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# PERFORMANCE ANALYSIS OF ZIGBEE AND OWC IN WIRELESS BODY AREA NETWORK

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***Abstract--****In wireless body area network (WBAN), Zigbee is one of the most promising technologies that are being widely employed. It is due of its small size and power consumption. But it has some disadvantages over security, data rates and shadowing effects. To overcome this disadvantage, an upcoming technology Optical Wireless Communication (OWC) may be used. It is an auspicious alternative or a complement to radio-frequencies for indoor transmissions. Using OWC, a very high data rate, low power consumption and comparatively the higher level of security can be obtained. OWC also aims to reduce the electromagnetic pollution in human environment. This technology can be also a good alternative for Wireless Body Area Networks (WBANs) mainly for medical applications such as health monitoring. This work is aimed at comparing the aforementioned technologies over the body area network application and the same has been done by Qualnet and Qofi simulator. The power consumed by the OWC technology is comparatively lesser than the Zigbee.*
***Keywords--****Wireless Body Area Network, OWC, Power consumption.*

## I INTRODUCTION

The research in the field of low-power embedded systems such as WLAN, IEEE 802.15, etc. was done, new networking concepts were thought of which led to the creation of new concepts such as Wireless Sensor Networks (WSNs), Body Area Networks (BANs). A wireless sensor network is networks which consist of a large number of nodes that are interconnect together. WSN features limited computation and sensing from all of its nodes to collect a data. When a network consists of wearable Computing device is used for medical purposes and then the network is known as a Body Area Network (BAN). In BAN, the devices can either be implanted inside the body or directly placed on the user body. Wireless Sensor Networks were earlier designed copyright form and the form should accompany your final submission.to be used for defense purposes but due to the availability of the industrial, scientific and medical (ISM) band these networks came to be used for medical purposes also. The WSNs require a large number of sensors nodes in order to communicate with each other. So the nodes are placed in a very dense manner to collect the data. The density of nodes is very high where they placed is to be observed. Each sensor

node in a network communicates with its neighboring node in order to forward a message.WSN is a reliable network because it contains some of the following features: self-organization, low power, low memory, low bandwidth, self-configurable, wireless and infrastructure less. Body Area Network was emerged due to the advancements in the field of sensor networks. The example for BAN scenario is in Fig.1. BAN combines connectivity and miniaturization of devices. BANs were developed due to rapid growth in the field of WSNs which required the use of sensor nodes. But BANs cover a smaller area as compared to WSNs due to the use of smaller but intelligent physiological nodes which can be used in a wide variety of applications ranging from health monitoring to control of devices. BAN can also include sensors directly implanted inside a being rather than a wearable. The data transmitted by the sensors in a BAN is limited due to various reasons.

The IEEE 802.15 working group of the IEEE 802 standards committee categorizes Wireless Personal Area Networks (WPANs) which further includesWireless Sensor Networks and Body Area Networks as its task groups. The IEEE 802.15.4 task group categorizes Wireless Sensor Networks intoLow Rate Wireless Personal Area Network. The IEEE 802.15.4 technology is known as Zigbee.

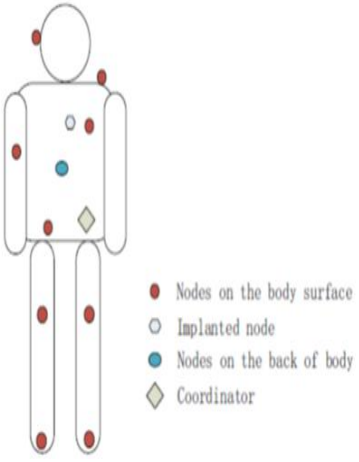


**Fig.1. An example for Body Area Network**

It is a specification suitable for high-level communication protocols used to create personal area networks built from

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small, low-power digital radios. Even though its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on its power output and environmental characteristics. It devices can transmit data over long distances by passing data through a mesh network of intermediary devices to reach more distant ones. Zigbee is typically used in low data rate applications that required long battery life and secure networking. Zigbee has a defined rate of 250kbit/s, best suited for sporadic data transmissions from a sensor or input device. OWC is an alternating solution to this problem. It provides the high level of security and data rate when compared to IEEE 802.15.4. The compare and contrast of these technologies are discussed in the following sections.

## II RELATED WORK

Considerable work has been reported in medical monitoring related BASNs in the recent past. Most of this work is concerned with developing wearable medical sensors, while some others have developed infrastructures for individual patients monitoring during daily activity, at home, or in hospital .Some research findings on wireless BASN based on the performance of Zigbee and OWC in terms of power .They have mostly concentrated on designing a MAC protocol achieve low power consumption.

