	N 9-byte data structures of last raw distances, see table below

Structure of each raw distance data item:

Type	Description
uint8_t	Address of ultrasonic RX device (1…254) 0 - this data item is not filled
uint8_t	RX Head index (TBD)
uint8_t	Address of ultrasonic TX device (1…254) 0 - this data item is not filled
uint8_t	TX Head index (TBD)
uint32_t	Distance from TX device to RX device, mm
uint8_t	TBD

11.4.1.16 Get height of the hedgehog

Returns height of mobile beacon (hedgehog).

Function name: **mm_get_hedge_height**
Declaration in C: bool mm_get_hedge_height (uint8_t address, void *pdata);
Available for API versions: V4+
License required: none

Returned value:

Type	Description
bool	true – function successfully executed, height is returned false – error in execution

Parameters:

Type	Description
uint8_t	Address of the hedgehog
void *	Pointer to buffer with height data

Structure of data by pointer:

Type	Description
int32_t	Height of the hedgehog, mm

11.4.1.17 Set height of the hedgehog

Setup height of mobile beacon (hedgehog).

Function name: **mm_set_hedge_height**
Declaration in C: bool mm_set_hedge_height (uint8_t address, void *pdata);
Available for API versions: V4+
License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, height is changed false – error in execution

Parameters:

Type	Description
uint8_t	Address of the hedgehog
void *	Pointer to buffer with height data

Structure of data by pointer (should be filled before function call):

Type	Description
int32_t	Height of the hedgehog, mm

11.4.1.18 Get height of the stationary beacon in submap

Returns height of stationary beacon in submap.

Function name: **mm_get_beacon_height**
Declaration in C: bool mm_get_beacon_height (uint8_t address, void *pdata);
Available for API versions: V4+
License required: none

Returned value:

Type	Description
bool	true – function successfully executed, height is returned false – error in execution

Parameters:

Type	Description
uint8_t	Address of the beacon
void *	Pointer to buffer with height data

Structure of data by pointer:

Type	Description
uint8_t	Submap ID, should be filled before function call
int32_t	Height of the beacon, mm

11.4.1.19 Set height of the stationary beacon in submap

Setup height of stationary beacon in submap.

Function name: **mm_set_beacon_height**
Declaration in C: bool mm_set_beacon_height (uint8_t address, void *pdata);
Available for API versions: V4+
License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, height is changed false – error in execution

Parameters:

Type	Description
uint8_t	Address of the beacon
void *	Pointer to buffer with height data

Structure of data by pointer (should be filled before function call):

Type	Description
uint8_t	Submap ID
int32_t	Height of the beacon, mm

11.4.1.20 Get location update rate setting

Reads location update rate setting from modem.

Function name: **mm_get_update_rate_setting**
Declaration in C: bool mm_get_update_rate_setting (void *pdata);

Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, update rate was retrieved false – error in execution

Parameters:

Type	Description
void *	Pointer to data to be filled

Structure of data returned via pointer:

Type	Description
uint32_t	Location update rate setting in mHz. So, 1000 is returned for 1 Hz, 16000 for 16 Hz, 50 for 0.05 Hz mode.

11.4.1.21 Set location update rate setting

Writes location update rate setting to modem.

Function name: **mm_set_update_rate_setting**
Declaration in C: bool mm_set_update_rate_setting (void *pdata);

Available for API versions: V1+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, update rate was changed false – error in execution

Parameters:

Type	Description
void *	Pointer to data

Structure of data by pointer (should be filled before function call):

Type	Description
uint32_t	Location update rate setting in mHz. So, 1000 is returned for 1 Hz, 16000 for 16 Hz, 50 for 0.05 Hz mode. The system will use most close to specified update rate from the series: 0.05 Hz, 0.1 Hz, 0.2 Hz, 0.5Hz, 1 Hz, 2 Hz, 4 Hz, 8 Hz, 12 Hz, 16 Hz, 16+Hz.

11.4.1.22 Add submap

Adds new submap.

Function name: **mm_add_submap**
Declaration in C: bool mm_add_submap (uint8_t submapId);
Available for API versions: V1+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, submap was added false – error in execution

Parameters:

Type	Description
uint8_t	Submap ID to add (0…254)

11.4.1.23 Delete submap

Delete existing submap.

Function name: **mm_delete_submap**
Declaration in C: bool mm_delete_submap (uint8_t submapId);
Available for API versions: V1+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, submap was removed false – error in execution

Parameters:

Type	Description
uint8_t	Submap ID to delete (0…254)

11.4.1.24 Freeze submap

Freezes submap.

Function name: **mm_freeze_submap**
Declaration in C: bool mm_freeze_submap (uint8_t submapId);
Available for API versions: V1+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, submap is frozen false – error in execution

Parameters:

Type	Description
uint8_t	Submap ID to freeze (0…254)

11.4.1.25 Unfreeze submap

Unfreezes submap.

Function name: **mm_unfreeze_submap**
Declaration in C: bool mm_unfreeze_submap (uint8_t submapId);
Available for API versions: V1+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, submap is unfrozen false – error in execution

Parameters:

Type	Description
uint8_t	Submap ID to unfreeze (0…254)

11.4.1.26 Get submap settings

Reads submap settings from modem.

Function name: **mm_get_submap_settings**
Declaration in C: bool mm_get_submap_settings (uint8_t submapId , void *pdata);
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, submap settings were retrieved false – error in execution

Parameters:

Type	Description
uint8_t	Submap ID (0…254)
void *	Pointer to data to be filled

Structure of data returned via pointer:

Type	Description
uint8_t	Starting beacon trilateration
uint8_t	Starting set of beacons, beacon 1
uint8_t	Starting set of beacons, beacon 2
uint8_t	Starting set of beacons, beacon 3
uint8_t	Starting set of beacons, beacon 4
bool	true = 3D navigation enabled
bool	true = Submap is used only for Z coordinate
bool	true = manual limitation distance false = auto limitation distance
uint8_t	Maximum distance, meters (for manual limitation distances)
int16_t	Submap X shift, cm
int16_t	Submap Y shift, cm
int16_t	Submap Z shift, cm
uint16_t	Submap rotation, centidegrees
int16_t	Plane rotation quaternion, W (quaternion is normalized to 10000)
int16_t	Plane rotation quaternion, X
int16_t	Plane rotation quaternion, Y
int16_t	Plane rotation quaternion, Z
int16_t	Service zone thickness, cm
int16_t	Hedges height in 2D mode
bool	true = submap is frozen
bool	true = submap is locked
bool	true = stationary beacons are higher than mobile
bool	true = submap is mirrored
4 bytes	List of addresses of beacons in submap (0 = none)
8 bytes	List of ID’s of nearby submaps (255 = none)
uint8_t	Number of service zone polygon points (P)
P*4 bytes	List of service zone polygon points structures (see below)

Structure of service zone polygon point:

Type	Description
int16_t	X, cm
int16_t	Y, cm

11.4.1.27 Set submap settings

Writes submap settings to modem.

