IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ICRAESIT - 2015

B V Raju Institute of Technology, Narsapur

Vol. 2, Special Issue 2, December 2015

Power Efficient and Robust Ubiquitous Sensor Networks

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Abstract: Ubiquitous Sensor Networks need to extend the features like minimum power utilization for transmitting large amount of data through sensors increase the security in case of node identification by the jammer and to reduce the untrusted nodes by constructing self organizing trusted node network by adding so many features like integrating LEACH with CDMA instead of TDMA. We have proposed the new method to improve the security by hopping method which converts the real data into noise by using pseudo random code. Pseudo random code diverts the intruders in the way that they will only concentrates on data without noise. Here we transmit the data in the form of noise. To convert the data in the form of noise we use spread spectrum technique. M-ary PSK will control the high power consumption which is included in frequency hopping CDMA.

Index Terms: USN, Frequency Hopping, Pseudo Random Code, Spread Spectrum, M-ary PSK, LEACH with FHCDMA.

I. INTRODUCTION

USN is defined as a conceptual network built over existing physical networks which makes use of sensed data and provides knowledge services to anyone, anywhere and at anytime, and where the information is generated by using context awareness. In this definition "physical networks" means not only various types of WSNs, but also wired sensor networks and RFID readers. RFID (radio frequency identification) is a technology which is used to acquire information anytime and anywhere through network access service. Such ubiquitous network yields better results when integrated with wireless sensor networks (WSNs)[1]. This integrated network is called a ubiquitous sensor network (USN).

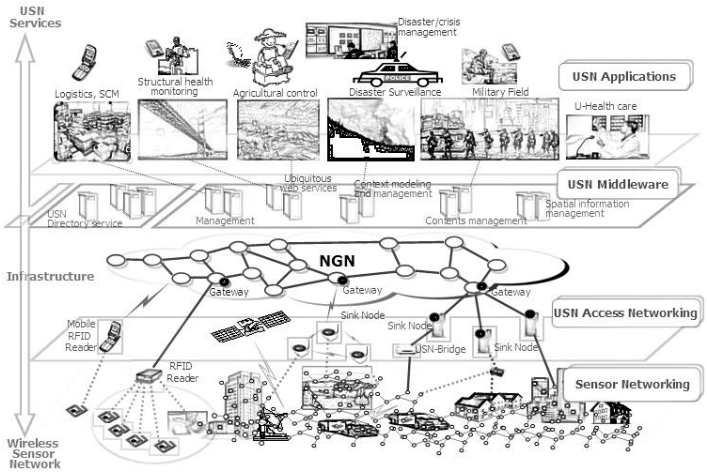

Fig 1: Ubiquitous Sensor Networks

II. PROPOSSED IDEA

In Proposed thought main aim is to improve efficiency of power control to reduce the high power consumption in USN which is most important resource to be utilized effectively by implementing M-ary phase shift keying with CDMA[2]. We also concentrate on quality of data nothing but data transmission should be reliable, i.e. to improve the reliability we have to maintain channel jamming ,frequency hopping by using techniques like Spread spectrum, pseudo random code. Spread spectrum is used to maintain the security because if any intruder tries to hack the data he only focuses on actual data but not the noise. We translate the original data in form of noise by using pseudo-random code.

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III. METHODOLOGICAL APPROACHES

