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The Generic Design of a High-Traffic Advanced Metering Infrastructure Using ZigBee

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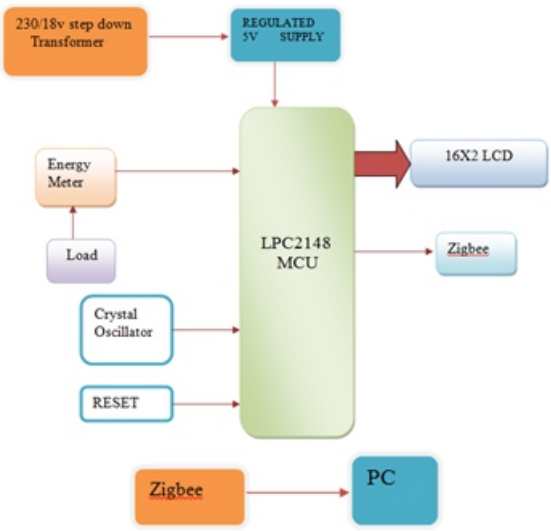
Abstract:

A multi-interface ZigBee building area network (MIZBAN) for a high-traffic advanced metering infrastructure (AMI) for high-rise buildings was developed. This supports metermanagement functions such as Demand Response for smartgrid applications. To cater for the high-traffic communicationin these building area networks (BANs), a multi-interface managementframework was defined and designed to coordinate theoperation between multiple interfaces based on a newly definedtree-based mesh (T-Mesh) ZigBee topology, which supports bothmesh and tree routing in a single network. To evaluate MIZBAN,an experiment was set up in a five-floor building. Based on themeasured data, simulations were performed to extend the analysisto a 23-floor building. These revealed that MIZBAN yields animprovement in application-layer latency of the backbone and thefloor network by 75% and 67%, respectively. This paper providesthe design engineer with seven recommendations for a genericMIZBAN design.

Index Terms:

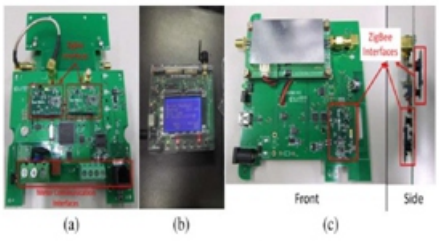
LPC2148, smart grid, ZigBee.

BLOCK DIAGRAM:



LITERATURE SURVEY :

High Traffic Zigbee Ban For HTAMI ZigBee belongs to the class of wireless sensor networks whose adoption bears a crucial meaning. It was discussed that, because of the inherent nature of scalability and mesh capability of ZigBee, ZBAN for AMI can be established and set up quickly in most existing buildings at a lower cost. Such an adaptive and scalable wireless structure will certainly help to build up an efficient demand response smart metering infrastructure for various smart grid applications. A good demand and response smart metering system will help the gross domestic product (GDP) grow healthily (less carbon emission) to a great extent. Attention should be drawn to the fact that traffics in a BN in a high-rise BAN is a few hundred times more than in a traditional AMI network used for individual houses or low rises. Since data are normally collected every 15–30 min, the major challenge presented to the AMI system in a high-rise BAN is the design of high density traffic for smart metering. From the HTAMI system design perspective, high-density meter data aggregation in the backbone yields high traffic.



Prototype of dual-interface MIZBAN. (a) Z-BMT. (b) Z-IHD. (c) Z-BGW

In addition, it is not uncommon that wireless local area networks (WLANs) are normally used in households. WLANs operate in the same frequency band as ZigBee at 2.4 GHz. Under such circumstances, closely packed packets of different standards around the same general area may cause inference to the target AMI system. However, it was well documented that ZigBee and WiFi may coexist [18]. Hitherto, the remaining issue is to design a mechanism for high traffic. To tackle the challenge of high traffic, the network structure of a multi-interface ZigBee BAN (MIZBAN) is proposed

