ADVANCE TOPICS IN COMPUTER COMMUNICATIONS (SYSC 5801X)

Project Proposal

CLOUD-BASED ENERGY DATA MANAGEMENT FOR SMART GRIDS

Submitted By:

Arslan Ahmed (101054715)

Supervisor:

Prof. Mohamed Ibnkahla

Dated 13th Feb, 2017

I. **Brief Overview**

With the advent of smart appliances and home energy management systems, the amount of data generated about consumer energy consumption has rapidly increased [1]. This huge amount of data should not be processed and controlled from on-site device because of limited computation resources of devices and exponentially increasing amount of data. Here comes the concept of Internet of Things (IoT) that helps us harnessing the data for our best interests using cloud-based services and providing intelligent control over our appliances.

II. **Project Description and Objectives**

- This course project is an extension in smart grids final year project in which an IP based local Wireless Mesh Network (WMN) was created between the Customer Agents (CAs) and a Transformer Agent (TA). Here in this project, we propose an automated and intelligent bidirectional information sharing system between home and cloud that also provides graphical view of all the energy consumption data on the web dashboard in user friendly way for Hydro Ottawa.
- Data of each CA collected at the TA will be uploaded to the cloud in real time, where energy consumption of each neighborhood will be analyzed and processed as per specific algorithms designed by Hydro Ottawa to meet the overall grid's dynamic capacity limit.
- Based on the result of this processing, response information specific to each CA will be sent to the corresponding TA, which can send control commands to that CA through the local WMN to manage the load on the grid.
- Currently, consumers do not have real-time access to their own data and are limited to the analysis provided by their utility. **Future prospect** of this project will be providing the consumers with real time access to their private usage data. Therefore, they can analyze it with personalized algorithms and optimize their usage accordingly.

