



HACETTEPE UNIVERSITY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ELE417 - EMBEDDED SYSTEM DESIGN

2019 - 2020 FALL

Embedded System Design Course IOT Project Service API

Description

This document explains an IOT service data provider service that is hosted in Hacettepe University Department of Electrical and Electrical Engineering. IOT service provides some of the common data that may be propagated through an IOT network such as weather information (temperature, humidity etc.) as well as other miscellaneous data related to the network itself (uptime, # of online users, system temperature etc.).

This network is only accessible over a Wi-Fi network that is hosted on the department computer laboratories. In order to connect to this network, each IOT client must be registered through the MAC address of device's Wi-Fi interface. Name (SSID) of the network is **ELE417** and the password for Wi-Fi authentication is **"Embedded"** without quotes. This Pre-Shared Key is case-sensitive.

The server is reachable through a **TCP** connection. IP address for the service is **"10.50.106.10"** and the port number is **10000**. The data that can be collected from this system is based on a request-and-response mechanism. Each device must greet the server by sending the message "hi" when it establishes the TCP connection each time. Otherwise **requests will be ignored**. After the first greeting, devices don't need to send greeting message again until they disconnect from the server.

Response Format

Data server responses with a regular package format for each request. This format is given in the figure below.

XXh	XXh	XXh XXh XXh XXh ... XXh	XXh	XXh
TypeID	Length	Data Payload	CRC16H	CRC16L

Each blue cell is a single byte that can be parsed and used. Second field (Length) shows the length of the data for all the transmission, and calculated as

Length = **1 byte** (TypeID) + **1 byte** (Length) + **X bytes** (Data Payload Size) + **2 bytes** (CRC16 for Data Payload)

Payload is ASCII data unless otherwise specified.

CRC16 is calculated for the Payload Data only.



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CRC Information

CRC16 calculation method is selected as “**CRC-16-IBM**” also known as “**CRC-16-ANSI**” or “**CRC-16 (Modbus)**” in some sources. Flow chart for calculation of CRC16 in this applications is given at the end of this document. It results in two bytes of data that you can use to check the integrity of the payload. After first two weeks of publishing this document, intentional data corruption will be injected to the system, you need to ignore corrupted data by checking CRC16 and request the same data until a healthy result is obtained.

For the testing purposes one of the following online CRC generators may be used to verify the results of your CRC calculation functions.

<https://crccalc.com/> (Calculate with “CRC-16/MODBUS”)

<https://www.lammertbies.nl/comm/info/crc-calculation> (Calculate with “CRC-16 (Modbus)”)

<http://www.tahapaksu.com/crc/> (Calculate with “CRC-16 (Modbus)”)

You can also check out the following IEEE article for the details of CRC calculations:

<http://kilyos.ee.bilkent.edu.tr/~ee538/crc.pdf> (A Tutorial on CRC Computations)

Request Format

Request format is much simpler. It includes a single byte for the type of request and another single byte for the ID of the data that is requested.

For now, only Get Data request is valid and it is expressed with the byte 0xEE. IDs for several types of data is given the table below.

TypeID	Description	Example Response Payload
0x01	Temperature (°C) (Weather)	13.36
0x02	Air Pressure (hpa) (Weather)	1016
0x03	Humidity (%) (Weather)	50
0x04	Wind Speed (m/s) (Weather)	4.5
0x05	Cloudiness (%) (Weather)	30
0x06	Weather Status	Rain
0x07	Current Time (HH:MM:SS)	16:05:12
0x08	Current Date (YYYY/MM/DD)	2019/11/20
0x09	Uptime (Server)	1w4d10h15m
0x0A	System Temperature (°C) (Server)	40.5
0x0B	Connected # of Clients	5
0xFF	Greeting Message (for Testing)	hi



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Example communication session

Side	Data (Hex)	Payload (ASCII)
(Client)	68 69	hi (Required for the first time)
(Server)	FF 06 68 69 5E EE	hi
(Client)	EE 01	Request (Temperature)
(Server)	01 09 31 33 2E 34 35 5E E0	13.45
(Client)	EE 02	Request (Pressure)
(Server)	02 08 31 30 31 35 50 DB	1015
(Client)	EE 0B	Request (Number of Clients)
(Server)	0B 05 32 95 3E	2
(Client)	EE 08	Request (Date)
(Server)	08 0E 32 30 31 39 2F 31 31 2F 33 30 62 BF	2019/11/30

As an example the second response of the server can be parsed with proper meaning as:

01 → Request Type (01 = Temperature Info)

09 → Total Length of the response (=Length (01 09 31 33 2E 34 35 5E E0))

31 33 2E 34 35 → Payload (=13.45)

5E E0 → CRC-16 for Payload (=CRC-16(31 33 2E 34 35))



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Flow Chart for Calculation of CRC-16 for Data Integrity

