A Survey on Recent Research Trends Towards Near Field Body Coupled Communication

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Abstract: In the era of Internet of Things (IoT) and accurate sensor nodes, the recent advancements of information and communication technologies enables deployment of human body as communication channel. Therefore the present communication scenario enables the dynamic and continuous data transmission by configuring small transceiver near to human body. Wireless Body Area Networks (WBAN) are one of the special kinds of networks which have been visualized to be a reality in future for remote data transceiving system referring the concept of Near Field Body Coupled Communication System (NFBCC). The concept of implementing the congruent and ubiquitous systems needs proper synchronization in between various heterogeneous nodes such as Near Field Coupling Communication transceiver network. The novel information transmission method to transmit the data using human body as communication channel is defined in the process called Intra Body Communication (IBC). The proposed study provides an overview of the state of art techniques towards reliable communication strategies in NFBCC. The significant contribution of the proposed study is highlighted over research gap which illustrates the existing research issues associated with the NFCC communication systems. This review presents brief overview of current research in hardware and software systems for NFBCC. We lead off this discussion by examining different research trends.

Keywords: component: Wireless Body Area Networks, Near field Body Coupled Communication, Intra Body Communication.

I. INTRODUCTION

The proliferation of computing and communications is driving a requirement of revolutionary change in the networking and processing units. The requirement of large sale wired and/or wireless communication networks characterized by extremely complicated topologies and requirement of huge bandwidth are truly colossal. This review will serve as a brief introduction to the rapidly evolving field of near field body coupled communication, bringing readers quickly up to speed on developments from the last half decade.

There are lot of existing research trends in communication systems which talks about the cost optimization and ensuring quality of service by minimizing the size of it. In today's world, the communication is accomplished over either wired or wireless network channels. The hurdle in wired communication network is cable routing. The hindrance of wireless communication is packet collision and security risk which are whelmed by proposed system. Near field body coupled communication network uses the surface of human body as transmission channel to transmit the data from connected device placed in or in close proximity to the human body called "touch and connect" using quasi-electrostatic field signal.

A typical field body coupled communication network has basically four major components such as i) A transceiving device iii) A real-Time operating system, iii) A processing unit iv) Communication channel. The sensed electromagnetic signal is further converted into data using different modes and pre-processed by its controller chips. A typical wireless communication using Radio Frequency

waves is established in order to initiate a communication in between the networking nodes. A battery with limited electric power constantly supplies power to maintain the above stated operations [1] [2].

A WBAN is considered and integrated as a special purpose wireless communication network which has been conceptualized to operate and accessible in human body area. The network collaborates various methods to consider human body as a networking node and appliances which are located near human body. Presentation of a WBAN for person identification and different applications will offer adaptabilities and cost optimization choices to both social insurance experts and publics. A WBAN framework can offer two huge auspicious circumstances contrasted with current electronic human identification frameworks. The main point of interest is the portability of system because of utilization of compact mobile gadgets. Second point will be the preference towards area autonomous processing unit facility [3].

A NFBCC unit/node is a self-governing gadget can seek a suitable correspondence system to transmit information to a remote database processing unit. It is likewise conceivable that a NFBCC node will associate itself to transmit information in a non-blatant way. The utilization of NFBCC in person identification systems might comprise of mobile transmitting nodes can be joined to or embedded into a human body in near proximity [4] [5]. These mobile nodes have remote transmission adopt abilities thus they can transmit over a short path on human body to a transmitting gadget worn on the body or placed

at near proximity area. At first for cogitating very small region within the communication range, an immediate correspondence from individual node to the sink node has been established and configured as the memoranda scope of nodes falls inside of the area of sink. As the power from the battery assist transmission node to constantly keep transmitting the low power energy [6].

The paper is organized as follows, section II summarize the background of existing prior techniques. Section III and IV illustrates an overview of problem description and the existing techniques respectively whereas section V discusses about the research issues associated with the existing state of art studies. In the end Section VI summarize the whole paper.