A. Spread-spectrum characteristics of CDMA

Most modulation schemes try to minimize the bandwidth of the signal since bandwidth is a limited resource. However, spread spectrum techniques use a transmission bandwidth that is several orders of magnitude greater than the minimum required signal bandwidth. One of the initial reasons for doing this was military applications including guidance and communication systems. These systems were designed using spread spectrum because of its security and resistance to jamming. Asynchronous CDMA has some level of privacy built in because the signal is spread using a pseudo-random code; this code makes the spread spectrum signals appear random or have noise-like properties[2]. A receiver cannot demodulate this transmission without knowledge of the pseudo-random sequence used to encode the data. CDMA is also resistant to jamming. A jamming signal only has a finite amount of power available to jam the signal. The jammer can either spread its energy over the entire bandwidth of the signal or jam only part of the entire signal. CDMA can also effectively reject narrow band interference. Since narrow band interference affects only a small portion of the spread spectrum signal, it can easily be removed through notch filtering without much loss of information. Convolution encoding and interleaving can be used to assist in recovering this lost data. CDMA signals are also resistant to multipath fading [3]. Since the spread spectrum signal occupies a large bandwidth only a small portion of this will undergo fading due to multipath at any given time. Like the narrow band interference this will result in only a small loss of data and can be overcome. Another reason CDMA is resistant to multipath interference is because the delayed versions of the transmitted pseudo-random codes will have poor correlation with the original pseudo-random code, and will thus appear as another user, which is ignored at the receiver. In other words, as long as the multipath channel induces at least one chip of delay, the multipath signals will arrive at the receiver such that they are shifted in time by at least one chip from the intended signal[3]. The correlation properties of the pseudo-random codes are such that this slight delay causes the multipath to appear uncorrelated with the intended signal, and it is thus ignored.

Some CDMA devices use a rake receiver, which exploits multipath delay components to improve the performance of the system. A rake receiver combines the information from several correlators, each one tuned to a different path delay, producing a stronger version of the signal than a simple receiver with a single correlation tuned to the path delay of the strongest signal. Frequency reuse is the ability to reuse the same radio channel frequency at other cell sites within a cellular system. In the FDMA and TDMA systems frequency planning is an important consideration. The frequencies used in different cells must be planned carefully to ensure signals from different cells do not interfere with each other. In a CDMA system, the same frequency can be used in every cell, because channelization is done using the pseudo-random codes. Reusing the same frequency in every cell eliminates the need for frequency planning in a CDMA system; however, planning of the different pseudo-random sequences must be done to ensure that the received signal from one cell does not correlate with the signal from a nearby cell.

Since adjacent cells use the same frequencies, CDMA systems have the ability to perform soft hand offs. Soft hand offs allow the mobile telephone to communicate simultaneously with two or more cells. The best signal quality is selected until the hand off is complete. This is different from hard hand offs utilized in other cellular systems. In a hard hand off situation, as the mobile telephone approaches a hand off, signal strength may vary abruptly. In contrast, CDMA systems use the soft hand off, which is undetectable and provides a more reliable and higher quality signal

B. Frequency Hopping spread spectrum for FH- CDMA

Frequency-hopping spread spectrum (FHSS) is a method of transmitting radio signals by rapidly switching a carrier among many frequency channels, using a pseudorandom sequence known to both transmitter and receiver. It is used as a multiple access method in the frequency-hopping code division multiple access (FH-CDMA) scheme.

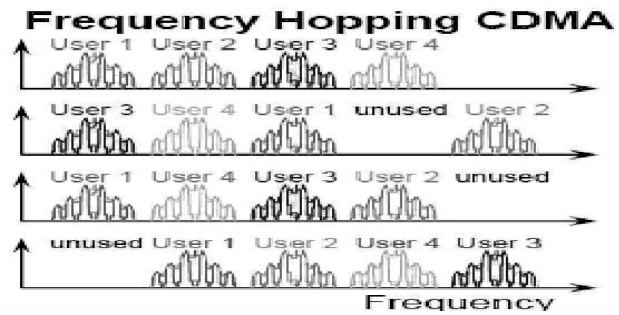

Fig 2: Frequency hopping CDMA

A spread-spectrum transmission offers three main advantages over a fixed-frequency transmission. Spread-spectrum signals are highly resistant to narrowband interference. The process of re-collecting a spread signal spreads out the

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interfering signal, causing it to recede into the background. Spread-spectrum signals are difficult to intercept. A spread-spectrum signal may simply appear as an increase in the background noise to a narrowband receiver. An eavesdropper may have difficulty intercepting a transmission in real time if the pseudorandom sequence is not known. Spread-spectrum transmissions can share a frequency band with many types of conventional transmissions with minimal interference. The spread-spectrum signals add minimal noise to the narrow-frequency communications, and vice versa. As a result, bandwidth can be used more efficiently. Spread-spectrum signals are highly resistant to deliberate jamming, unless the adversary has knowledge of the spreading characteristics. Military radios use cryptographic techniques to generate the channel sequence under the control of a secret Transmission Security Key (TRANSEC) that the sender and receiver share in advance.