Function name: **mm_set_submap_settings**
Declaration in C: bool mm_set_submap_settings (uint8_t submapId , void *pdata);
Available for API versions: V1+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, submap settings were changed false – error in execution

Parameters:

Type	Description
uint8_t	Submap ID (0…254)
void *	Pointer to data to be written (see 'get submap settings' function).

11.4.1.28 Freeze map

Freezes submap.

Function name: **mm_freeze_map**
Declaration in C: bool mm_freeze_map ();
Available for API versions: V4+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, map is frozen false – error in execution

11.4.1.29 Unfreeze map

Freezes submap.

Function name: **mm_unfreeze_map**
Declaration in C: bool mm_freeze_map ();
Available for API versions: V4+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, map is unfrozen false – error in execution

11.4.1.30 Get ultrasonic settings of the beacon

Reads ultrasonic settings from specified beacon.

Function name: **mm_get_ultrasound_settings**
Declaration in C: bool mm_get_ultrasound_settings (uint8_t address , void *pdata);
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, ultrasonic settings were retrieved false – error in execution

Parameters:

Type	Description
uint8_t	Address of the beacon (1…254)
void *	Pointer to data to be filled

Structure of data returned via pointer:

Type	Description
uint16_t	Frequency of ultrasound TX (not relevant for DSP RX-only beacons)
uint8_t	Number of TX periods (not relevant for DSP RX-only beacons)
bool	true= use AGC for RX false = manual gain for RX
uint16_t	Manual gain value (0…4000)
bool	true = Sensor RX1 is enabled in normal mode
bool	true = Sensor RX2 is enabled in normal mode
bool	true = Sensor RX3 is enabled in normal mode
bool	true = Sensor RX4 is enabled in normal mode
bool	true = Sensor RX5 is enabled in normal mode
bool	true = Sensor RX1 is enabled in frozen mode
bool	true = Sensor RX2 is enabled in frozen mode
bool	true = Sensor RX3 is enabled in frozen mode
bool	true = Sensor RX4 is enabled in frozen mode
bool	true = Sensor RX5 is enabled in frozen mode
uint8_t	Index of DSP RX filter (relevant only for DSP beacons) 0 = 19 kHz 1 = 25 kHz 2 = 31 kHz 3 = 37 kHz 4 = 45 kHz

11.4.1.31 Set ultrasonic settings of the beacon

Write ultrasonic settings to specified beacon.

Function name: **mm_set_ultrasound_settings**
Declaration in C: bool mm_set_ultrasound_settings (uint8_t address, void *pdata);
Available for API versions: V1+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, ultrasonic settings were changed false – error in execution

Parameters:

Type	Description
uint8_t	Address of the beacon (1…254)
void *	Pointer to data to be written (see 'get ultrasonic settings' function).

11.4.1.32 Erase map

Erase map in modem – remove all submaps (except submap 0), reset submap 0 to initial state, remove all connected beacons from network.

Function name: **mm_erase_map**
Declaration in C: bool mm_erase_map ();
Available for API versions: V1+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, map erased false – error in execution

Parameters: none

11.4.1.33 Reset device to default settings

Reset device to default settings (radio, ultrasonic etc).

Function name: **mm_set_default_settings**
Declaration in C: bool mm_set_default_settings (uint8_t address);
Available for API versions: V1+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, device was reset to default settings false – error in execution

Parameters:

Type	Description
uint8_t	Address of the device (1…254) 255 – reset to default the device connected via USB

11.4.1.34 Connect beacons to axes

Shift map so selected beacons will be on axes.

Function name: **mm_beacons_to_axes**
Declaration in C: bool mm_beacons_to_axes (uint8_t address_0, uint8_t address_x, uint8_t address_y);
Available for API versions: V2+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, map shifted false – error in execution

Parameters:

Type	Description
uint8_t	address_0 – address of beacon which should be in the center (X=0, Y=0)
uint8_t	address_x – address of beacon which should be along X axis (Y= 0)
uint8_t	address_y – address of beacon which should be in positive direction of Y (Y>0)

11.4.1.35 Read dump of modem's configuration memory

Reads dump of modem's configuration memory. Allows saving modem's settings and stored map.

Function name: **mm_read_flash_dump**
Declaration in C: bool mm_read_flash_dump(uint32_t offset, uint32_t size, void *pdata);

Available for API versions: V3+
License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, dump was read false – error in execution

Parameters:

Type	Description
uint32_t	offset – offset from start of configuration memory, bytes
uint32_t	size – size of data to read, bytes
void *	pdata – pointer to user's buffer for receiving data

11.4.1.36 Write dump of modem's configuration memory

Write data dump to modem's configuration memory. Allows to restore modem's settings and map.

Function name: **mm_write_flash_dump**

Declaration in C: bool mm_write_flash_dump(uint32_t offset, uint32_t size, void *pdata);

Available for API versions: V3+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed, dump was written false – error in execution

Parameters:

Type	Description
uint32_t	offset – offset from start of configuration memory, bytes For correct operation offset should be aligned to 4096 bytes page (value 0, 4096, 8192 and so on).
uint32_t	size – size of data to write, bytes
void *	pdata – pointer to user's buffer with data

Note: After writing the configuration, software reset of the modem (**mm_reset_device(255)**) is recommended to apply new settings and prevent overwriting them.

11.4.1.37 Restart (soft reset) of the device

Executes software reset for specified device.

