DESIGN OF MULTIMODE GATEWAY FOR DATA ACQUISITION TO HIGH END DATA MONITORING USING IEEE802.15.4

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Abstract
Wired Electronic systems with or without current loops are used for these purposes. But such system heavily demands infrastructure developments with heavy costing for planting wires and then their maintenance. Sometime increased noise levels in signals also incorporate for inaccuracy in acquired data which may hamper entire DBMS.Our project research work titled "Design a Multimode Gateway for Data Acquisition to High End Data Monitoring using IEEE802.15.4" briefly focuses on solutions to overcome these difficulties in data acquisitions with improved noise immunity, cost redundancy and guaranteed and quality signal transmission and receiving outcomes.
Keywords: Signal Transmission cable, Wi-Fi High speed internet ,LAN,Microcontroller,Data Bank, Hardware IEEE802.15.4 transreceiver etc..

1 Introduction

A data acquisition system plays on influencing role for monitoring and mentoring applications for industrial culture. Sensors and I/O calibration on techniques for PLC's highly demands the data base managing for research development and quality up gradation processes. Numbers of sensors are analog sensors few are dependent on digital or hybrid modules. Many a time need comes to transmit their responses and acknowledges over a long distance and store that in some software ERP systems. Traditionally wired systems with or without current loops are used for these purposes. But such system heavily demands infrastructure developments with heavy costing for planting wires and then their maintenance. Sometime increased noise levels in signals also incorporate for inaccuracy in acquired data which may hamper entire DBMS.Our project research work titled "Design a Multimode Gateway for Data Acquisition to High End Data Monitoring using IEEE802.15.4" briefly focuses on solutions to overcome these difficulties in data acquisitions with improved noise immunity, cost redundancy and guaranteed and quality signal transmission and receiving outcomes. Since such system demand a wireless technology with low transmission rates and moderate distances for communication, ZigBee will be highly demanded air interface for this. Due to inherent ZigBee properties which are standardize with IEEE 802.15.4.

1 Properties of ZigBee Protocol:

ZigBee will provide a robust, strong, secured and low cost to interface as a replacement part of traditional wired communication techniques for data interfaces. Wireless technology, which has boomed in the IT sector over the past years, can be suitable for industrial control networks as well, providing solutions with high ROI for diagnostics, control and safety. In managing the move to wireless, it is clear that common wireless protocols such as Wi-Fi and Bluetooth can be utilized on the factory floor. The challenge is to understand how to utilize wireless solutions, developed for IT applications, as replacements for wired systems in time-critical scenarios typical of factory floor domains. To date, most wireless systems in production systems are focused on applications that require polling frequencies on the order of seconds or longer. However, the fundamental capabilities of these protocols allow support of much higher-speed applications such as motion control and closed

loop distributed logic. To address this challenge, the following issues must be addressed in wireless technology for manufacturing:

1. Determining the performance of wireless technology (data rate, transmission, jitter and link reliability)
2. Developing best practices for wireless solution deployment and maintenance
3. Implementing standardized device testing across industries, including automated performance benchmarking.

But, while considering applications specific to Industrial environment system demands:

Profile the performance of wireless de-vices and systems as it relates to metrics important for production system applications (e.g., speed, determinism and jitter)

- Provide best practices for migrating to and maintaining wireless systems in manufacturing domains
- Give a plant engineer a prior knowledge of performance limitations and tools to identify potential liabilities
- Provide a platform for industry standardized testing and benchmarking of wireless devices and systems
- Provide an understanding of the implementation areas for wireless that will provide the highest return on Investment.