III. **Implementation (Block diagram shown on next page)**

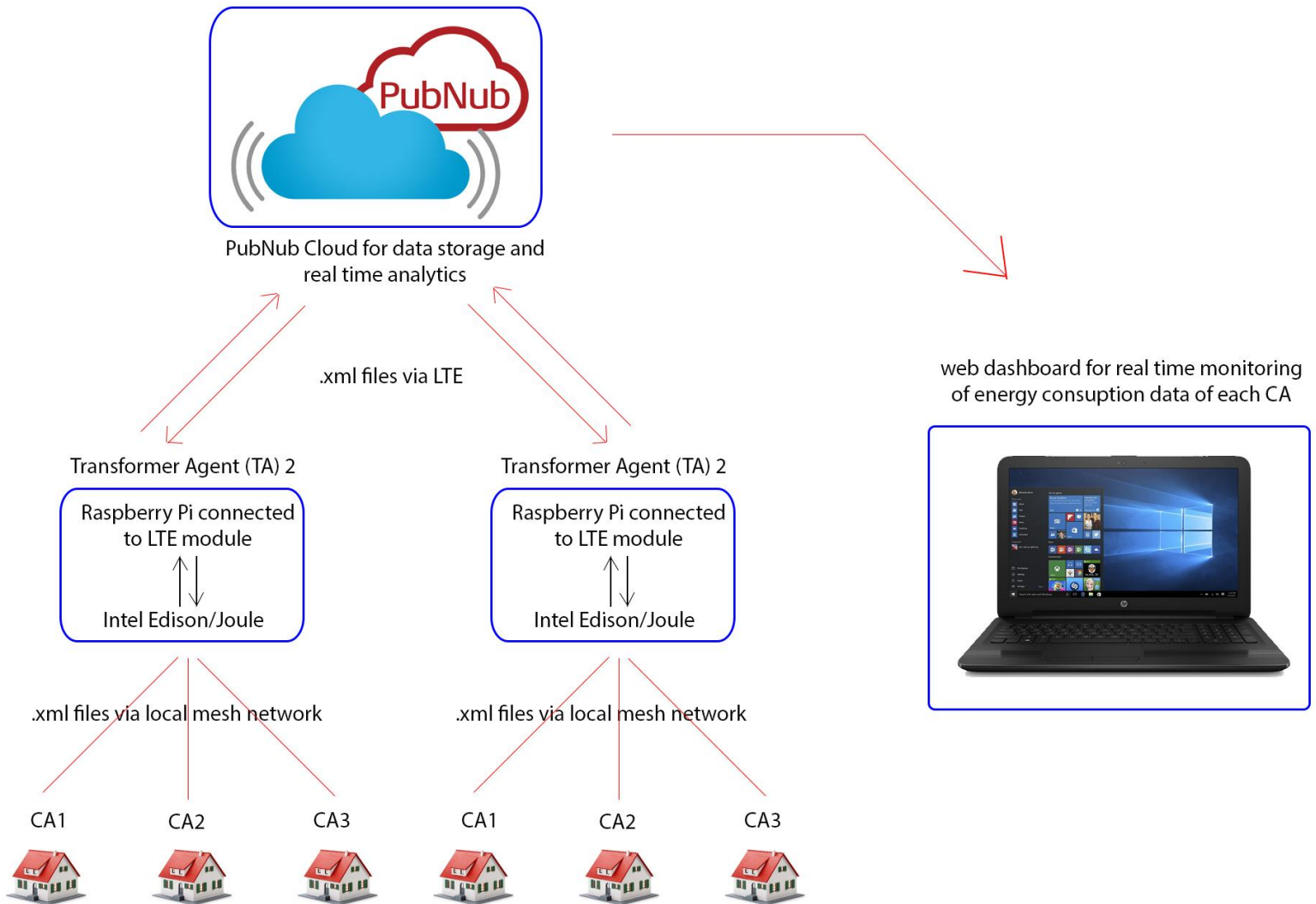The challenging parts in this project are to:
- establish a reliable and **real time two-way communication** between TA and Cloud through **LTE.**
- display the consolidated data on a **web dashboard** using PubNub **JavaScript APIs**.
  We have chosen **PubNub for Cloud** because it is the only backend-as-a-service provider that supports APIs for building secure real-time mobile, web and IoT Applications along with necessary tools for **data analytics** [2]. When this project gets scaled up, PubNub alone will not be sufficient so **IBM Bluemix** and **DashDB** will have to be coupled with it for better analytics and storage of data and control over CA [3]. Therefore, we are using **Raspberry Pi** as it has good support available for PubNub and IBM Bluemix. **Intel Edison** and **Intel Joule**, on the other hand, are relatively new boards and come with very limited support.

IV. **Hardware/Software requirements**

- Raspberry Pi along with LTE Module
- No Software requirements as we will be using the limited free services of PubNub.

V.   Implementation block diagram

PubNub Cloud for data storage and real time analytics

.xml files via LTE

web dashboard for real time monitoring of energy consuption data of each CA

Transformer Agent (TA) 2

Raspberry Pi connected to LTE module

Intel Edison/Joule

Transformer Agent (TA) 2

Raspberry Pi connected to LTE module

Intel Edison/Joule

.xml files via local mesh network

.xml files via local mesh network

CA1   CA2   CA3   CA1   CA2   CA3

VI.   References

[1] Singh, R. P., Keshav, S., & Brecht, T. (2013, January). A cloud-based consumer-centric architecture for energy data analytics. In Proceedings of the fourth international conference on Future energy systems (pp. 63-74). ACM.

[2] PubNub Support. (2013). Developer Tutorials & SDKs for building realtime apps | PubNub. Retrieved February 14, 2017. from https://www.pubnub.com/docs

[3] Purkayastha, S. (2016, November 29). Is your home energy efficient? Bluemix can figure it out. Retrieved February 14, 2017, from https://www.ibm.com/blogs/bluemix/2016/10/is-your-home-energy-efficient-ask-bluemix/