# Integration of HEMS and Battery Management System

Report: 1   **Date:** 19.3.2013

1 Introduction:

The main goal of this project is to integrate Home Energy Management System (HEMS) and Battery management System (BMS) by transmitting the messages between HEMS which is ThereGate in our experiment and BMS through the CAN bus. The following figure depicts the elements, communication protocols and issues which are related to this project. (*In the next phase of the project, communication between BMS and inverter also will be considered*)
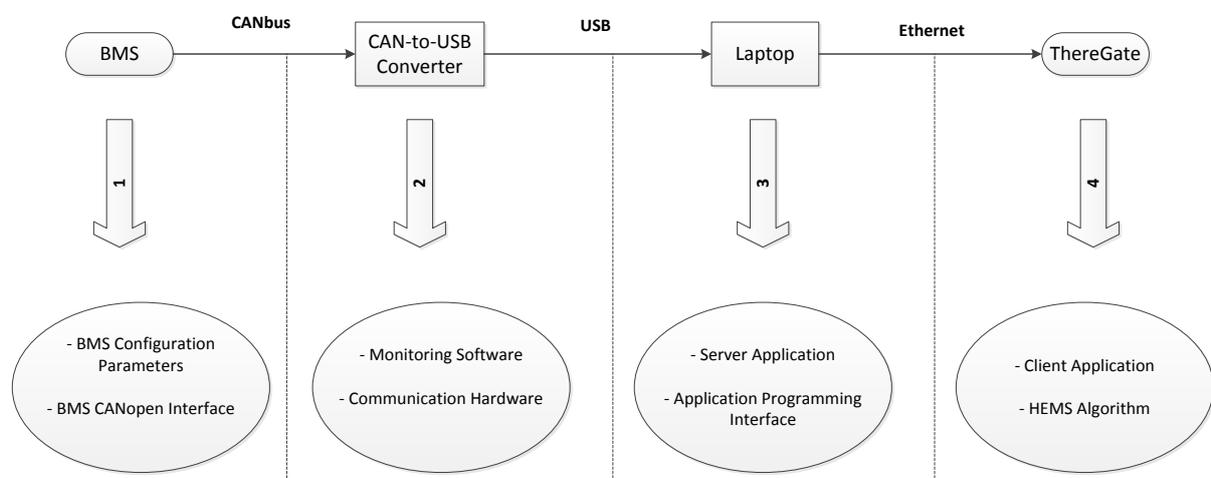

Figure 1: *General Layout of the Project*

The idea is to send and receive messages between the Battery Management System and ThereGate. As it can be seen in the figure, the communication task can be divided to 3 sub-tasks: between BMS and CAN-to-USB converter, between CAN-to-USB converter and Laptop, and between Laptop and ThereGate. The explanation about communication in each sub-task are presented in the section 3.

2 Interaction Diagram

Figure 2 proposes the preliminary interaction diagram for the algorithm in the ThereGate that communicates with BMS, charger, and battery loads. In this model, the communication between ThereGate and BMS is done through Laptop and CAN-to-USB converter which have not shown in the figure in order to have better clarity in the figure.
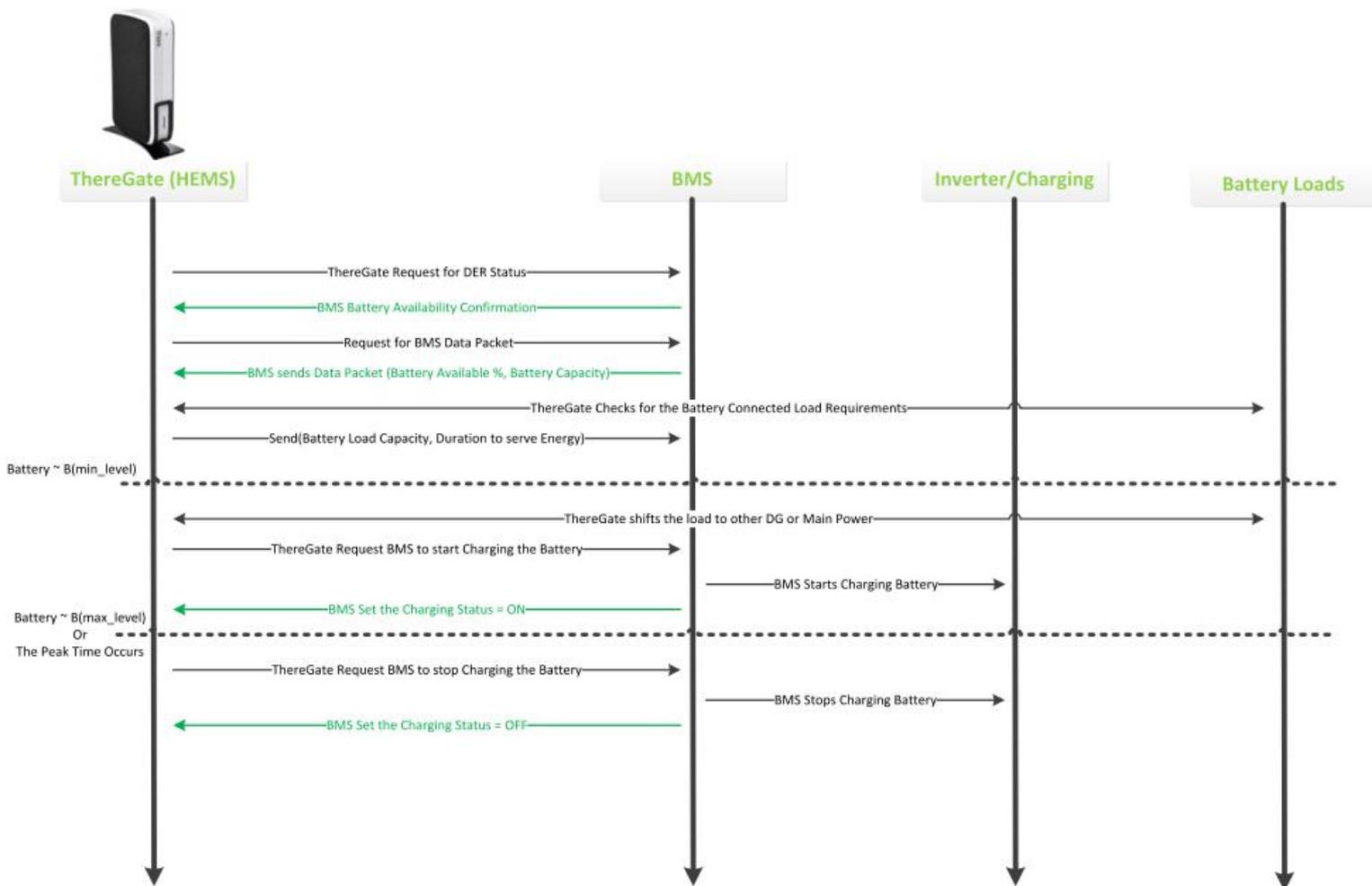
Figure 2: *Interaction Diagram of the System*