Function name: **mm_reset_device**

Declaration in C: bool mm_reset_device (uint8_t address);

Available for API versions: V3+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, device is resetting false – error in execution

Parameters:

Type	Description
uint8_t	Address of the device (1…254) 255 –software reset for device connected via USB

11.4.1.38 Read temperature of air setting from modem

Reads temperature of air setting (in Celsius degrees) from modem.

Function name: **mm_get_air_temperature**

Declaration in C: bool mm_get_air_temperature (void *pdata);

Available for API versions: V3+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, temperature is returned false – error in execution

Structure of data returned via pdata pointer:

Type	Description
int8_t	Temperature of air, Celsius degrees

11.4.1.39 Write temperature of air setting to modem

Setup temperature of air setting (in Celsius degrees) in modem.

Function name: **mm_set_air_temperature**

Declaration in C: bool mm_set_air_temperature (void *pdata);

Available for API versions: V3+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed, temperature was written false – error in execution

Structure of data which user should supply via pdata pointer:

Type	Description
int8_t	Temperature of air, Celsius degrees

11.4.1.40 Get beacon real-time player settings

Reads real-time player settings for the beacon.

Function name: **mm_get_realtime_player_settings**

Declaration in C: bool mm_get_realtime_player_settings (uint8_t address, void *pdata);

Available for API versions: V6+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
uint8_t	address - address of the beacon (1…254)
void *	pdata - pointer to data to be filled

Structure of data returned via pointer:

Type	Description
bool	true = real-time player is enabled
uint8_t	Number of real-time player forward samples to process
uint8_t	Number of real-time player backward samples to process
uint8_t	Reserved (0)
uint8_t	Reserved (0)

11.4.1.41 Set beacon real-time player settings

Setup real-time player settings for the beacon.

Function name: **mm_set_realtime_player_settings**

Declaration in C: bool mm_set_realtime_player_settings (uint8_t address, void *pdata);

Available for API versions: V6+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
uint8_t	address - address of the beacon (1…254)
void *	pdata - pointer to data to write (see 'Get beacon real-time player settings' function)

11.4.1.42 Get georeferencing settings

Reads georeferencing settings (geo location of point (X=0 ,Y=0) of Marvelmind map).

Function name: **mm_get_georeferencing_settings**

Declaration in C: bool mm_get_georeferencing_settings (void *pdata);

Available for API versions: V6+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
void *	pdata - pointer to data to be filled

Structure of data returned via pointer:

Type	Description
int32_t	Latitude, $x10^{-7}$ degrees
int32_t	Longitude, $x10^{-7}$ degrees

11.4.1.43 Set georeferencing settings

Setup georeferencing settings (geo location of point (X=0 ,Y=0) of Marvelmind map).

Function name: **mm_set_georeferencing_settings**

Declaration in C: bool mm_set_georeferencing_settings (void *pdata);

Available for API versions: V6+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
void *	pdata - pointer to data to write (see 'Get georeferencing settings' function)

11.4.1.44 Get mode of updating positions

Reads current mode of updating positions of mobile beacons.

Function name: **mm_get_update_position_mode**

Declaration in C: bool mm_get_update_position_mode (void *pdata);

Available for API versions: V6+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
void *	pdata - pointer to data to be filled

Structure of data returned via pointer:

Type	Description
uint8_t	Mode of updating positions of mobile beacons: 0 – auto update positions (default mode) 1 – update positions by user request at next update cycle 2 – update positions by user request immediately
7 bytes	Reserved (0)

11.4.1.45 Set mode of updating positions

Setup mode of updating positions of mobile beacons.

Function name: **mm_set_update_position_mode**

Declaration in C: bool mm_set_update_position_mode (void *pdata);

Available for API versions: V6+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
void *	pdata - pointer to data to write (see function 'Get mode of updating positions')

11.4.1.46 Command to update positions

Send command to update positions of mobile beacons (if update mode is not automatic).

Function name: **mm_set_update_position_command**

Declaration in C: bool mm_set_update_position_command (void *pdata);

Available for API versions: V6+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
void *	pdata - pointer to data to write

Structure of data by pointer:

Type	Description
8 bytes	Reserved (0)

11.4.1.47. Set geofencing alarm state for the beacon

Send command to setup alarm state on the beacon's alarm pin (for Super-Beacon).

Alarm state of the pin can be specified via 'Alarm pin mode' setting in the 'Interfaces' section of settings in the dashboard (if MMSW0006 license is activated).

Function name: **mm_set_alarm_state**

Declaration in C: bool mm_set_alarm_state (uint8_t address, void *pdata);

Available for API versions: V9+

License required: MMSW0005, MMSW0006

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
uint8_t	address - address of the beacon (1…254)
void *	pdata - pointer to data to write

Structure of data by pointer:

Type	Description
uint8_t	Alarm pin mode: 0 – pin is automatically controlled according to geofencing status 1 – pin is manually controlled – no alarm state 2 – pin is manually controlled – alarm state
uint8_t	Geofencing zone index – number of geofencing zone which beacon will stream out in the alarm state
6 bytes	Reserved (0)

11.4.1.48. Send generic user payload data

Sends generic user payload data. If the API is connected to the modem, data will be transmitted via UART/USB port of the specified mobile beacon. If the API is connected to the mobile beacon, data will be transmitted via UART/USB port of the modem. Received data are available on the remote side by receiving API function, Arduino examples, ROS and other software.

Function name: **mm_send_user_payload_data**

Declaration in C: bool mm_send_user_payload_data (uint8_t address, void *pdata);

Available for API versions: V9+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
uint8_t	address - address of the beacon (1…254) if the API is connected to modem n/a if the API is connected to the beacon
void *	pdata - pointer to data to write

Structure of data by pointer:

Type	Description
uint8_t	Size of data to transmit
256 bytes	Generic data buffer to transmit

11.4.2. Get generic user payload data

Receives generic user payload data, sent by transmitting API function, Arduino, ROS or other user software. If the API is connected to the modem, this function can receive data transmitted via UART/USB port of the mobile beacon. If the API is connected to the mobile beacon, this function can receive data transmitted via the modem.

Function name: **mm_get_user_payload_data**

Declaration in C: bool mm_get_user_payload_data (void *pdata);

Available for API versions: V9+

License required: MMSW0005

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
void *	pdata - pointer to data to receive

Structure of received data by pointer:

Type	Description
uint8_t	address – address of the beacon
int64_t	Timestamp of data transmission – number of milliseconds from 01.01.1970 (Unix time)
uint8_t	Size of data to transmit
256 bytes	Buffer of received data

11.4.3. Send command for manual distances measurement

Sends command for measurement distances from specified beacon to other beacons in the system. In current version of software **supported in IA** (Inverse architecture).