II.BACKGROUND

Wirless Body Area Netwrok:

Wireless Body Area Network is a form of special purpose network around the human body that is designed to operate autonomously to provide applications such as sharing of personal information, remote health monitoring systems, interactive gaming, security authentication and train ticket wickets [4]. The use of WBAN in person identification, sharing of personal information, security authentication will offer flexibilities and economic benefits. WBAN network node is autonomous device which continuously consign the eccentric data by some means and finds an appropriate communication network to identify the data by the remotely located sensing system [6].Wireless Body area network is very popular for person identification and security authentication applications.

If we consider an example of ration dispensing system, India's public Ration Dispensing System With the network of 4.78 lakh fair price shop is conceivably the largest retail system in the world, where 40 crore Indians below poverty line with monthly supply of subsidized food grains but the major problems in the system are inefficiency in targeting the beneficiaries, resulting leakage of subsidies and possibility of ration burgles. Earlier when public used to enter the ration depot he used to undergo identification checking provided by some means of identification proofs and then accordingly the respective amount of ration was dispensed to appropriate person.
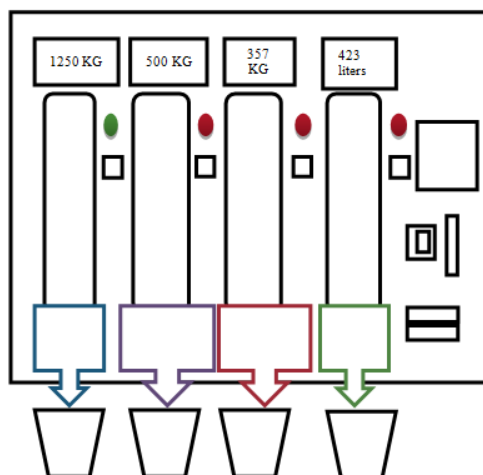
In certain case the person who look after the ration depot can commit the ration burgle where he can sell the ration for unauthorized person, where it could be loss full for both government and the public.

The core idea of WBAN is to eliminate the entire intermediate person between public and government by means of fully automated Ration dispensing systems. All the constituent devices are connected using wireless medium and thereby increasing public comfort. Two types of hardware device are used in WBAN. They are: i) Wearable devices which are used in near proximity to human body which is primary means of identification. ii) Implanted receiving (sensing) device inserted within the local identifying system to provide security authentication. In wireless body area network devices, wearable systems are used as a prime technology for the continuous data transmission which is essential for person identification. WBAN's permit to sense the identification data of the person and allow the person to access the needs.

III. RELATED WORK

NFBCC networks can be implemented using several different ways; previous studies have investigated the usage of Bluetooth or zigbee to establish communication over devices. The problem is that these technologies were not specially designed for IBC networks thus they projected the non-ideal characteristics therefore body coupling technology is used for communication where body is effectively coupled as the channel of communication.

The process of intra body communication was originally proposed in the work of Zimmerman [1] et al which focused on the concept to use the human body as the communication channel between two mobile terminals and gave IBC fundamentals, IBC mathematical models of human body. In his study he said that, the IBC can operate at very low frequency at low transmission power. As it stands, the IBC potentially provides more reliable, efficient and naturally secure short range communication method for near field body coupled communication networks, besides with tremendous benefits, the evolution of IBC is still under infancy.

