Insight into exemplary work of RFID system expending ZigBee: Compact to Crossover

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***Abstract*— Augmented depiction of ZigBee using RFID. ZigBee and RFID are two independent wireless technologies in which one supports sensor networks and the other supports tracking of low power wireless tracking of animate and inanimate objects. The alliance of ZigBee and RFID would integrate the mesh network with tracking capability, which enhances the overall activity from a single hop to multi hop in a network.**

***Index Terms*— RFID, Hop, ZigBee,tags**

I. INTRODUCTION TO RFID

Radio-frequency identification (**RFID**) is a technology to electronically map and record and monitor the presence of an animate or inanimate object using radio signals. The method is implemented using RFID tags which are small transponders (a combination of transmitters and receivers) . The other hardware used for RFID tags is RFID tag reader.

[1] An RFID tag is parameter having an integrated circuit for storing information with or without battery, that can be assimilated into a product, animal, or person for the purpose of identification and tracking using radio waves. Some tags can be read from quite a few meters away and afar the line of sight of the reader. Most tags carry a plain text inscription and a barcode as complements for direct reading and for cases of any failure of radio frequency electronics. Tags capable of carrying 2,000 bytes of data or less.

II. EVOLUTION OF RFID

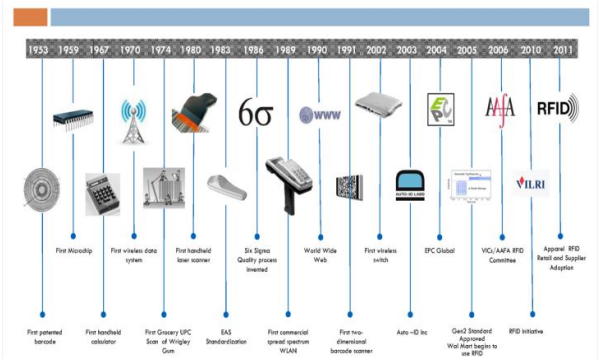

Fig. 1.1: Evolution of RFID

The roots of radio frequency identification technology[2], Since World War II, from aircraft radar systems to today's implementation of RFID in Wal-Mart retail chain is journey of evolution of RFID Fig. 1.1. Though RFID systems will not be limited only to retail but expanding horizons into every domain including in London, double-decker buses operated by Stagecoach London are being equipped with RFID-enabled tire-pressure sensors. Also In addition, about 50 gas stations in Italy store fuel in RFID-equipped storage tanks

Also, Over 50 cities and municipalities in the U.S. use RFID tags in residential recycling and trash containers, and reader systems on the trucks that pick them up. Clearly, RFID has moved beyond its logistics roots. Fig.1.3.

Earlier they were used on shipping containers, now they have moved onto normal trucks to help owners track shipments and their locations in real time.

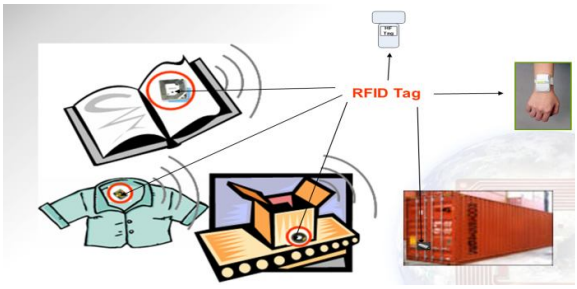

Fig. 1.2 : RFID Tags

III. WORKING OF AN RFID SYSTEM:

RFID systems comprise of three components in two combinations: a transceiver transmitter/receiver) and antenna that are integrated as an RFID reader.[4] A transponder (transmitter/responder) and antenna are integrated to make an RFID tag Fig. 1.2. An RFID tag is read when a radio signal is emitted by the reader that activates the transponder, which sends data back to the transceiver. A basic RFID system consists of three components:

- An antenna or coil
- A transceiver (with decoder)
- A transponder (RF tag) electronically programmed with unique information

There are two types of transponders, which associate to the two major types of RFID tags.