Function name: **mm_send_distances_measurement_command**

Declaration in C: bool mm_send_distances_measurement_command (void *pdata);

Available for API versions: V9+

License required: MMSW0011

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
void *	pdata - pointer to data to send

Structure of data by pointer:

Type	Description
uint8_t	Mode: 0 – auto 1 – manual (by this command)
uint8_t	Address of the beacon
uint32_t	Maximum distance to measure, mm
8 bytes	Reserved

11.4.4. Get streaming data from modem

Reads modem's streaming data in the previously described format.

Function name: **mm_get_stream_data**

Declaration in C: bool mm_get_stream_data (void *pdata);

Available for API versions: V9+

License required: none

Returned value:

Type	Description
bool	true – function successfully executed false – error in execution

Parameters:

Type	Description
void *	pdata - pointer to data to send

Structure of data by pointer:

Type	Description
uint8_t	Number of stream records in this reply (0…16)
138*16 bytes	16 streaming records by 138 bytes (see below)
8 bytes	Reserved

Structure of stream record:

Type	Description
uint8_t	Record size, bytes
uint8_t	Record type. Same value as 'line type' in the dashboard log file. For example, 41 means Marvelmind protocol data
8 bytes	Reserved
128 bytes	Stream record data

11.4.5. Check whether device type is modem

Checks whether the specified device type corresponds to modem.

Function name: **mm_device_is_modem**
Declaration in C: bool mm_device_is_modem (uint8_t deviceType);
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – specified device type corresponds to modem

Parameters:

Type	Description
uint8_t	Device type to check

11.4.6. Check whether device type is stationary beacon

Checks whether the specified device type corresponds to stationary beacon.

Function name: **mm_device_is_beacon**
Declaration in C: bool mm_device_is_beacon (uint8_t deviceType);
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – specified device type corresponds to stationary beacon

Parameters:

Type	Description
uint8_t	Device type to check

11.4.7. Check whether device type is hedgehog

Checks whether the specified device type corresponds to hedgehog.

Function name: **mm_device_is_hedgehog**
Declaration in C: bool mm_device_is_hedgehog (uint8_t deviceType);
Available for API versions: V1+

License required: none

Returned value:

Type	Description
bool	true – specified device type corresponds to hedgehog

Parameters:

Type	Description
uint8_t	Device type to check

11.5 Description of C example for Marvelmind API

C example is used for testing of Marvelmind API and can be used as basis for building of user application.

The C example is the console application. It was tested on following platforms:

- CPU: Intel Core 2 Duo, OS: MS Windows XP;
- CPU: Intel Core i5, OS: Linux Ubuntu 16.04;
- Raspberry Pi 3 Model B+, OS: Raspbian (2018-11-13-raspbian-stretch-full)

On the Windows platform the example was built with CodeBlocks IDE and so the example includes CodeBlocks project file.

On the Linux platforms, the example was built with using make utility and so the example includes makefile for this.

The example includes following modules:

File name	Description
main.c	Module with main () function. Calls of functions of example and implements simple command line interface.
marvelmind_example.c marvelmind_example.h	marvelmindStart() – initialization of the example marvelmindFinish() – called after finishing work with API marvelmindCycle() – frequently called from main loop Also, module includes several function for processing commands entered by user.
marvelmind_api.c marvelmind_api.h	marvelmindAPILoad() – loads API library marvelmindAPIFree() – frees memory used by API library All functions of communication with API library.
marvelmind_devices.c marvelmind_devices.h	Supports list of beacons retrieved from modem by calling 'get devices list' command. Each beacon includes data about its location and distances to other beacons.
marvelmind_pos.c marvelmind_pos.h	Reads latest location data and latest raw distances. Updates these data in the devices list.
marvelmind_utils.c marvelmind_utils.h	Some helper functions used by other modules.

How the example works:

1. Try to open serial port until success
2. When port is opened, the program reads version of device connected via USB. If this is modem, the program continues to execute next steps
3. When connected to modem, the program reads the devices list with 1 Hz rate. The devices list is compared with currently stored in marvelmind_devices.c module and the list in marvelmind_devices.c is updated, if any changes are detected. All changes are printed in console
4. When connected to modem, the program reads the latest location data with 20 Hz rate. If the flag of new raw distances data is set, the program reads latest raw distances. The program compares locations and distances with data in devices list in marvelmind_devices.c and updates the data if they are changed. All changed data are printed in console
5. If the program can't get latest location data for 10 times, it closes the port and returns to step 1 – tries to open the port again. Reopening of the port is needed for cases when modem was disconnected and connected back to USB

6. If user press '**space**' button, the program shows 'Enter command: ' message and waits for user command. Most of API functions are called by user command, see below for details

User commands:

If user press '**space**' button when program is running, the program shows message '**Enter command:** '. User should type command on keyboard and press **enter**.

The table below contains format of all user commands:

Commands group	Description
API version	Format of command: **version** Action: Prints version of API library
Exit from program	Format of command: **quit** Action: Finishes program execution
Sleep/wake	Format of command: **wake <address>** Action: Execute wake command. Examples: **wake 5** - send command to wake device 5 **wake 0** - send command to wake all devices
	Format of command: **sleep <address>** Action: Execute sending to sleep command. Examples: **sleep 5** - send to sleep device 5 **sleep 0** - send to sleep all devices
Default	Format of command: **default <address>** Action: Execute reset to default settings command. Examples: **default 5** - set default settings for device 5
Read telemetry	Format of command: **tele <address>** Action: Reads and prints telemetry data of beacon. Examples: **tele 5** - read and print telemetry of beacon 5
Submap commands	Format of command: **submap add <submapId>** Action: Execute command to add submap with specified submap ID. Example: **submap add 1** - add submap 1