Tarique Rashid, et.al suggested that the performance investigation of ZigBee network in intra-hospital environment for multi-patient cardiac monitoring. A medical to scenario has been proposed where ECG signals of patients in Cardiac Care Unit (CCU) are the data being transmitted using ZigBee network. The signals are monitored continuously at Nursing Station on compact handheld devices like mobile phones, Personal Digital Assistant (PDA). The low power and small data rate, ZigBee devices have the ability to perform self-configuring networks (Ad-hoc network) that can extend themselves through a hospital network. The Performance of Wireless Body Area Network (WBAN) is evaluated for various routing protocols by varying transmission power and the simulation results are obtained in terms of though put, latency, end to end delay, packet delivery ratio (PDR), total power consumed and network lifetime.

Mohammad Deylami, et.al proposed The Wireless Body Area Networks (WBANs) for health monitoring systems are needed to meet the performance demands to meet the tradeoff between reliability, PDR, latency, and power efficiency. WBANs features are in limited range and bandwidth and they are prone to interference. Considering the critical life nature of some WBAN systems, they investigate scenario situations where the dynamic coexistence of multiple WBANs may hugely affect their performances. The author analyzed the performance of effects of coexistence on the operation of WBAN.

AntoniosArgyriou, et.al deal with the problem of power level consumption of nodes to gateway. To overcome this problem the author present a new WBAN architecture that uses two communication technologies. The system consists of two architectures. One network is formed between on-body nodes, and is accomplished with capacitive body-coupled communication, while an IEEE 802.15.4 network is used for forwarding data to the gateway. The WBAN networks that have been blocked RF links due to the body shadowing effects which forward their data through the BCC link to a node that exploit as a relay and has an active RF connection. The medium access control (MAC) protocols for the independent communication links is designed in order to be analysis the system based on previous algorithms. Finally, the analytical models are used for further optimizing power level and delay efficiency.

Ludovic Chevalier, et.al proposed that the Optical wireless communications (OWC) technology is a capable surrogate or a complement to radio-frequencies for indoor transmissions. OWC permits the reduction of electromagnetic pollution in humanenvironment, this technology can play a major in Wireless body area networks (WBANs) in particular for medical applications. The author investigates the use of on-body OWC for mobile medical WBAN for reducing power consumption. The author performs a theoretical analysis to regulate the performance of such network considering that the patient is moving in the room environment. The feasible quality of service for a typical health monitoring application is obtained and discussed regarding the performance required by medical applications.

## III DIFFERENCE BETWEEN ZIGBEE AND OWC

The latest trends in WBAN technologies are zigbee and optical wireless communication. The OWC is different from zigbee in many aspects; some of them are described below

**Deployment:** The zigbee technology is easy to deploy when compared to OWC. Zigbee is based on RF technology. Whether the OWC is based on optical based communication, the cost is comparatively high. The laser diode is acts as a source of transmission in OWC.

**Data rate:** The data rate is the most important parameters in all type of networks. The data rate of zigbee is 250 kbps while the data rate of OWC ranges from 10's of Mbps. Because of high data rate we can transmit the signal at any traffic condition.

**Security:** In security issue, the OWC is highly secured because of light signal. It cannot pass through the wall. So they provide better security compared to the other technologies.

**Shadowing:** The major problem in RF transmission is shadowing effects. In OWC, the shadowing effect is minimized. It consists of more number of receivers for singletransistor. Therefore the signal reaches the receiver properly. The optical signal takes multipath to reach the receiver.

## IV SIMULATION

In order to analysis the performance of Zigbee and OWC, a scenario is needed to be simulated. We use two kind of simulation software. One is QUALNET for radio frequencies i.e. Zigbee and another one is QOFI which is for optical wireless communication. The simulation scenario is same for both the cases. For IEEE 802.15.4 simulation in Qualnet, area of this network is 10m*10m and the simulation time for this scenario is 300second.Thesimulation area is same as the patient room. Here zigbee is used to monitor the patient in the hospital environment. The nodes are placed randomly in a human body. The nodes are further classified into two types which are pan coordinator and normal sensor nodes. Each and every node should be connected to any one of the Pan coordinator.The pan coordinators are responsible for collecting and forwarding the data from all other nodes. The scenario for this Zigbee simulation is shown in Fig.2.It

consists of nearly 21 nodes. The pan coordinator nodes are 1, 8, 11 and 16. It collects the data from neighboring nodes and forwards to the destination node or outside environment.