- Passive transponders and RFID tags have no energy source of their own, relying on the energy given off by the reader for the power to respond. Cheaper, passive RFID tags are the most likely to be used for general purposes.

An active transponder or tag has an internal battery source, which is expended to generate a signal in response to a signal reader. Active transponders are more expensive than passive ones. And can communicate over miles like ordinary radio communications. They are commonly used in navigation systems for commercial and private aircraft. At its most basic level, [7] RFID is a wireless link to uniquely identify objects or people. It is sometimes called dedicated short range communication (DSRC). RFID systems include electronic devices called transponders or tags, and reader electronics to communicate with the tags. RFID communication is through radio signals that carry data which is unidirectional or bidirectional.

When a transponder enters a read zone, the data is captured by the reader and can then be transferred through standard interfaces to a host computer, printer, or programmable logic controller for storage or action.

The antenna emits radio signals to activate the tag and to read and write data to it. The reader emits radio waves in ranges of any wherefrom one inch to 100 feet or more, depending upon its power output and the radio frequency used. When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal. The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer for processing.

The purpose of an RFID system is to enable data to be transmitted by a portable device, called a tag, which is read by an RFID reader and processed according to the needs of a particular application. The data transmitted by the tag may provide identification or location information, or specifics about the product tagged, such as expiry date, status, price, color, date of purchase, etc. RFID quickly gained attention because of its ability to **track moving objects**. As the technology is refined, more pervasive - and invasive – uses for RFID tags are in the works. Fig. 1.4[22].

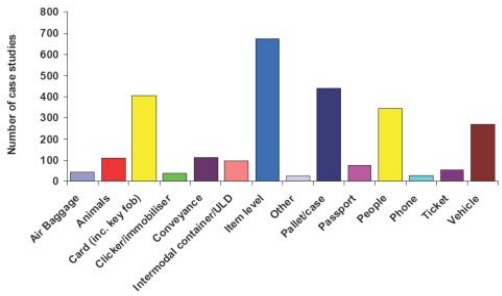

Fig. 1.3. RFID Domains

To retrieve the data stored on an RFID tag, you need a reader. A typical reader is a device that has one or more antennas that emit radio waves and receive signals back from the tag. The reader then passes the information in digital form to a computer system which is further used for monitoring and tracking.

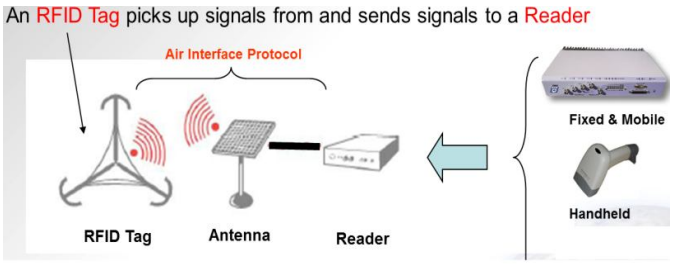

Fig. 1.4 RFID Mechanism

IV. INTRODUCTION TO ZIGBEE TECHNOLOGY

[3]ZigBee technology is an IEEE 802.15.4 standard for wireless communication of data. ZigBee is a low-cost, low-power, wireless mesh network standard enabling batteries to last forever. ZigBee, a wireless sensor n/w

consists of s/w having embedded Operating System, protocol stack, and application program. Complete ZigBee works at various layers of OSI Model as, physical layer, MAC layer, network layer, and security layer. Each layer accomplishes a precise task for the layer above. The standards are defined by IEEE 802.15.4 [6] for enabling simple devices and consuming power at their least. ZigBee in combination consists of 3 things: ZigBee Coordinator (Acts as an n/w head), ZigBee Router (performs data routing function between nodes), ZigBee End Device (the leaf nodes). ZigBee works on protocols which work on nodes network in form of cluster of clusters.

ZigBee enables implementation of networked homes where all nodes and networks are operated and monitored by single unit hence may be used for automation of homes, and telecommunication applications.[8] Traffic on ZigBee can accommodate all types as Data transfer can be periodic or intermittent or repetitive. ZigBee communicates in two modes, beacon and non beacon modes.