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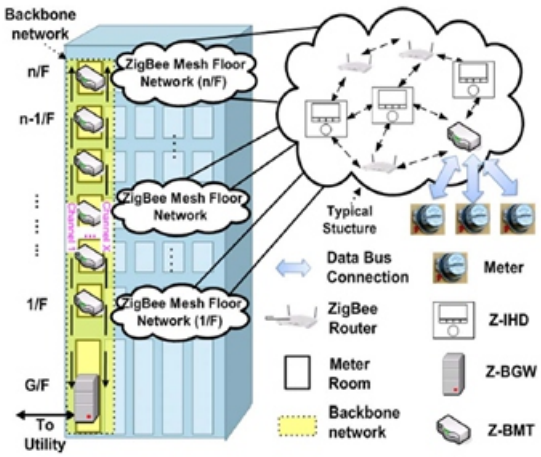
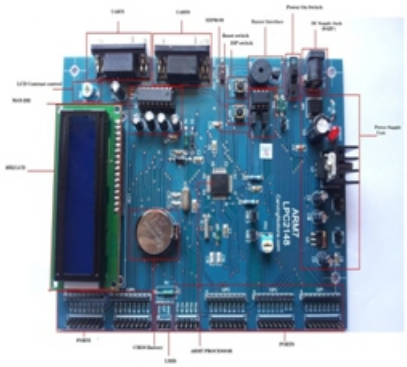


MIZBAN design for HTAMI

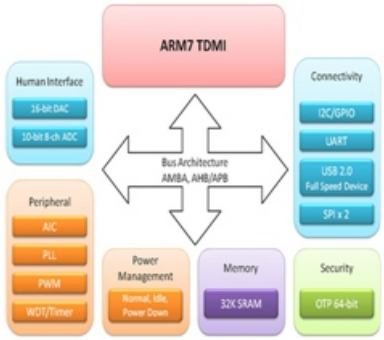
I.Hardware modules

A.LPC2148 controller

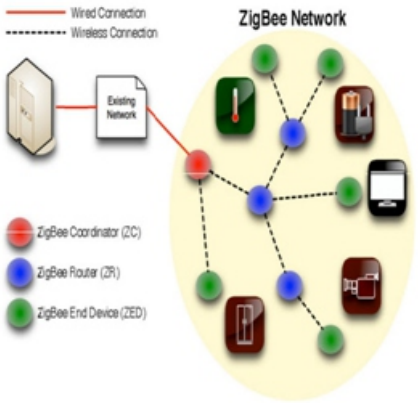
The LPC2148 are based on a 16/32 bit ARM7TDMI-S™ CPU with real-time emulation and embedded trace support, together with 128/512 kilobytes of embedded high speed flash memory.



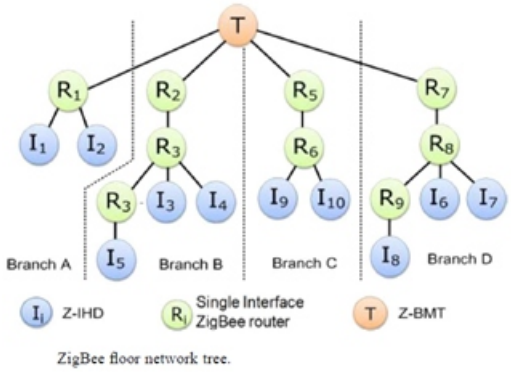
A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at maximum clock rate. For critical code size applications, the alternative 16-bit Thumb Mode reduces code by more than 30% with minimal performance penalty. With their compact 64 pin package, low power consumption, various 32-bit timers, 4- channel 10-bit ADC, USB PORT,PWM channels and 46 GPIO lines with up to 9 external interrupt pins these microcontrollers are particularly suitable for industrial control, medical systems, access control and point-of-sale. With a wide range of serial communications interfaces, they are also very well suited for communication gateways, protocol converters and embedded soft modems as well as many other general-purpose applications.



