ZigBee Electric Vehicle Charging System

K. L. Lam, K. T. Ko, H. Y. Tung, H. C. Tung, K. F. Tsang and L. L. Lai

Abstract-- **This paper presents a Information system for ZigBee Energy Dispenser (ZED), with onsite Charging Hotspot subsystem (Z-key, Z-Charger and Data Hub) and backend Web portals subsystem (i-Plug), over wireless transmission by using ZigBee module and wired transmission on internet network. ZED is an AMI solution dedicated to electrical vehicle charging for both private and public car parks. It is a platform which aimed to coordinate the data flow among customer, Utility information system (e.g MDMS, billing) and Charging Hotspot.**

I. INTRODUCTION

Along with to the growth of the number of private car, it increases the toxic chemicals released and the need of fossil fuel. These toxic chemicals probability causes Greenhouse effect and respiratory disease which is harmful to both human being and environment. To improve the situation, electric car is published as a replacement. And there are several new infrastructure published to act in concert**.** With the increasing number of electric cars usage, management of the power consumption of the electric cars becomes another important issue [1]. People are willing to pay more attention on how many power is consumed. So, it will be an essential for a platform which enables data exchange between automobile owner, Utility information systems (e.g. MDMS, billing) and the Charging Hotspot subsystem.

ZED is an AMI solution dedicated to electrical vehicle charging for both private and public car parks. ZED is divided into two main parts: onsite subsystem (Charging Hotspot) and backend subsystem (i-Plug). Charging Hotspot subsystem consists of Z-key, Z-Charger and Data Hub which server the Electric Vehicle (EV) owners at the car park. Z-Key is a handheld device for users to initialize the charging process. Z-Charger is outlet adopting latest short range communication ZigBee [2] that measures the energy consumption during the charging process. The Data Hub collects the readings from the Z-Charger and forwards the data to i-Plug. i-Plug is a platform enables data exchange between EV owner, Utility information systems (e.g. MDMS, billing) and the Charging Hotspot subsystem. Finally, the EV owner could obtain the latest charging information via the web portal of i-Plug. A High Level Deployment of a ZED system is shown in Fig. 1.

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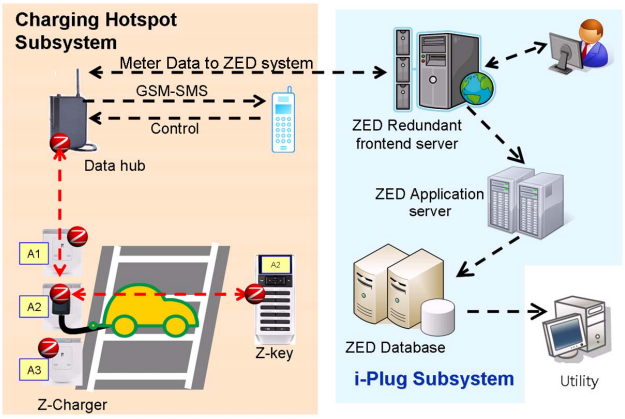

Fig.1 High Level Deployment of a ZED system

II. THE ARCHITECTURE

Generally, i-Plug is divided into three parts: web portals, information infrastructure and data base management. Web portal is a series of web page that enable interactive communication between user and i-Plug while information infrastructure comprises of a group of servers which serve different purposes such as Service Management, Service Deployment, Group Communication, Node Management, Cluster Management and Load Balancing. These functionalities will be elaborated under the Abstract System View. Finally, multiple databases are designed to store the customer information, meter data and energy profile systematically. (Fig. 2)

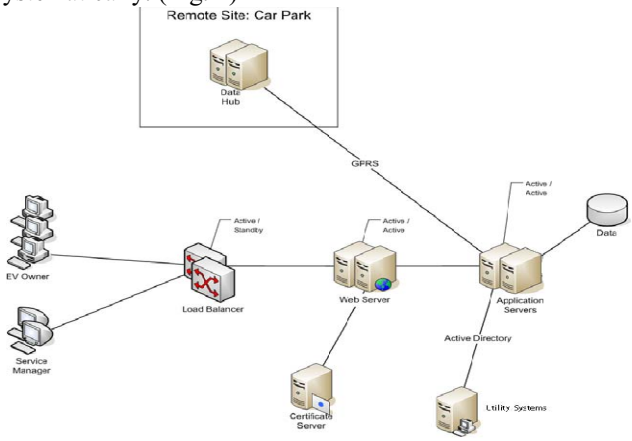

Fig.2 System Architecture of i-Plug

i-Plug adopts the three-tier architecture including web tier, application tier and enterprise information tier. Web tier handles presentation and communication function while application tier supports the business intelligence and finally the enterprise information tier organize the data systematically. The abstract system architecture of i-Plug is illustrated in Fig. 3.