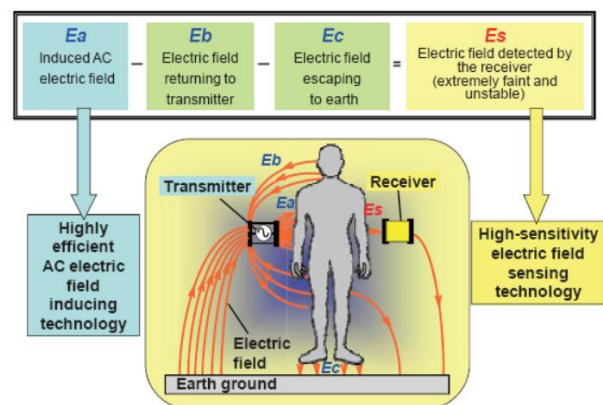Fig 1: Example of automated Ration dispensing system

Fig 2: Issues with Intra body communication

Mitsuru shinagawa [12] et al, describes the user friendly technologies that enable communication between peoples

and objects in close proximity and focused on naturalness, inevitability and sense of security conveyed by touching. It also discussed the possibility of using human body as transmission medium supporting IEEE 802.3 half duplex communication at 10 M bits/s. As shown in figure 2 in his proposal the transceiver was implemented with an electric field sensor made of bismuth silicon dioxide electro optic crystal which intern changed the polarization of laser light.
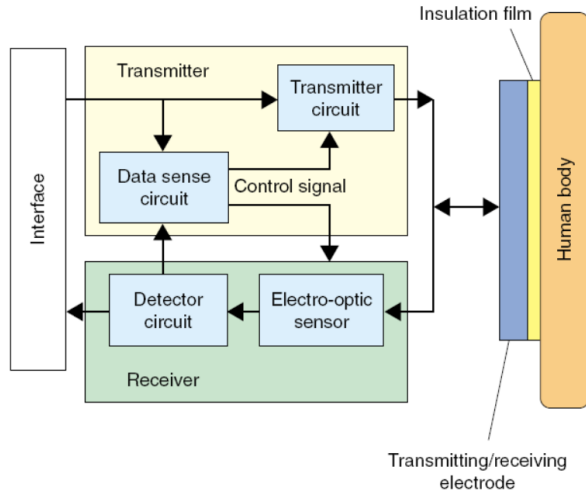

Fig 3: Red Tacton transceiver

Figure 3 shows the prototype was built with transceiver connected to electronic PDA device and communication between two hands was demonstrated. The reliability of communication was checked not only on human skin but also on clothes and shoes. Human safety was also investigated on human health as a result the insulating film was covered on RedTacton transceivers so that person acting as transmitting medium is completely insulated here a name RedTacton was given for the Intra Body Communication.

In the study of simon attard [9] focused on understanding the effects of human body as the channel for communication in two ways by measuring and experimenting signal properties on the human body by investigating two types of body movement and the obtained results were used as the model for behavior of body coupled communication channel under moving body consideration.
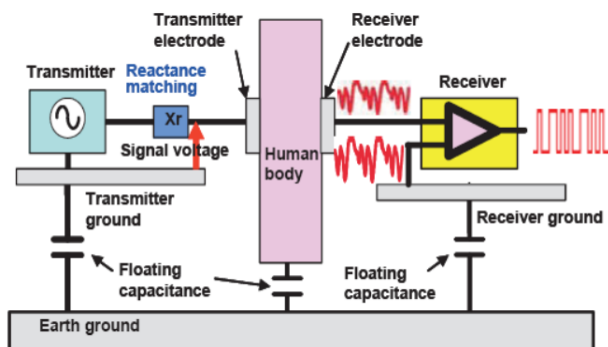

Fig 4: Technology for Stable Communication

It was found that different type and speed of body movement provided different BCC channel behavior. In this study the use of capacitive coupled IBC is investigated, and it was that the capacitive coupled communication exhibits several favorable properties that helped to increase the reliability of communication, those properties include low signal attenuation and the signal power stays very close, confined to human body which intern increase the battery life and make the system less security against the external interference as shown in Figure 4. masashi takahashi [15] et al, proposed near field coupling communication based on human area networking which uses quasi electrostatic component that propagates all along the surface of human body by suppressing the radiation field from the human body which make the communication possible within the reach. The author simulated the electric field distribution radiated from human body phantom with high frequency structure simulator, and said that human body can be regarded as the conductor at about 6.75MHz where electric field does not penetrate into it.