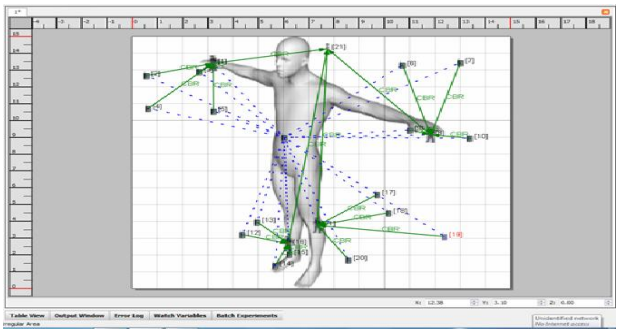

**Fig.2.Simulation scenario for Zigbee**

The simulation parameter for Zigbee scenario is in Table.1.

| | |
|---|---|
| AREA | 10*10M$^2$ |
| SIMULATION TIME | 30 SECONDS |
| NUMBER OF NODES | 21 |
| OPERATING FREQUENCY | 2.4GHz |
| PHY AND MAC | ZIGBEE |

**Table.1. Simulation parameters**

The OWC has certain advantageous over RF technology. It contains high data rate and high level of security. The OWC isimplemented using QOFI simulator. In QOFI, thesimulation environment is created by furnishing the indoor location by objects, obstacles and optical module. The optical module isresponsible for data transmission between the nodes. The optical modules are optical access point and base station. The optical access point acts like a PanCoordinator node in Zigbee. The simulation scenario for OWC is in Fig.3.

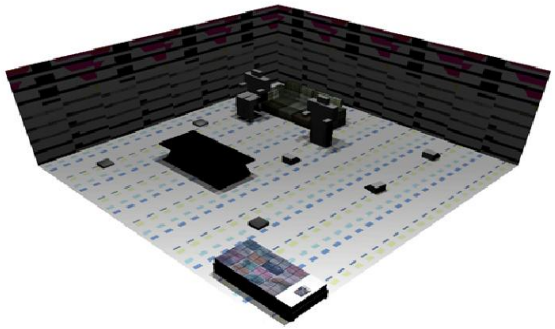

**Fig.3. Simulation scenario for OWC**

## V SIMULATION RESULTS

In Qualnet, during simulation the parameters needed to be considered are though put and power consumed by the nodes. The simulation analysis for throughput is shown in Fig.4. The throughput is defined as number of bits received per unit time. Its unit is bits/second. Here, we calculate the throughput for Pan Coordinator nodes. The throughput is high for the PAN coordinator nodes when compared to other nodes. The throughput is elevated for pan coordinator which is responsible for aggregating the packets.

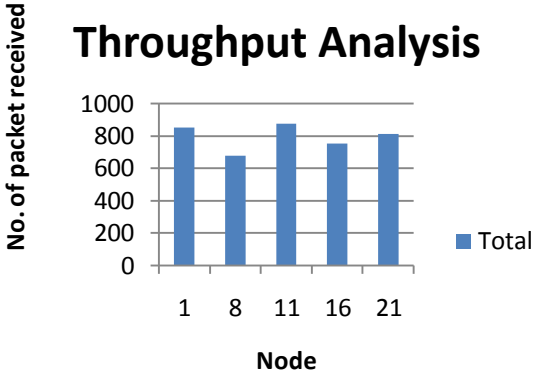


**Fig.4. Throughput analysis for Zigbee**

## POWER CONSUMED BY A NODE

The power consumed by the node is shown in Fig.5. Initially the energy level remains the samefor all nodes. The system consists of nearly 21 nodes. The pan coordinator which consumes large amount of energy compare to the other nodes. The pan coordinator is responsible for aggregating the data. The though put of Pan Coordinator node is high therefore which consumes comparatively large power. The power consumed is in terms of.09mv. The peak value for pan coordinator nodes is high

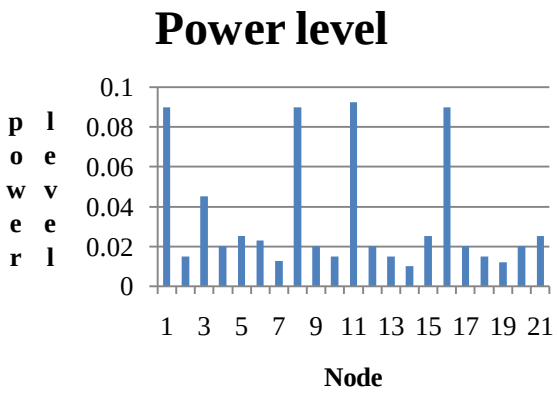


**Fig.5. Power level consumed for Zigbee Scenario**

### POWER CONSUMPTION IN OWC

The power consumed for optical wireless communication is shown in Fig.6. The optical base station compares large power compared to the optical modules. The power consumed is in terms of 36.93dBm. The power consumed is very less comparatively to Zigbee.