B.Zigbee:



It is the wireless device for transmitting and receiving purpose or simply it called as Transceiver. Zigbee is based on the IEEE802.15.4 protocol. The range of the Zigbee is covered as 100m. It range is 10 times better than bluetooth device so it can be more preferable one in wireless device. The data rate is very low for transmission while using this device.



ZigBee floor network tree.

C.Grid:

The term grid usually refers to a network, and should not be taken to imply a particular physical layout or breadth. Grid may also be used to refer to an entire electrical network, a regional transmission network or may be used to describe a sub network such as a local utility's transmission grid or distribution grid.

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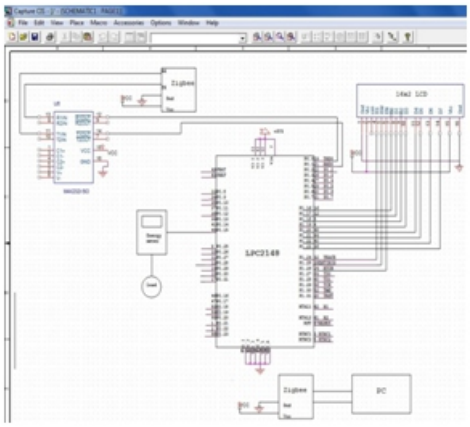
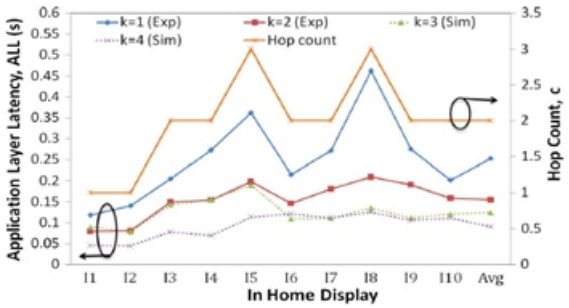
Schematic representation of project:



II.PERFORMANCE EVALUATION:

The performance evaluation is divided into two parts: ZigBeemesh floor (horizontal communication) network and BN (verticalcommunication).



ALL and c of $I_1 - I_{10}$ for k = 1–4 and n = 1.

III.SOFTWARE DETAILS

A.Keil compiler:

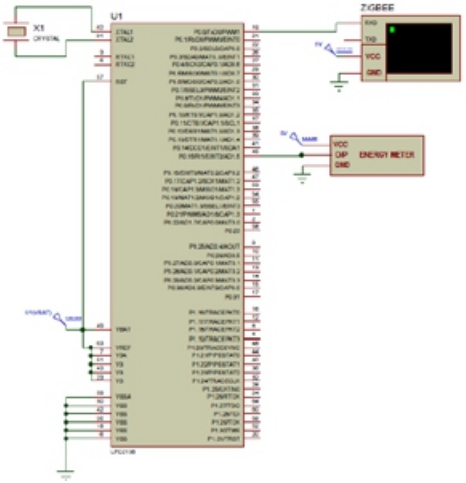
Keil compiler is a software used where the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further processing. Keil compiler also supports C language code.

B.Proload:

Proload is a software which accepts only hex files. Once the machine code is converted into hex code, that hex code has to be dumped into the microcontroller placed in the programmer kit and this is done by the Proload. Programmer kit contains a microcontroller on it other than the one which is to be programmed. This microcontroller has a program in it written in such a way that it accepts the hex file from the keil compiler and dumps this hex file into the microcontroller which is to be programmed.

IV.Results:

Simulation Results



V.Conclusion:

To facilitate efficient deployment of AMI for existing buildings, a first BAN is presented in this paper which suggested breaking the network into backbone and floor network to handle inter-floor and infra-floor communication separately. To gain more insight, this paper discussed the practical design of a BAN based on ZigBee and implemented successfully.

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