ZigBee protocol communicates in range of 10 m to 1000 m i.e. a WPAN (wireless personal N/w). ZigBee devices operate in bands of 2.4 GHz which are not licensed. At this frequency, 16 channels are available with a throughput rate of 250 kbps. As defined in 802.15.4, ZigBee networks can function as FFD (full function device) o r RFD (reduced function device)

Both ZigBee and RFID use RF technology for communication, but each has a different enactment.

V. RFID AMIDST ZIGBEE

Although the RF technologies i.e. RFID and ZigBee use the same Radio frequencies, but they are completely different in all three characteristics:

1. Power
2. Bit rate
3. Range.

ZigBee has low power consumption over RFID as it goes into a sleep mode often when not in active mode thus increasing the lifespan of battery from months to years.. The bit rate send via ZigBee is 250 kb/sec as compared to 54bits/sec RFID. It covers range approximately 1000 meters as compared to RFID.

The alliance of ZigBee with RFID would create a ZigBee mesh network with tracking feature of RFID as the former supports advanced sensor networks while the latter is suitable for low-power wireless tracking of animate and inanimate objects.

ZigBee is actually a network platform enabling device and not a alternate option for RFID. With no human interference active RFID tags can work for years in any given bad to worst conditions and communicate data at long range .They can also monitor changes in different environmental conditions when integrated with different sensor types, alike the components of an end device in a ZigBee system.

The RFID tags receive several tags at a time in a single hop through RFID reader thus consuming more power and reducing the battery life. These tags may also collide with another while trying to provide information at the same time and same channel to the RFID reader.[17] ZigBee , on the other hand ,supports a large number of nodes, by reducing the power consumption with a low-current or sleep mode (allowed by time synchronization), can run on a single battery for several years. A ZigBee end device (tag) can be awakened from sleep mode periodically to perform its scheduled task. [20]Owing to all the these features, a ZigBee end device (RFD) can be allied with RFID to act as an active RFID tag (with appropriate program) enabling it to operate in any environments for several years at a time by performing independent monitoring with an active RFID reader layer for connection with RFID tags, and initiating or controlling communications.

With multiple sensors, each sensor forms a node on the network (owing to peer-to-peer network), sending or receiving data to and from any other nodes. Thus enabling the nodes to form a mesh or an ad hoc network that can self-configure and self heal, maximize reliability and minimize the cost of network deployment and maintenance.

VI. CONCLUSION & FUTURE SCOPE

The major challenge in current era is cost of RFID readers. RFID readers are very costly; nearly thousands of US dollars per reader the cost of integrating such devices would be even greater. Hence by using ZigBee, the network enabled device the cost of the tags can be minimized. As research and development in RFID reader technology progresses, new innovative manufacturing

Techniques will emerge over time. Banks can provide their customers with cards integrated with RFID tags. RFID reader integrated mobile phones can be used to read the RFID banking card. This can allow the customer to purchase things wirelessly and with the help of the ZigBee network the customer information can be accessed globally in a secured manner.

The future scope of this project is to implement the above project for large scale industries for e.g. in home appliances, defence, health systems, sanitary systems (garbage maintenance), tracking population of trees and people in metro rails as well as in various domains.[5][10] RFID technology can be integrated into mobile phones also. It is believed that in future, persons will be integrated with an RFID chip inside them which will be used to identify the person .This chip will store his identity which will be used for every transaction he performs such as purchasing,

[21]Banking transactions etc. and other places where he needs to authenticate his identity. If such chips are integrated in persons then mobile phones can be used to track persons which may be security threat to the individual. Hence expending ZigBee with the above will ensure the security of the system.

"Science can amuse and fascinate us all, but it is engineering that changes the world."

ISAAC ASIMOV, *Isaac Asimov's Book of Science and Nature Quotations*, 1988. (S&S)

Expending ZigBee with RFID will bring best of both the technologies veiling the loop holes and optimizing the system.

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