	Format of command: **submap delete <submapId>** Action: Execute command to delete submap with specified submap ID. Example: **submap delete 1** - delete submap 1
	Format of command: **submap freeze <submapId>** Action: Execute command to freeze submap with specified submap ID. Example: **submap freeze 0** - freeze submap 0
	Format of command: **submap unfreeze <submapId>** Action: Execute command to unfreeze submap with specified submap ID. Example: **submap unfreeze 0** - unfreeze submap 0
	Format of command: **submap get <submapId>** Action: Execute command to get settings of submap with specified submap ID. Example: **submap get 0** - get and print settings of submap 0
	Format of command: **submap testset <submapId>** Action: Execute command to set settings of submap with specified submap ID. The program writes some predefined settings for testing of the command; please see the example code. Example: **submap testset 0** - modify settings of submap 0
Map commands	Format of command: **map erase** Action: Execute erase map command. Example: **map erase** - erase map in modem
	Format of command: **map freeze** Action: Execute freeze map command. Example:

	map freeze - freeze map
	Format of command: **map unfreeze** Action: Execute unfreeze map command. Example: **map unfreeze** - unfreeze map
Update rate commands	Format of command: **rate get** Action: Execute reading update rate setting command. Example: **rate get** - read and print update rate setting
	Format of command: **rate set <value>** Action: Execute change update rate setting command. Value is given in Hz Example: **rate set 0.5** - set update rate 0.5 Hz
Ultrasound commands	Format of command: **usound get <address>** Action: Execute reading ultrasonic settings for specified beacon. Example: **usound get 5** - read and print ultrasound settings of beacon 5
	Format of command: **usound testset <address>** Action: Execute writing ultrasonic settings for specified beacon. The program writes some predefined settings for testing of the command; please see the example code. Example: **usound testset 5** - modify ultrasound settings of beacon 5
Connect to axes command	Format of command: **axes <address_0> <address_x> <address_y>** Action: Execute connect beacons to axes command.. Example: **axes 3 4 5** - set beacon 3 to X=0, Y=0; beacon 4 along X (Y=0) and beacon 5 above X (Y>0)

Read configuration memory dump from modem	Format of command: **read_dump <offset> <size>** Action: Execute read dump of modem configuration memory command. Example: **read_dump 0 1000** - read first 1000 bytes from beginning of configuration memory
Write configuration memory test dump to modem	Format of command: **write_dump_test <offset> <size>** Action: Execute write dump of modem configuration memory command. Example: **write_dump_test 0 1000** - fills first 1000 bytes from beginning of configuration memory by test pattern
Software reset of device	Format of command: **reset <address>** Action: Execute software reset command. Example: **reset 255** - executes software reset for device connected via USB
Temperature of air commands	Format of command: **temperature get** Action: Execute reading temperature of air setting from modem Example: **temperature get** read and print ultrasound temperature of air setting
	Format of command: **temperature set <value>** Action: Execute writing temperature of air setting to modem Example: **temperature set 30** setup temperature of air setting to 30 Celsius degrees
Set location of beacon	Format of command: **setloc <address> <X > <Y > <Z>** Action: Execute set location of the beacon command. X, Y, Z are coordinates in meters. Example: **setloc 12 1.51 3.45 2.0** - sets location of beacon 12 to X= 1.51 m, Y= 3.45 m, Z= 2.0 m

Set distance between beacons	Format of command: **setdist <address1> <address2 > <distance>** Action: Execute set distance between beacons command. Address1 and address2 are addresses of beacons. Distance is distance in meters. Example: **setdist 12 13 16.5** - sets distance between beacons 12 and 13 to 16.5 meters
Heights commands	Format of command: **height_h get <address>** Action: Execute get hedge height command. Address is the address of the hedgehog. Example: **height_h get 15** - reads and prints height of hedgehog 15
	Format of command: **height_h set <address> <height>** Action: Execute set hedge height command. Address is the address of the hedgehog. Height in meters Example: **height_h set 15** 2.5 - setup height of hedgehog 15 to 2.5 meters
	Format of command: **height_b get <address> <submap_id>** Action: Execute get stationary beacon height command. Address is the address of the beacon. Submap_id is ID of submap where beacon belongs. Example: **height_b get 12 0** - reads and prints height of stationary beacon 12 in submap 0.
	Format of command: **height_b set <address> <submap_id> <height>** Action: Execute set stationary beacon height command. Address is the address of the hedgehog. Submap_id is ID of submap where beacon belongs. Height in meters Example: **height_b set 12 0 5.1** - setup height of beacon 12 in submap 0 to 5.1 meters
Real-time player commands	Format of command: **rtp get <address>** Action: Execute get real-time player settings command. Address is the address of the beacon. Example:

	rtp get 15 - reads and prints real-time player settings of beacon 15
	Format of command: **rtp testset <address>** Action: Execute set real-time player settings command. Address is the address of the beacon. The program writes some predefined settings for testing of the command; please see the example code. Example: **rtp testset 15** - setup test real-time player settings for beacon 15
Georeferencing commands	Format of command: **georef get** Action: Execute get georeferencing settings command. Example: **georef get** - reads and prints georeferencing settings
	Format of command: **georef set <latitude> <longitude>** Action: Execute set georeferencing settings command. Example: **georef set 10 20** – write georeferencing 10 degrees latitude, 20 degrees longitude
Update mode commands	Format of command: **update_mode get** Action: Execute get positions update mode command. Example: **update_mode get** - reads and prints positions update mode
	Format of command: **update_mode set <mode>** Action: Execute set positions update mode command. Example: **update_mode set 0** - set automatic mode of positions update
	Format of command: **update** Action: Execute update positions command. Example: **update** - update positions of mobile beacons according to current mode
Set geofencing alarm state	Format of command: **alarm <address> <mode> <zone>** Action: Execute set geofencing alarm state command. Example:

	alarm 10 2 5 - set geofencing alarm signal on the beacon n10 with geofencing zone number 5
User payload commands	Format of command: **payload read <address>** Action: Execute get user payload data command. Example: **payload read** - read user payload from any beacon/modem Example: **payload read 10** - read user payload from beacon n10
	Format of command: **payload write <address>** Action: Execute send user payload data command. Example: **payload write 10** - write test payload data to beacon n10 Test pattern is 40 bytes started from 100: 100,101,…, 139
Manual distance measurement command	Format of command: **distance <manual/auto> <address> <max distance>** Action: Execute manual distance measurement command. Example: **distance manual 10 5** – measure distances from beacon 10 to others, maximum distance 5 meters Example: **distance manual 10** – measure distances from beacon 10 to others, maximum distance 30 meters (default) Example: **distance auto** - return to automatic distances measurement mode