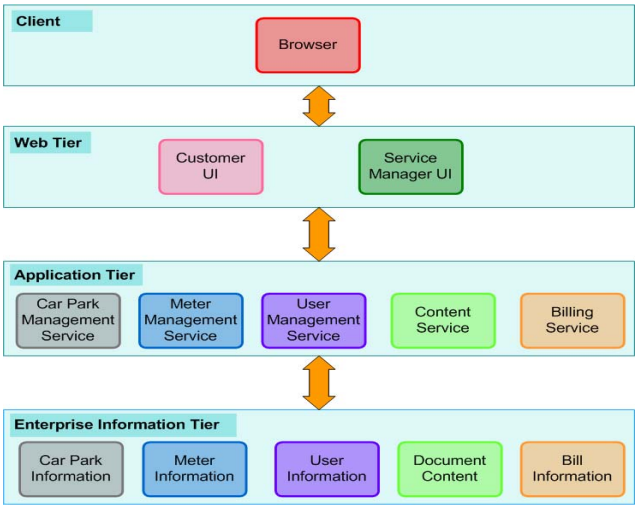

Fig.3 Abstract system architecture

III. IMPLEMENTATION

i-Plug could be broken down into five subsystems: Car Park Management (CPM) subsystem, Meter Management (MM) subsystem, User Management (UM) subsystem, Content Service (CS) subsystem and Billing Service (BS) Subsystem, and each of them serves clients in different purposes.

A. Car Park Management (CPM) subsystem

This subsystem handles the information of car park and it contains two major components Car Park Management Service module and Car Park Information database. CPM subsystem helps the service manager (Utility employee) managing the information of car park and so the EV owner could the obtains the updated information via the portal.

B. Meter Management (MM) subsystem

This subsystem handles the information of meter and it contains two major components Meter Management Service module and Meter Information database. MM subsystem collects meter reading and status from Charging Hotspot system and so the service manger and EV owner could obtain the energy consumption information though their web portals. Furthermore, this subsystem monitors the status of the meter and generates meter error report automatically if any operation failure is detected. Such report will deliver to service manager via email and also the warning message will display on the web portal.

C. User Management (UM) subsystem

This subsystem handles the information of user and it contains two major components User Management Service module and User Information database. UM subsystem identifies the role of user and helps the service manger managing the EV owner information easily.

D. Content Service (CS) subsystem

This subsystem handles the information of user and it contains two major components Content Service module and Document database. CS subsystem generates reports and documents and it allows Utility information system obtaining the document via predefined communication interface such as active directory.

E. Billing Service (BS) Subsystem

This subsystem handles the billing information and it contains two major components Billing Service module and Bill Information database. BS subsystem cooperates with MM and CS subsystem in order to generate the most updated payment record.

IV. DISCUSSION

When the electrical vehicle owners login the i-Plug web portal, the owners get the latest news from the welcome page, the current status and the last charging record are also displayed. Users are allowed to check the current charge info and their current and previous monthly bills. They can also view the monthly and yearly energy consumption by different time and different locations. The total energy consumption is plotted by different chart type chosen by users. (Fig.4). If the user want to locate the car parks which provide EV Charger, the user can search the car park through the map in the i-Plug web portal. The numbers of available chargers in the car parks shown are real time. The owner can sort the car park results by price, and time.

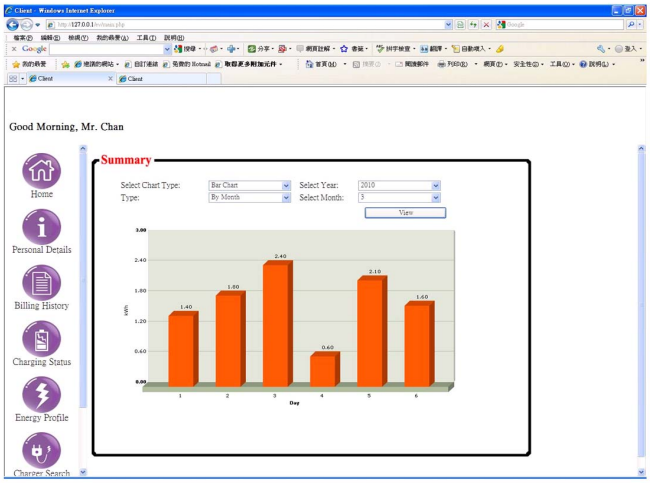

Fig.4 User Interface of i-Plug

V. CONCLUSION

In this paper, Information system for ZigBee Energy Dispenser (ZEM) is proposed as a new platform which coordinates the data flow among customer, Utility information system and Charging Hotspot. The usage and architecture are briefly introduced. And the advantages are also discussed.

REFERENCE

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[2] ZigBee Alliance, ZigBee Specifications, version 1.0, April 2005