A. Issues of NFBCC towards quality enable WBAN.

Wireless intra body communication network is an agile, low-cost, intelligent and ultra-low power technology developed by using tranceivers that can identify data and help in security authentication issues. For healthcare monitoring system the wearable and implantable wireless body area network emphasis on some significant components such as drug administration, by embedded medicine bottles transmits information on medicine attributes, if user tries to administrate the wrong medicine then the system would perturb. WBANs have some own characteristics which are different from conventional wireless sensor networks and also characterized into some categories such as architecture, network density, data rate, latency, mobility, and many more. It may include many devices and applications and has the characteristics of general wireless sensor networks. In our review paper we have studied and analyzed the major challenges while developing a QoS based WBAN. The most important QoS challenges in WBANs are illustrated in following Table 1.

B. Human Safety Considered for NFBCC.

The impact of the technology on the human health is obviously an important issue to be given prime consideration. As discussed in related works the previous technologies include the concept of completely covering both transmitter and Receiver with insulating film so that the human body acting as the communication channel gets completely insulated from contact of direct harmful electrical energy. When the human body come in contact with the transmitter, the displacement current is generated on the surface of the human body because human body is subjected to the minute electric charges which are later used as the channel for communication thus the need of the communication is fulfilled, but this may reduce the effectiveness or reliability of the communication.

NFBCC conforms the needs of "Radio Frequency – Exposure Standards (RCR STD – 38) granted by the association of Radio Industries and Business (ARIB) and conformed that the signaling level used for NFBCC is below these safety limit specified by RCR STD – 38 standards[14].

Table 1: Major Challenges in Order to Develop Qos Based WBAN

Parameters	Related challengeable Circumstances to ensure QoS
Limited resources and capabilities	Limited energy, bandwidth, memory, and processing and communication capabilities.
Scalability	Number of WBAN nodes may be increased or decreased, but QoS should not be affected for this reason.
Multi-source multi-sink systems	Platform heterogeneity, service-oriented architecture, resource self-management and security requirements, and also critical Infrastructure protection.
Dynamic system topology	QoS is steady and it should not be influenced with system topology changes because of connection disappointments, large power failures.
Different method of applications	Huge number of application as well as different kids of QoS services.
Different traffic schemes	QoS technique should be equivalent successful administration top and low movement periods.
Wireless link unreliability	The remote connections among the sensor nodes can be effectively influenced by different ecological elements; shorter connections seem by all accounts to be more solid than longer connections.
Real-time system	Medical considerations are for the most part utilized as a part of continuous WBANs framework. They have high prerequisites on data transmission, delay ensures and conveyance time, delivery time, ensured medium access furthermore end-to-end delay ensure.
Data redundancy	It is imperative in multimedia and constant WSNs and WBANs, It is normally diminished with various information accumulation advances and else it should be considered in QoS systems.
Multimedia data in WSNs and WBANS in some cases	High throughput, data redundancy, low delay and effective delivery of multimedia data.

Table 2: Comparison between Different Communication Protocols

Protocol	Range (in m)	Data (in M.Byte)	Speed (in Mbps)	Usage with multiple users	Duplex communication	Security of information
RedTacton (NFBCC)	10 – 15	10	10	Good	Poor	Excellent
Bluetooth	Max 100	0.5 – 1	256 - 1	Average	Poor	Poor
Zigbee	30	0.5 – 0.8	256 - 512	Average	Poor	Poor
U W B	50 - 60	0.4 – 0.5	1	Poor	Better	Poor
Infrared	5 – 8	0.3 – 0.5	128 – 256	Poor	Poor	Poor
W Lan	6 – 7 k	Unlimited	Unlimited	Excellent	Excellent	Poor