Methodology and Experimental Work:As a unique protocol of IEEE 802.15.4 satisfy these entire requirements, a compliant technology for this will be required. ZigBee provides all suitable data rates as compared to other wireless technology so this withstands suitably for such applications

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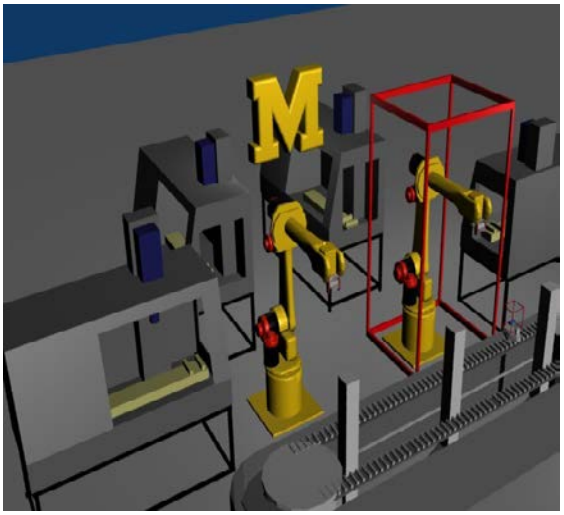

Fig1

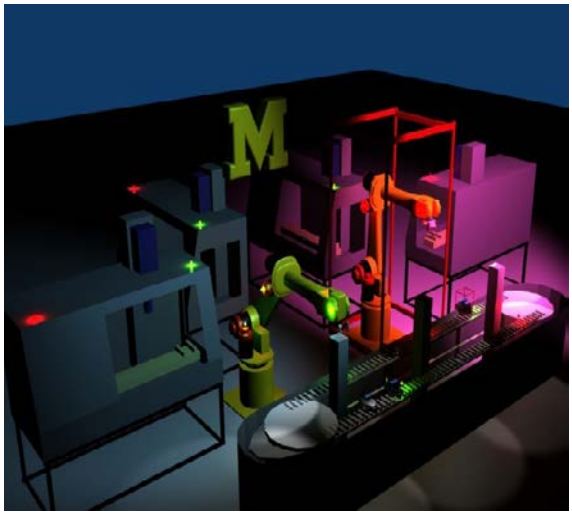

Fig:2

1. About ZigBee:

ZigBee is the product of the ZigBee Alliance, an organization of manufacturers dedicated to developing a networking technology for small, ISM-band radios that could welcome even the simplest industrial and home end devices into wireless connectivity. The ZigBee specification was finalized in December 2004, and products supporting the ZigBee standard are just now beginning to enter the market.

ZigBee is designed as a low-cost, low power, low-data rate wireless mesh technology. The ZigBee specification identifies three kinds of devices that incorporate ZigBee radios, with all three found in a typical ZigBee network (Figure 1):

■ A coordinator, which organizes the network and maintains routing tables.

■ Routers, which can talk to the coordinator, to other routers and to reduced-function end devices.

■ Reduced-function end devices, which can talk to routers and the coordinator, but not to each other.

To minimize power consumption and promote long battery life in battery-powered devices, end devices can spend most of their time asleep, waking up only when they need to communicate and then going immediately back to sleep. ZigBee envisions that routers and the coordinator will be mains-powered and will not go to sleep

