A Review of Zigbee Smart Energy

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Abstract — Smart Energy is an approach to the cleverly, effectively use of energy and providing this feature by the use of Zigbee is called Zigbee SEP. In this literature review we provides an overview of Zigbee base different SEP profile like SEP-1.0,SEP-1.x and SEP-2.0 also show comparison of different wireless technologies standards, Zigbee base SEP Architecture – how it will be implemented on existence technology and SEP feature offer by Zigbee SEP.

***Keywords*— Smart Energy Profile, Internet Protocol, Home are network.**

I. INTRODUCTION

ZigBee Smart Energy is the world's leading standard for interoperable products that monitor, control, inform and automate the delivery of that energy. It helps to create green world by giving energy consumers the information regarding (unnecessary/unwanted use of energy) and automation needed to easily reduce their consumption. This is achieve with the use of two primary devices like energy meter and energy management device.

Most smart meters being deployed are use ZigBee Smart Energy Profile 1.0 or 1.x, which uses protocol that was designed specifically for low-power wireless communication solutions. Our one limitation is that we still need a gateway device or something similar, to convert the ZigBee protocol to Internet Protocol when you want to communicate with other devices, such as home automation devices, any device that is connected to Internet.

ZigBee Smart Energy version 2.0 (SEP 2) the newest version for product development, SEP 2 offers a global standard for IP-based control, both wired and wireless, for energy management in Home Area Networks.

SEP 2 is an evolution of ZigBee Smart Energy 1.x and provides new capabilities such as control of plug-in hybrid electric vehicles (PHEVs) charging, HAN deployments in multi-dwelling units such as apartment buildings, support for multiple energy service interfaces into a single[1].

Smart Energy Profile 2 does not replace ZigBee Smart Energy 1.x. Instead, it offers utilities and energy service providers another choice in the creation of HAN.

II. COMPARISON OF TECHNOLOGIES

Parameter	ZigBee	Wi-Fi	Bluetooth
Range	10-100 meters	50-100 meters	10 – 100 meters
Networking Topology	Ad-hoc, peer to peer, star, or **mesh**	Point to hub	Ad-hoc, very small networks
Operating Frequency	868 MHz (Europe) 900-928 MHz (NA), 2.4 GHz (worldwide)	2.4 and 5 GHz	2.4 GHz
Complexity (Device and application impact)	**Low**	High	High
Power Consumption (Battery option and life)	**Very low** (low Power is a design goal)	High	Medium
Security	128 AES plus application layer security	WPA	64 and 128 bit encryption
Typical Applications	Industrial control and monitoring, sensor networks, building automation, home control and automation	Wireless LAN connectivity, broadband Internet access	Wireless connectivity between devices such as phones, PDA, laptops, headsets

Table – 1: Key Characteristics of Zigbee, Wi-Fi and Bluetooth

Table 1 summarizes main differences among three wireless technology protocols [4]. Each protocol is based on an IEEE standard. Obviously, Wi-Fi provide a higher data rate, while Bluetooth and ZigBee give a lower one. In general, Bluetooth and ZigBee are made for WPAN communication (about 10m), while Wi-Fi is oriented to WLAN (about 100m). However, ZigBee can also reach 100m in some applications by the use of mesh networking technology.

The popular wireless standards Bluetooth, ZigBee, and Wi-Fi with a quantitative evaluation in terms of transmission time, data coding efficiency, protocol complexity, and power consumption. Furthermore, the radio channels, coexistence mechanism, network size, and security are also preliminary compared. Which one is superior since suitability of network protocols is greatly influenced by practical applications, of which many other factors such as the network reliability, roaming ability, recovery mechanism, chipset price, and installation cost need to be considered in the future.

Bluetooth and ZigBee are suitable for low data rate applications with limited battery power (such as mobile devices and battery-operated sensor networks), due to their low power consumption leading to a long lifetime. On the other hand, for high data rate implementations (such as audio/video surveillance systems), Wi-Fi would be better solutions because of their low normalized energy consumption.

For wireless HAN as well as many industrial automation application Zigbee SEP-2.0 protocol is best and most reliable solution because of their long battery life (1 to 2 year) and mesh networking support by the use of this mesh networking we are able to cover 10-100 meter distance.

III. SEP 2.0 ARCHITECTURE

The SEP 2.0 application protocol is built on a representational state transfer (REST- Not based on details of component implementation and protocol syntax but focus on the roles of components) architecture that is used widely to deploy Web services over Hypertext Transfer Protocol (HTTP). A REST architecture is based on a client-server model in which servers contain and perform operations on resources. Servers expose resource representations to clients and clients make requests to access representations of resources on the servers such as read, write, create and delete.

SEP 2.0 resource representations are built to be compatible with the International Electrotechnical Commission's Common Information Model (CIM). The result is an Extensible Markup Language –based (XML) protocol developed on a REST architecture utilizing HTTP for transport. In addition, the protocol uses other commonly used Standards. For example, it uses Multicast Doman Name System (mDNS) and DNS-Service Discovery to enable SEP 2.0 devices to be discovered on a local network implementing the service discovery method. Also, SEP 2.0 makes use of Transport Layer Security (TLS) to secure communications between devices, thus ensuring that the protocol meets rigorous security requirements needed to protect sensitive consumer information and to ensure integrity of Smart Grid transactions.