11.6 Device types

Here is the list of 'Device type ID' values for specific devices:

Device type ID	Device description
22	Beacon HW V4.5
23	Beacon HW V4.5 (hedgehog mode)
24	Modem HW V4.9
30	Beacon HW V4.9
31	Beacon HW V4.9 (hedgehog mode)
32	Beacon Mini-RX
36	Beacon Mini-TX
42	Super-Beacon, SuperBeacon-2, Super-Beacon-3
43	Super-Beacon, SuperBeacon-2, Super-Beacon-3 (hedgehog mode)
44	Industrial Super-Beacon, Industrial Super-Beacon-2, Industrial Super-Beacon-3, Industrial RX, Industrial RX-2, Industrial RX-3
45	Industrial Super-Beacon (hedgehog mode), Industrial Super-Beacon-2 (hedgehog mode), Industrial Super-Beacon-3 (hedgehog mode), Industrial RX (hedgehog mode), Industrial RX-2 (hedgehog mode), Industrial RX-3 (hedgehog mode)
46	Super-Modem
48	Modem HW V5.1
56	Super-Beacon-4
57	Super-Beacon-4 (hedgehog mode)
58	Industrial Super-Beacon -4, Industrial RX-4
59	Industrial Super-Beacon -4 (hedgehog mode), Industrial RX-4 (hedgehog mode)

You can get device type id from devices list and reading device version commands.

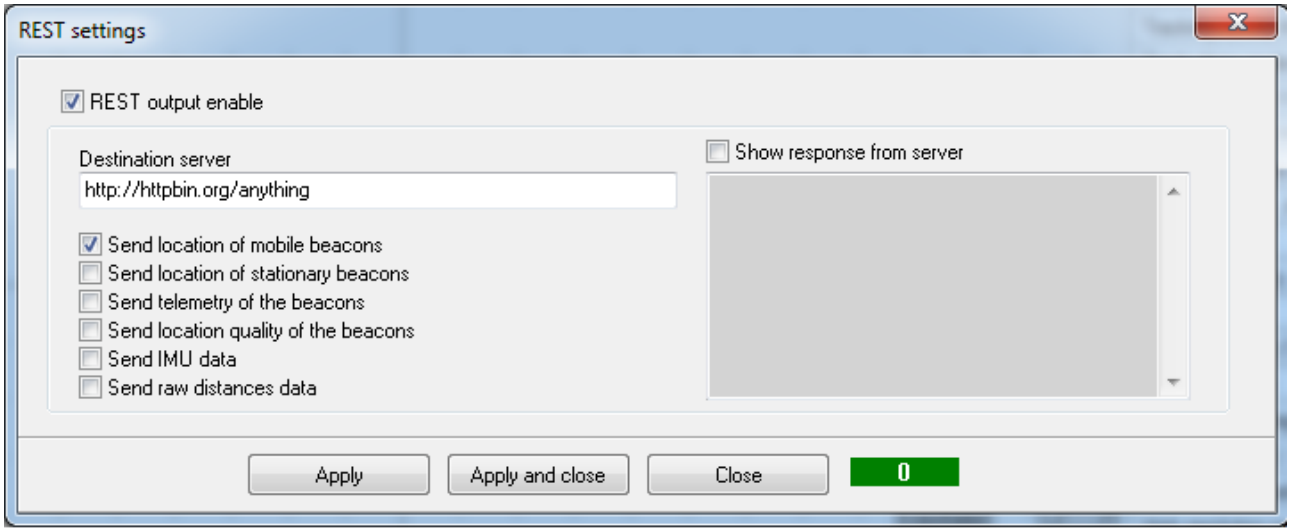
12. Marvelmind REST API

Marvelmind system can transmit location and other data to specified http server via REST API.

REST API is available on following component of the system:

Dashboard:	supported
Super-Modem:	on demand

Dashboard settings of REST API are available via menu ‘Settings/REST settings’:



Default destination server (http://httpbin.org/anything) just replies the echo of the request and can be used for testing. You can set the checkbox “Show response from server” to see last servers answer.

You can also install on your http server this server side example written on **node.js**. This example also replies echo of the request and can be used as base for users application.

Basic concepts of the Marvelmind REST API:

- Client application (dashboard or Super-Modem) sends http POST requests to the specified server;
- Because of possible high latency of success to server, the client doesn’t send each portion of data (location update etc) as separate packet. The data are buffered on the client side and sent to the server one time per 1 sec or after accumulation more than 1 Kbyte of the data. So one REST request can contain an array of multiple data items;
- Data are sent in JSON format

Below is the description of the JSON data format of the API.

12.1 Top level format of the JSON data

On the top level, the JSON data is an array of buffered data items:

```
{
  “Marvelmind_data”: [
     <data item 1>,
     <data item 2>,
     ……..
    <data item n>
  ]
}
```

Each data item is also JSON structure of one of the formats described in following sections.

12.2 Mobile beacon location data item

Mobile beacon location data have following format:

```
{
  “HedgePos”: {
     <parameter 1>,
     ……..
    <parameter n>
  }
}
```

Parameters of the mobile beacon location are listed in the table:

Name	Type	Description
“Address”	integer	Address of the mobile beacon
“Timestamp”	integer	Timestamp of the location update. If “IsRealtime” is true, this timestamp means Unix time - number of milliseconds from 1970.01.01 00:00:00 If “IsRealtime” is false, this timestamp means time from reset of the mobile beacon in milliseconds
“IsRealtime”	boolean	See timestamp description
“X_mm”	integer	X coordinate of location, mm
“Y_mm”	integer	Y coordinate of location, mm
“Z_mm”	integer	Z coordinate of location, mm
“Flags”	integer	Byte of flags: Bit 0: 1 - coordinates unavailable. Data from fields X,Y,Z should not be used. Bit 1: always 1 Bit 2: 1 - user button is pushed Bit 3: 1 - data are available for uploading to user device Bit 4: 1 - want to download data from user device Bit 5: 1 – second user button is pushed Bit 6: not used Bit 7: – 1 – out of geofencing zone
“Angle_deg”	integer	For paired mobile beacons – heading angle, degrees