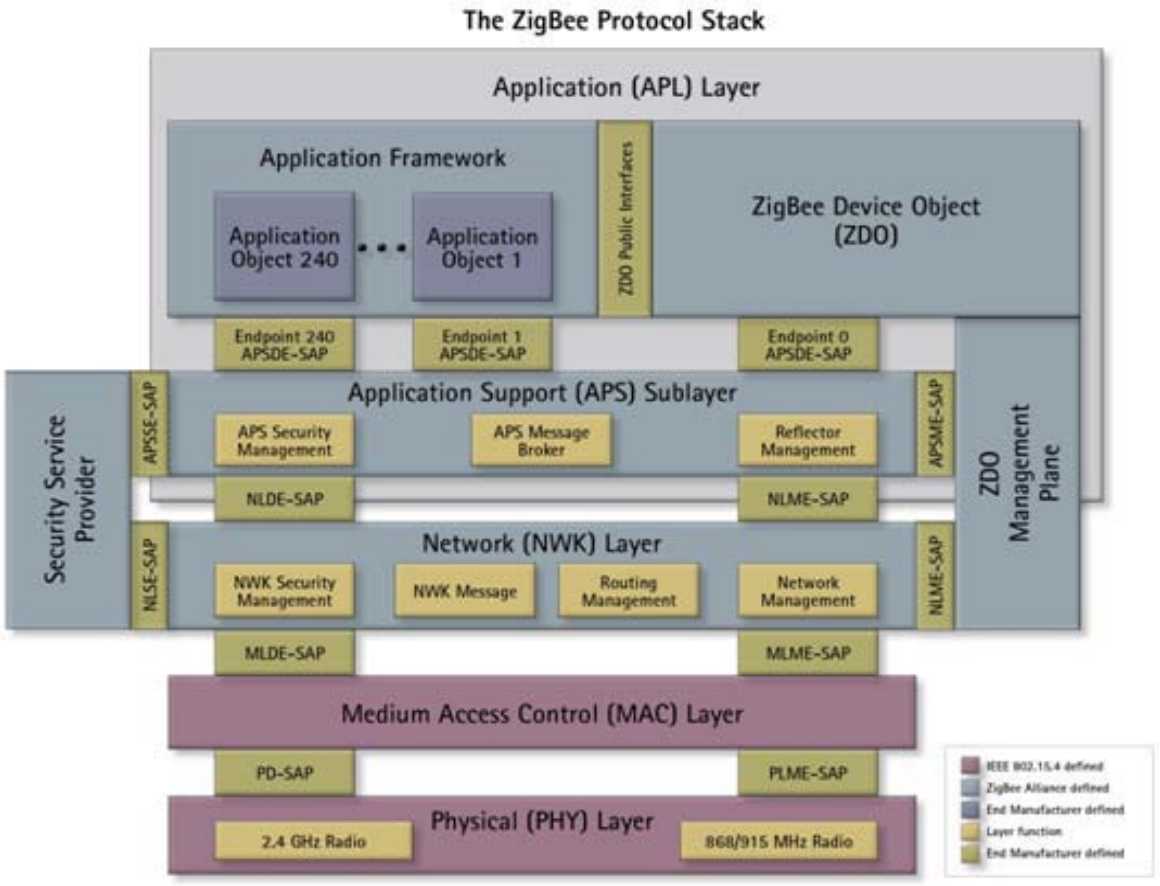

Fig3. ZigBee Protocol Stack Architecture

As above architecture shows, three areas of architectural responsibility are in a ZigBee engineering effort: The physical and MAC layers take full advantage of the physical radio specified by IEEE 802.15.4. The 802.15.4 specification describes a peer-to-peer radio using direct sequence, spread spectrum (DSSS). The specification also calls out the data rates, channelization and modulation techniques to be employed. The ZigBee Alliance specifies the logical network, security and application software, which are implemented in a firmware stack. It is the ZigBee networking stack that creates the mesh networking capability. Each microcontroller/ RF chip combination requires its own ZigBee stack due to the differences in

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microcontrollers and RF chips. Typically, the ZigBee stack is included with either the microcontroller or RF chip. The stack may belong to the chip vendor, be provided by the chip vendor from a third-party source, or be provided by a third-party source for a specific microcontroller/RF chip combination. The application layer is defined by profiles, of which there are two types: public profiles are those certified by the ZigBee Alliance for interoperability purposes, and private profiles are for use in closed systems.

1. **Comparing ZigBee with Others:** Sustainability for ZigBee as compared to other can be confirmed from table of comparison & occupancy of area network

Standard	Frequency	Data Rate[1]	Range	Type
802.11a	5 GHz	54 Mbps	120m	LAN
802.11b	2.4 GHz	11 Mbps	140m	LAN
802.11g	2.4 GHz	54 Mbps	140m	LAN
802.11n	2.4/5 GHz	248 Mbps[2]	250m	LAN
802.15.1	2.4 GHz	3 Mbps[3]	100m[4]	PAN
802.15.4	868/915 MHz 2.4 GHz	40 kbps 250 kbps	75m	PAN
802.15.6[5]	1 THz	>1 Gbps	10m	BAN

[1] Specified for outdoor environments with few obstructions.
[2] 802.11n device with two streams (four antennas).
[3] Bluetooth version 2.0.
[4] Bluetooth class 1 device.
[5] All 802.15.6 values are unconfirmed.