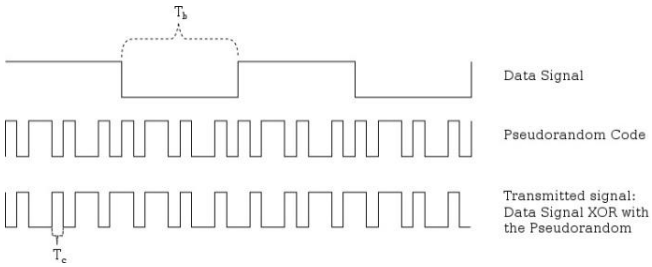

Fig 3: spread spectrum with pseudorandom code

C (i). COMPARING MODULATION TECHNIQUES

Comparing below techniques we can choose best modulation technique

- ASK(Amplitude Shift Keying)
- FSK(Frequency Shift Keying)
- PSK(Phase Shift Keying)

a) ASK:

ASK requires $4A^2$ Energy for signal of amplitude A. It Requires Less Bandwidth because it uses only one frequency to indicate 1.

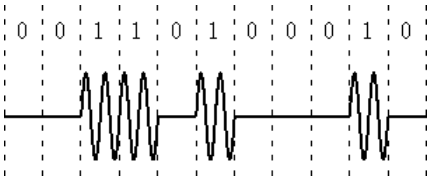

Fig 4: Amplitude shift keying

b) FSK:

FSK requires $A^2/2$ Energy for signal of amplitude A. It Requires More Bandwidth because we need different frequencies for each symbol

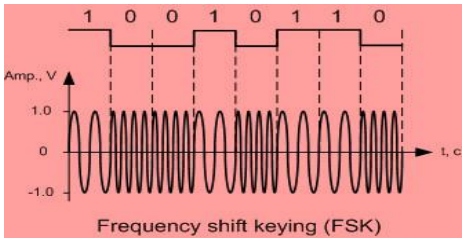

Fig 5: Frequency Shift Keying

c) PSK:

PSK requires $A^2/2$ Energy for signal of amplitude A. It Requires Less Bandwidth, it is power and bandwidth efficient.

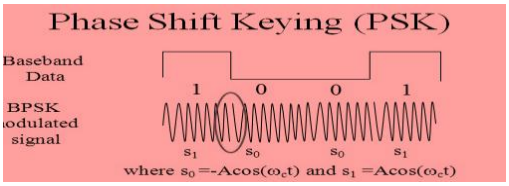

Fig 6: Phase Shift Keying

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C (ii).M-ary Phase Shift Keying (PSK)

M- ary PSK There are many forms of PSK. BPSK is modulated with just two phases of the carrier. Another term for BPSK is 2- ary PSK. In this case M= 2.M- ary PSK by showing vectors that represent the phase angles associated with the most common types of M- ary PSK modulation[3]. BPSK is represented by two arrows facing away from each other at a 180° angle. Each of the two phases of BPSK can represent only one bit of information, either a (0) or a (1).

IV. CLUSTERING ALGORITHM

Here we propose the best clustering algorithm which supports CDMA so that each cluster uses a different set of CDMA codes, to minimize interference between clusters. LEACH is a hierarchical protocol in which most nodes transmit to cluster heads, and the cluster heads aggregate and compress the data and forward it to the base station (sink)[8]. Each node uses a stochastic algorithm at each round to determine whether it will become a cluster head in this round. LEACH assumes that each node has a radio powerful enough to directly reach the base station or the nearest cluster head, but that using this radio at full power all the time would waste energy. Nodes that have been cluster heads cannot become cluster heads again for P rounds, where P is the desired percentage of cluster heads. Thereafter, each node has a 1/P probability of becoming a cluster head in each round [4]. At the end of each round, each node that is not a cluster head selects the closest cluster head and joins that cluster. The cluster head then creates a schedule for each node in its cluster to transmit its data. All nodes that are not cluster heads only communicate with the cluster head in a TDMA fashion, according to the schedule created by the cluster head[8]. They do so using the minimum energy needed to reach the cluster head, and only need to keep their radios on during their time slot.