12.3 Stationary beacon location data item

Stationary beacon location data have following format:

```
{
  “StationaryBeaconPos”: {
     <parameter 1>,
     ……..
    <parameter n>
  }
}
```

Parameters of the stationary beacon location are listed in the table:

Name	Type	Description
“Address”	integer	Address of the stationary beacon
“X_mm”	integer	X coordinate of location, mm
“Y_mm”	integer	Y coordinate of location, mm
“Z_mm”	integer	Z coordinate of location, mm

12.4 Beacon telemetry data item

Telemetry of mobile or stationary beacon have following format:

```
{
  “BeaconTelemetry”: {
     <parameter 1>,
     ……..
    <parameter n>
  }
}
```

Parameters of the telemetry are listed in the table:

Name	Type	Description
“Address”	integer	Address of the beacon
“Vbat_mv”	integer	Battery voltage of the beacon, mV
“RSSI_dBm”	integer	RSSI (received radio signal strength) level, dBm

12.5 Mobile beacon location quality data item

Location quality of mobile beacon have following format:

```
{
  “LocationQuality”: {
     <parameter 1>,
     ……..
    <parameter n>
  }
}
```

Parameters of the location quality are listed in the table:

Name	Type	Description
“Address”	integer	Address of the mobile beacon
“Quality”	integer	Quality

12.6 IMU data item

IMU data from mobile beacon have following format:

```
{
  “IMUData”: {
     <parameter 1>,
     ……..
    <parameter n>
  }
}
```

The packet can include raw IMU or IMU fusion data.

Parameters of the raw IMU data are listed in the table:

Name	Type	Description
“Address”	integer	Address of the mobile beacon
“Timestamp”	integer	Timestamp of the IMU data update. If “IsRealtime” is true, this timestamp means Unix time - number of milliseconds from 1970.01.01 00:00:00 If “IsRealtime” is false, this timestamp means time from reset of the mobile beacon in milliseconds
“IsRealtime”	boolean	See timestamp description
“Accel_x”	integer	Accelerometer, X axis, 1 mg/LSB
“Accel_y”	integer	Accelerometer, Y axis, 1 mg/LSB
“Accel_z”	integer	Accelerometer, Z axis, 1 mg/LSB
“Gyro_x”	integer	Gyroscope, X axis, 0.0175 dps/LSB
“Gyro_y”	integer	Gyroscope, Y axis, 0.0175 dps/LSB
“Gyro_z”	integer	Gyroscope, Z axis, 0.0175 dps/LSB
“Compass_x”	integer	Compass, X axis, 1100 LSB/Gauss
“Compass_y”	integer	Compass, Y axis, 1100 LSB/Gauss
“Compass_z”	integer	Compass, Z axis, 980 LSB/Gauss

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

Parameters of the IMU fusion data are listed in the table:

Name	Type	Description
“Address”	integer	Address of the mobile beacon
“Timestamp”	integer	Timestamp of the IMU data update. If “IsRealtime” is true, this timestamp means Unix time - number of milliseconds from 1970.01.01 00:00:00 If “IsRealtime” is false, this timestamp means time from reset of the mobile beacon in milliseconds
“IsRealtime”	boolean	See timestamp description
“Pos_x”	integer	Coordinate X of beacon (fusion), mm
“Pos_y”	integer	Coordinate Y of beacon (fusion), mm
“Pos_z”	integer	Coordinate Z of beacon (fusion), mm

“Quaternion_w”	integer	W field of rotation quaternion (angles)
“Quaternion _x”	integer	X field of rotation quaternion (angles)
“Quaternion _y”	integer	Y field of rotation quaternion (angles)
“Quaternion _z”	integer	Z field of rotation quaternion (angles)
“Velocity_x”	integer	Velocity X of beacon (fusion), mm/s
“Velocity_y”	integer	Velocity Y of beacon (fusion), mm/s
“Velocity_z”	integer	Velocity Z of beacon (fusion), mm/s

IMU fusion location and velocity are available only for HW v4.9 beacons with IMU.

12.7 Raw distances data item

Raw distances data for mobile beacon have following format:

```
{
  “RawDistances”: {
     <parameter 1>,
     ……..
    <parameter n>
  }
}
```

Parameters of the raw IMU data are listed in the table:

Name	Type	Description
“HedgeAddress”	integer	Address of the mobile beacon
“Distances”	array	Array of distances to stationary beacons: [<distance item 1>, ……. <distance item m>]

Parameters of each distance item are listed in the table

Name	Type	Description
“Address”	integer	Address of the stationary beacon
“Distance_mm”	integer	Distance from mobile to stationary beacon, mm

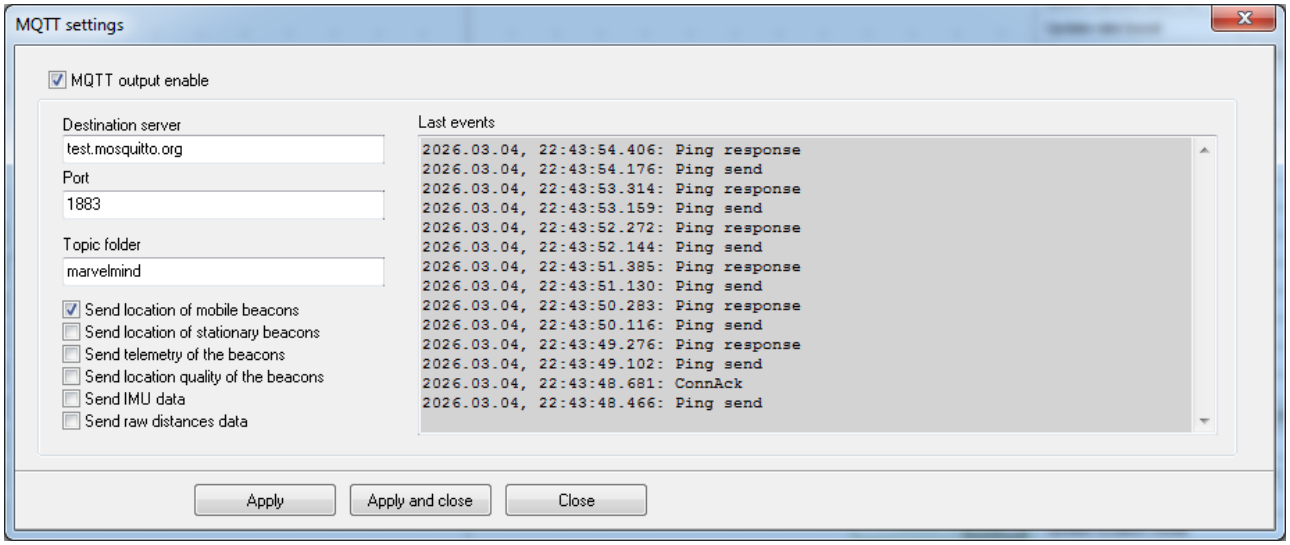
13. MQTT protocol

Marvelmind system can publish location and other data to specified http server via MQTT protocol.