3 Communication between Elements

As it was shown in the figure 1, different communication protocols are used for transmitting of messages between elements in the system. CAN bus is used for communication between the BMS and CAN-to-USB converter, USB is utilized between CAN-to-USB converter and Laptop, and ThereGate connects to the laptop through the Ethernet.

3.1 Communication between the BMS and the CAN-to-USB Converter

CAN messages are used for communicating to the BMS. The higher layer protocol is used for CAN messages in the BMS system is CANopen. The BMS has three separate external CAN interfaces available: ExtCAN and CANopen profiles 418 and 401. The progress of the project in this part is described in the Table 1.

Table 1: Communication between the BMS and the USB-to-CAN Converter

Description	Status
Physical configuration of the system which includes connection between BMS, contactor module, charger, battery, and providing external control signal for turning on the BMS system.	Completed
Configuration of the internal parameters of the BMS system through console interface and SSH connection was completed. The adjusted parameters are consisted of defining CAN bus bitrate, assigning CANopen node-id for the external CAN interface of BMS, and MCC configuration for starting of CAN messages in the network.	Completed
Configuration of the external parameters of the BMS system through PCAN-view software tool was completed. The required CAN messages for starting of the communication from outside of the BMS was find out. These messages are included the network management messages, the messages for reset BMS, put BMS to the Pre-operational mode and put BMS to the operational mode. After this configuration, monitoring of the CAN messages from external CAN interface of the BMS will be possible.	Completed
Finding out the address of the required information from the battery (TPDOs & RPDOs) in the object dictionary of the BMS CANopen.	Completed
Finding out how to request the required information of the battery with Remote Frame Request.	Almost-Completed
Total Progress of this Part	**90%**

3.2 Communication between the CAN-to-USB Converter and the Laptop

Communication in this part is done by USB protocol. The idea in this part is to develop a server application in laptop to communicate with the converter. The PCAN-Basic API (application programming interface) is used in order to send/receive the messages to/from the server application. The progress of the project in this part is described in the Table 2.

Table 2: Communication between the CAN-to-USB Converter and the Laptop

Description	Status
Reading of the PCAN-Basic API document.	Almost-Completed
Studying about the API functionalities and creating interfaces between the device driver of the CAN-to-USB converter and server application.	In Progress
Developing of the server application in the laptop. (C/Java Socket Programming)	In Progress
Total Progress of this Part	**20%**

3.3 Communication between the Laptop and ThereGate:

The Ethernet port is used in order to create communication between the ThereGate and laptop. The client application (will be developed in the Theregate) which is capable of imitating the communication with server application in the laptop. The progress of the project in this part is described in the Table 3.

Table 3: Communication between the Laptop and ThereGate

Description	Status
Studying of the ThereGate documentation and its API documentation. In addition, working with ThereGate and some example programs.	Almost-Completed
Developing of the client application in the ThereGate. (Linux Socket Programming)	In Progress
Total Progress of this Part	**20%**

4 Summary

The summary of the project progress in different sections are shown in the table below.

Subject	Progress
The proposed interaction diagram for the system	100%
Communication between the BMS and the USB-to-CAN Converter	90%
Communication between the CAN-to-USB Converter and the Laptop	20%
Communication between the Laptop and ThereGate	20%