The SEP 2.0 architecture and technologies used by the protocol standard are same technologies that are used to implement rich ecosystem of applications running on smartphones, tablets and browsers communicating with Web-based services. Thus, there is a broad-based developer community, know-how and tools to innovate around SEP 2.0 enabled devices. Similar to recent innovation in the mobile

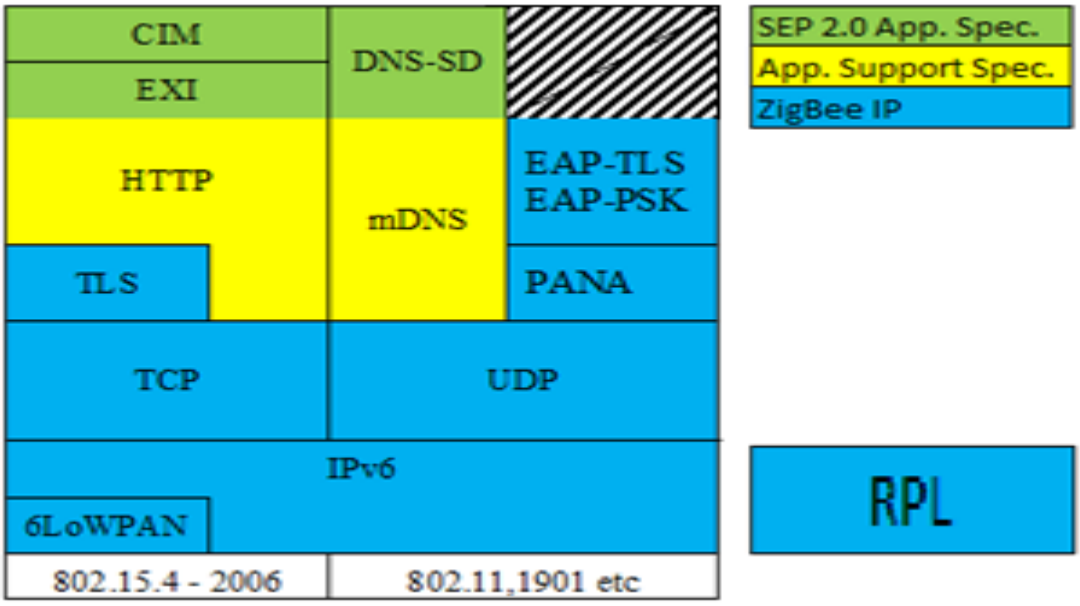

Figure 1: - Protocol Stack

Internet world, SEP 2.0 enables technology that can quickly build and deploy cloud-based services. The only missing ingredient is the lack of widely available smart-energy devices implementing SEP 2.0 based communications.

A. SEP 2 protocol Architecture

Fig. 1 shows most layers (802.15.4 and 802.11) define as the physical layer.

- IEEE 802.15.4
- Network discovery using MAC beacons
- Channel access scheme [2]
- Support for battery operated sensors nodes
- AES-128-CCM frame security

1) 6LOWPAN (IPv6 Over Low Power Wireless PAN) :

The 6LoWPAN concept originated from the idea that "the Internet Protocol could and should be applied even to the smallest devices and that low-power devices with limited processing capabilities should be able to participate in the Internet of Things. The 6LoWPAN group has defined encapsulation and header compression mechanisms that allow IPv6 packets to be sent to and received from over IEEE 802.15.4 based networks.

2) RPL :

RPL is a layer 3 routing protocol not tied to a specific link layer technology[3]. As presented in the "Low Power Link Layer" link layers technologies other than IEEE 802.15.4 may fit with the LLN definition, and PLC is a particularly good candidate.

3) Multicast domain name service :

Multicast domain name service come under the App support spec. which includes Controlled flooding of packets within PAN & Supports UDP applications.

4) Transport Layer Security :

Transport Layer Security includes Security used at application layer also added at link layer (Optional).

5) Hypertext transfer protocol :

It is used to interact with 'resources' in a 'RESTful' (Representational State Transfer) manner and provides interconnection with resources by four basic services GET, PUT, POST, DELETE.

6) Efficient XML Interchange :

EXI is come under the Sep 2.0 app spec. which includes Tokenized XML, W3C standard, Message format of the HTTP resources.

7) Common Information Model :

CMI is come under the Sep 2.0 app spec. which includes the "what"--Metering, Pricing, International Electronics Commission standard (61968/61970), Semantic model used and UML → Schema → Resources.

8) Domain Name System-Service Discovery :

DNS-SD is come under the Sep 2.0 app specification used in conjunction with mDNS, Service discovery --Types and Sub-Types, Essentially just DNS TXT records, "Give me all smart energy devices", "Give me all smart energy metering devices", Returns various information such as path.

IV. ZIGBEE SMART ENERGY FEATURES

DEMAND RESPONSE & LOAD CONTROL

- Scheduling of multiple events
- Built-in support for customer override
- Ability to individually or simultaneously target specific groups of devices including HVACs, water heaters, lighting, electric vehicles, and generation systems

PRICING

- Block tariff (inclining/declining rates) NEW
- Prepayment NEW
- Multiple commodities including electric, gas, water, and thermal
- Multiple currencies for international support (using ISO 4217)
- Support for price ratios/price tiers

TEXT MESSAGE

- Scheduling/canceling of messages
- Ability to request message confirmation
- Multiple urgency levels

SECURITY

- Support for consumer-only, utility-only or shared networks
- Automatic, secure network registration using either pre-installed keys or standard public-key cryptography methods
- Data encryption

OTHER[5]

- Tunneling of manufacturer specific protocols NEW
- Backwards compatible with ZigBee Smart Energy version 1.0 NEW
- Time Synchronization provided by ESP
- Designed for easy upgrade and adaptability within version 1.x

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