C. Qos Observations and Main Objectives.

For a given wireless sensor network it is very difficult to define and characterize the quality of service, which is decided by characteristics like data transmission and error rate. Quality of service also depends on network quality and types such as noise, bandwidth, latency, jitter, etc. quality of service also varies from application to application reliability, robustness, trustworthiness, timeliness and adaptability. Quality of service provides well organized and high quality NFBCC networks, at the same time it needs the grate attention over critical information about the communication network such as zero delay, real time data transmission without error or dropouts, deployments, reliability, security, privacy and some characteristics related to power, timing and area. Major qualities of wireless network are latency and reliability. The present phase in the NFBCC network typically consists of optical crystal invoked by the laser technology which converts the changes in electric field which intern uses direction based vascular pattern extraction algorithm for person identification [2]. This method uses near infrared light to capture and recognize images of blood vessels where the person has to scan his vascular pattern every time for communication, if image doesn't match then the access will not be granted. This system is time consuming and not reliable, as shown in figure 5.

Thus the other optimum method for communication to increase the reliability of the system is considered where the low frequency, low power PSK modulated signal with the baseband data signal is directly coupled and transmitted into the human body, at receiver side the baseband signal is decoded for the purpose of identification. The authorization is also provided in terms of password protection to provide security authorization.
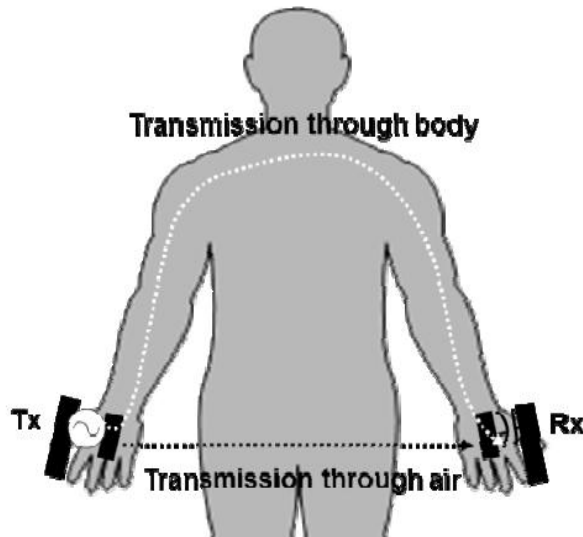
Figure 5: Channel model for NFBCC.

D.   Open Research Issues.

After a long discussion and analysis we found that the fundamental QoS metrics required for NFBCC network is:

- Decreasing overall energy consumption.
- Maximizing network lifetime.
- Maximizing network throughput.
- Minimizing end-to-end delay.
- Maximizing overall reliability.
- Providing effective communication system.

The author trust that the part of WBANs in application such as drug can be further developed. Soon, the utilization of WBANs will perturb since brilliant spaces will be empowered with remote sensor systems which can sense natural conditions and take preventive activities in light of the vicinity of people is those spaces. The framework can along these lines achieve non pervasive, where every individual would have a computational module ready to seamlessly cooperate with the keen space's framework and provide effective and reliable communication. The advantages supported by the use of NFBCC network are,

1. Highly reliable and efficient communication.
2. NFBCC provides improved throughput and latency.
3. Increased level of security for the data.
4. High speed base 10 communication.
5. NFBCC transceivers are highly programmable and we can efficiently have control over characteristics, such as what to share with whom.
6. Less amount of loss during data transfer.
7. Low power implementation.

IV. CONCLUSION

NFBCC network is most studied and highly researched technology which has inbuilt numerous applications. Quality of service of NFBCC networks has high research vicinity and foremost apprehension in the field of Wireless Body Area network, but much work has to be done standstill. Inclusion of Biometric concepts can increase the system adoptable vicinity which intern make the technology more feasible, instead of using complex

methods such as vascular pattern extraction algorithms other efficient means can be implemented to increase the reliability and efficiency of the communication system.

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