Table1. Comparing ZigBee with other Technologies

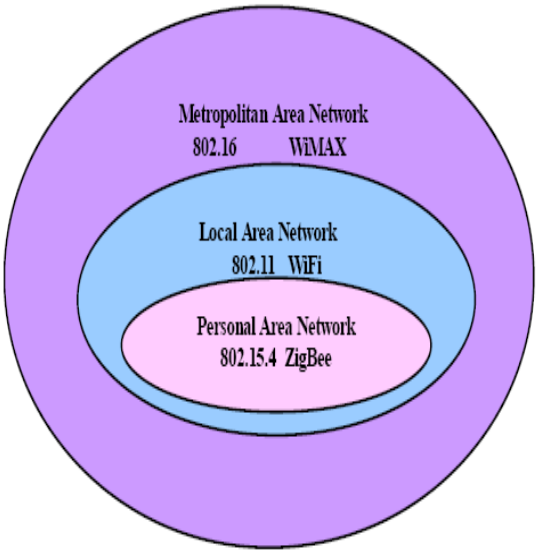

Fig4 Occupancy of Area Network

2. Network Topology for ZigBee:

The ZigBee network layer (NWK) supports star, tree, and mesh topologies. In a star topology, the network is controlled by one single device called the ZigBee coordinator. The ZigBee coordinator is responsible for initiating and maintaining the devices on the network. All other devices, known as end devices, directly communicate with the ZigBee coordinator. In mesh and tree topologies, the ZigBee coordinator is responsible for starting the network and for choosing certain key network parameters, but the network may be extended through the use of ZigBee routers. In tree networks, routers move data and control messages through the network using a hierarchical routing strategy. Tree networks may employ beacon-oriented communication as described in the IEEE 802.15.4-2003 specification. Mesh networks allow full peer-to-peer communication. ZigBee routers in mesh networks do not currently emit regular IEEE 802.15.4-2003 beacons. This specification describes only intra-PAN networks, that is, networks in which communications begin and terminate within the same network.

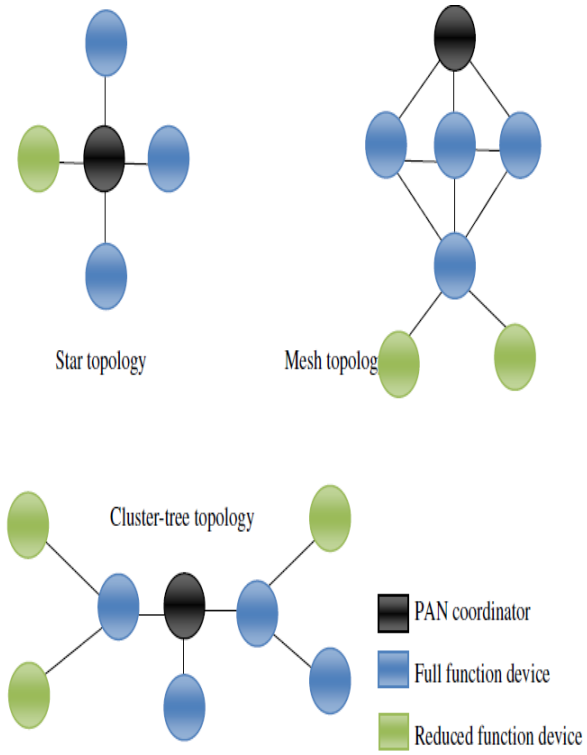

Fig5. Network Topologies

5. Project Prototype:

The proposed project research work keep the model in which remote PLC control industrial machineries will be controlled & regulated by the switching actions performed by FFD side. This FFD side also displays the status of the RFD side system on the LCD connected on its panel. Alarm & Indications as shown that corresponds to status monitoring effects on server side due to remote machine parameter dependency. As shown RFD side will be switched by FFD for production controlled mechanisms. Secondly electrical parameters will also be sensed on this side for the purpose of data transmission to FFD. Both the devices will be wirelessly linked by ZigBee with STAR topology. Industrial Automation profile of the ZigBee will be implemented here