MQTT protocol is available on following component of the system:

Dashboard:	supported
Super-Modem:	on demand

Dashboard settings of MQTT are available via menu ‘Settings/MQTT settings’:



Default destination server (broker) is test.mosquitto.org.

User also can specify destination port and topic for publishing.

Marvelmind provides an example of subscriber of the published data written on **python**. This example is adjusted to the shown above broker and topic settings and prints all received data to console.

Basic concepts of the Marvelmind MQTT protocol are the same as for REST API:

- Client application (dashboard or Super-Modem) publishes updated data to the specified broker and topic;
- Because of possible high latency of success to server, the client doesn’t send each portion of data (location update etc) as separate packet. The data are buffered on the client side and sent to the brocker one time per 1 sec or after accumulation more than 1 Kbyte of the data. So one MQTT request can contain an array of multiple data items;
- Data are sent in JSON format

Format of the JSON data transmitted via MQTT is the same as for the REST API.

14. Sending user data from/to user devices

Marvelmind supports different ways for transmission user data through Marvelmind system:

- transmit data via UART or USB of the modem and receive via UART or USB from the mobile beacon
- transmit data via UART or USB of the mobile beacon and receive via UART or USB of the modem.

Super-Modem also supports transmission and receiving user data via UDP.

The protocols of the data transmission are described in previous sections of this document:

- protocol of transmission data to user device and from user device;
- API function for transmission and receiving data.

Marvelmind provides different examples of software for the communication:

Examples	Arduino (UART)	PC / Raspberry Pi (USB)				PC / raspberry Pi (UDP Super-Modem)
		API	C	Python	ROS/ROS2	C example
User device ← beacon	+	+	+	+	+	n/a
Modem → User device	+	+	+	+	+	+
User device → beacon	+	+	-	-	+	n/a
Modem ← User device	+	+	-	-	+	+

The full list of the examples:

- Arduino examples for sending and receiving user data are placed in the Marvelmind software package in folder '01_Common_Indoor_positioning_SW/ 06_Examples/ arduino'. 'hedgehog_sample_uart_user_data_receive_v2' is for receiving user data, 'hedgehog_sample_uart_user_data_send_v2' is for sending user data
- API communication example is placed in the Marvelmind software package in folder '01_Common_Indoor_positioning_SW/ 05_API/example_source' (source code) and '01_Common_Indoor_positioning_SW/ 05_API/example_bin_win32' (binary for Windows). Data transmission or receiving can be called as described in this document.
- C example for receiving of the streaming data is placed in the Marvelmind software package in folder '01_Common_Indoor_positioning_SW/ 06_Examples/ c'. Also this example is available in the repository on the GitHub. This example simply prints all data received from mobile beacon or modem, including user data.
- Python example for receiving of the streaming data is placed in the Marvelmind software package in folder '01_Common_Indoor_positioning_SW/ 06_Examples/ python'. Also this example is available in the repository on the GitHub. This example simply prints all data received from mobile beacon or modem, including user data.
- ROS package example for receiving of the streaming data is placed in the Marvelmind software package in folder '01_Common_Indoor_positioning_SW/ 06_Examples/ ROS. Also this package is available in the repository. The ROS package allows to receive user data and send user data through the API. See documentation for the details.
- ROS-2 package example for receiving of the streaming data is placed in the Marvelmind software package in folder '01_Common_Indoor_positioning_SW/ 06_Examples/ ROS2. Also this package is available in the repository. The ROS package allows to receive user data and send user data through the API. See documentation for the details.

- C example for receiving data via UDP is placed in the Marvelmind software package in folder ‘01_Common_Indoor_positioning_SW/ 06_Examples/ c’. This example simply prints all data received via UDP from Super-Modem or Dashboard, including user data. Sending user data via UDP can be done via API if API is used for connection to the Super-Modem via UDP instead USB.

15. Contacts

For additional support, please send your questions to info@marvelmind.com

Appendix 1. Calculating CRC-16

For checksum the CRC-16 is used. Last two bytes of N-bytes frame are filled with CRC-16, applied to first (N-2) bytes of frame. To check data, you can apply CRC-16 to all frame of N bytes, the result value should be zero.

Below is the implementation of the algorithm in the 'C':

```
typedef uint16_t ModbusCrc;

typedef union {
	uint16_t w;
	struct{
		uint8_t lo;
		uint8_t hi;
	} b;
	uint8_t bs[2];
} Bytes;

static ModbusCrc modbusCalcCrc(const void *buf, uint16_t length)
{
	uint8_t *arr = (uint8_t *)buf;
	Bytes crc;

	crc.w = 0xffff;

	while(length--){
		char i;
		bool odd;

		crc.b.lo ^= *arr++;
		for(i = 0; i< 8; i++){
			odd = crc.w& 0x01;
			crc.w>>= 1;
			if (odd)
				crc.w ^= 0xa001;
		}
	}
	return (ModbusCrc) crc.w;
}
```

Appendix 2. Format of error reply from modem

Format of error frame (from modem to host)

Offset	Size (bytes)	Type	Description	Value
0	1	uint8_t	Address of modem	0xff
1	1	uint8_t	Type of packet	
2	1	uint8_t	Code of error	
3	2	uint16_t	CRC-16 (see appendix 1)	

Type of the error packet is the type of packet for the request frame with added high bit. For example, if type of packet for request is 0x03, the type of error packet will be 0x83.
Code of error may be one of following:

1 – unknown type of packet in request
2 – unknown code of data in request
3 – error in data field of request
6 – device is busy
10 – error message from remote device
11 – timeout of reply from remote device