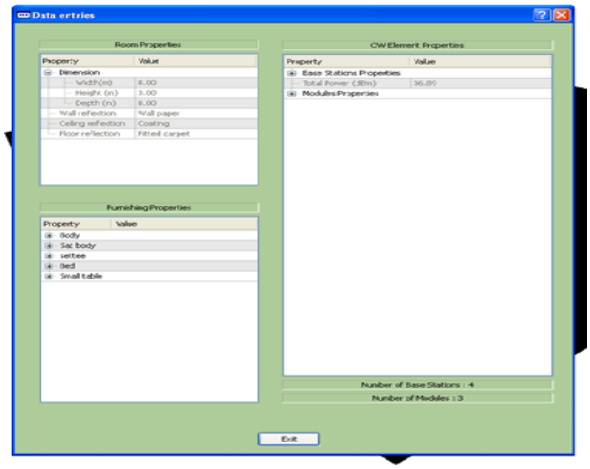

**Fig.6. Power consumed for OWC**

Power is the scarcest parameter in Body area network. The power level consumed is low when compared to RF transmission technology. In zigbee, the total power consumed for Zigbee is nearly 60dbm.whether OWC requires only half of the power needed for Zigbee. The power level is further optimized by using OCDMA techniques. It is important to determine the consumption power of the OCDMA scheme studied here, regarding the minimal transmission power needed to ensure a satisfying QoS, and so optimizing the system lifetime which is of main concern for WBAN.

### VI CONCLUSION

Zigbee is the basic technology used in WBAN. The performance is comparatively good but some disadvantages are there. They are power level consumption, security and shadowing effects. To overcome these disadvantages we are moving into the advanced standard which is known as IEEE 802.15.7 called the OWC.We implement this standard in a indoor environment and monitors its functionality using QOFI. In future implement this OWC technology in WBANand improve the performance of body area network.

The probability to satisfy a required BER of $10^{10}$ a QoS criterion, the typical health monitoring application requirements for a three nodes BAN considering data rates lower than 100Kbps can be theoretically achieved using OWC. The power obtained for Zigbee in this scenario is 60 dBm. For OWC, the power is nearly half of Zigbee. i.e. 30dBm. The power obtained for OWC is very small when compared to the Zigbee technique. The results permit considering a new possible application of OWC technology which can be an alternative or a complement for conventional radio-based WBAN. Such OWC-based solutions are only suitable for indoor systems because of diffuse propagation, especially in very sensitive environment where RF exposures of patients and medical staff, or where RF interferences are strong issues. In near future, the power level is further minimized by implementing a OCDMA techniques in OWC.

### REFERENCE

[1] Ludovic Chevalier, C. Otto, and E. Jovanov, "Wireless sensor networks for personal health monitoring: Issues and an implementation," Comput.Commun., vol. 29, no. 13/14, pp. 2521 2533, Aug. 2006.

[2] Mohammad Deylami,EmilJovano " Performance analysis of Co-existing IEEE 802.15.4 based Health Monitoring" IEEE 2012.

[3]AntoniosArgyriou, Member, IEEE, Alberto Caballero Breva, and Marc AounOptimizing Data Forwarding from Body Area Networks in the Presence of Body Shadowing with Dual Wireless Technology Nodes IEEE transactions on mobile computing, vol. 14, no. 3, march 2015

[4] Tarique Rashid, ShashwatPathak, Arvind Kumar, Performance Evaluation of ZigBee Network
for Multi-patient Cardiac Monitoring in Intra-hospital Scenario, vol-12,2013.

[5] Ludovic Chevalier, Stephanie Sahuguede, and Anne Julien-VergonjanneOptical Wireless Links as an Alternative to Radio-Frequency for Medical Body Area Networks,ieee journal on selected areas in communications, vol. 33, no. 9, September 2015

[6] M. Hämäläinen, A. Taparugssanagorn, J. Iinatti, "On the WBAN channel modeling for medical applications," in Proc. EUCAP, 2011, pp. 2967–2971.

[7]ShashwatPathak,Basant Kumar "Performance Evaluation of routing protocols for sending healthcare data over WiMAXnetwork.",IEEE InternationalConference on Signal Processing and IntegratedNetworks (SPIN) February,2014..

[8] M. Periyasami, "Electromagnetique interference on critical medical equipments by RF devices," in Proc. Int. Conf. Commun. Signal Process., Apr. 3–5, 2013, pp. 78–82.

[9] V. S. Benson et al., "Mobile phone use and risk of brain neoplasms and other cancers: Prospective study," Int. J. Epidemiology, vol. 42, no. 3, pp. 792–802, 2013.

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