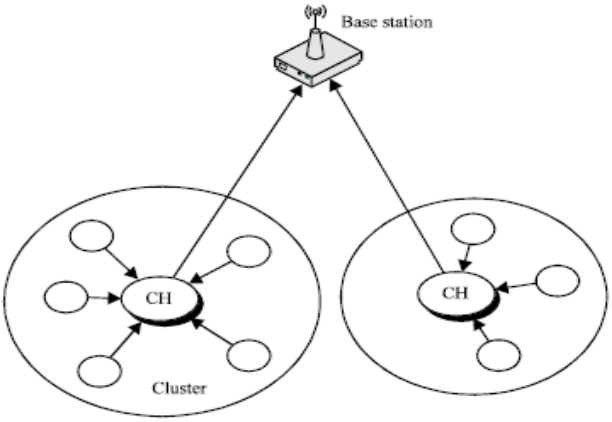

Fig 7: Tree Structure

A. LEACH with CDMA:

We integrate CDMA with LEACH which is energy efficient we transmitting data which is better than existing protocols. It is having features like Localized coordination and control for cluster set up and operation. Local compression to reduce global communication Randomized rotation of the cluster heads and the corresponding clusters. Random Death of nodes: there is no one section of the environment that is not being "sensed" as nodes die, as occurs in the other protocols. The high energy cluster head position rotates among the various sensors in order to not to drain the battery of a single sensor. (Currently just random)Sensors elect themselves to be the local cluster heads at any given time with a certain probability, and broadcast their status to other sensors each sensor node choosing the cluster-head with strongest signal (can minimize transmission power)[9].Each node takes the decision independent of the other nodes to become cluster head. It is based on the suggested percentage determined a priori and round number.

Transmission in one cluster will affect communication in a nearby cluster; hence each cluster communicates using different CDMA codes. Energy requirement is distributed among all the sensors by randomized rotation. Local fusion of data in cluster head reduces amount of data to be transmitted to the base station (computation for fusion is cheaper than communication). Main energy saving is due to combining lossy compression with the data routing [5]. Tradeoff between quality of output and amount of compression resulting in substantial reduction of overall energy dissipation.

VI. CHARACTERISTICS

- Low power consumption.
- Dynamic frequency channels.
- Reliable and secured through transmission.

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- Able to withstand from intrusion.
- Robust network topology.
- High level of privacy.
- Control channel jamming and Frequency hopping.

V. CONCLUSION

The proposed approach will improve the security and performance with the help of spread spectrum method and power consumption is low when compared to existing approach because of implementing CDMA with M-ary PSK supported instead of FDMA. By using Frequency Hopping method we can improve the security to our transmitted data which is converted in the form of noise by using pseudo-random code method. By using best clustering algorithm we can provide reliable service with quality.

Frequency hopping CDMA is power efficient because it consumes less power than FDMA because FHCDMA includes Phase Shift Keying which transmits the large amount of data by consuming less power. Frequency hopping method is best security method which changes the frequency channels continuously by interchanging the identifications of frequency channels. So intruder cannot access the channel without knowing the location, even he assume the channel frequency will change frequently.

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BIOGRAPHIES

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Dr. S. Madhavi received her M.S. Degree in Software Systems from B.I.T.S Pilani and Ph.D. in Computer Science and Engineering from Acharya Nagarjuna University. She is presently working as a Professor, in the Department of Computer Science and Engineering, affiliated to Jawaharlal Nehru Technological University, Kakinada. She has guided 40 postgraduate students projects. She has published 16 papers (International & National/Intl). Conference proceedings) and had Academic Participation in 11International workshops/conferences. She is a member of advisory/ Editorial Board of Masaum International journal of Basic Sciences and Engineering, Masaum International Journal of Computing, and SERC- International Journal of Applied Sciences and Technology and SCICON. Also a life member in Computer society of India and ISTE. She is also a member of IAENG. Her areas of interest are Network security, Wireless Networks, Network protocols, Mobile computing, Artificial Intelligence and Neural Networks.