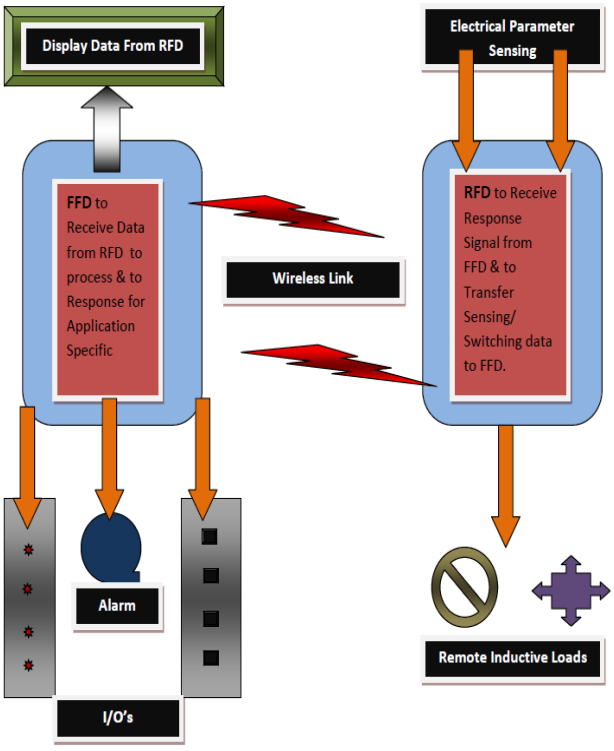

Fig 6. Project Prototype

6. Microcontroller & ZigBee Module:

In the application development, microcontroller mainly meant for the function of the data processing, data storage, human interfacing and interoperability with the external environment. While developing any application platform on any microcontroller the things to that can be taken into account are:

a) To choose requirement specific microcontroller with further scope of up gradation.

b)To study development tools with their version specification.

c) To study and apply High Level Language specification for application development as per compiler variations.

The basic architectural & peripheral requirement for microcontroller are:-

a) Instruction and data are on the separate buses, increasing speed & overall performance.

b) While instruction fetching on program bus, data can be read or written on data bus.

c) Program Memory Bus optimized to any widths that fit within the design goals of microcontroller.

d) Wider buses which may allow more information to be transferred from memory to the CPU, enabling many instructions to be executed in a single clock cycle.

e) Instructions are upward compatible to maximize processing efficiency.

For our project work we are going for the controllers and developments tools of **Microchip Technology.** Module of XB PRO Series2 of Digi will be used here as a part of ZigBee stack which will then be addressed by mixed API mode with hardware controlled flow control for USART interfacing with the desired baud rate.

7. Work Done for Project:

a. Analysis of ZigBee **data acquisition** Public Profile.
b. Study Require ZigBee stack.
c. To prepare software flow for implementation of ZigBee Profile for data acquisition.
d. To prepare hardware design for implementation.
e. Study & remove Software Vs Hardware convergence issues.
f. Develop application platform for the selected microcontroller.
g. Test & Debug the concerned issues regarding development environment.
h. Preparing observation & test reports.
i. Finally to implement this ZigBee interfacings for "**data acquisition**".

8. Conclusion & Future Scope:

- ZigBee has a lot to offer industrial automation applications because
  1. Low cost deployment and redeployment
  2. Mesh networking to cover entire industrial plants and factories
  3. Open standard with multiple vendors
  4. Battery operation
- **Hence data acquisition will demand the wide scope to utilize ZigBee for improve control & operations.**

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