
Network Design Issues in Wireless Body Area Network

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ABSTRACT

This paper presents a survey on various aspects of Wireless Body Area Network (WBAN) and its utility in healthcare system. Along with applications of WBAN in healthcare different areas of research with other prospective opportunities and prominent challenges are also discussed. Development in the field of wireless communication, particularly in the field of Personal Area Network and mobile networks, has lead to development of mobile healthcare system. As WBAN essentially consist of body sensors to sense various physical properties related to health. Apart from applications of WBAN, communication in WBAN and other important aspects like security, scalability are discussed. Some of the other important issues are physical and MAC layer design and network protocols being analysed.

1. Introduction

Terminology of Wireless Body Area Network was first introduced by Van Dam et al [1] in 2001. Wireless Body Area Network is a composition of various types of sensors on and around human body to sense various physiological parameters. The sensed values of these physiological parameters are used for monitoring the health of a person and stored on servers for further analysis. Wireless connection of many small and integrated sensors not only helps in maintaining the unobstructed mobility of user but also transfer information with any physical connection. This way various related parameters may be observed and analysed remotely and action may be taken accordingly. As a sensor may used to sense value of a critical parameter like blood pressure, an actuator used in conjunction with trigger values of sensed parameter may take preventive or diagnostic measures like injecting necessary emergency drug. Server is used to permanently store the real time values of health or physiological parameters for sample or constant monitoring as may be required based on need.

2. NETWORK DESIGN FOR WBAN

As Wireless Body Area Network may operate in real time scenarios most of the time, it must be designed keeping in mind the various quality aspects. In the network design of WBAN supporting monitoring and diagnostics, reliability of physiological parameters' data sharing and delay in these transactions of data becomes critically important aspect. These aspects directly depend on the design of physical layer and MAC layer of WBAN. In addition design physical and MAC layer also dictates the efficiency of power consumption. As power consumption in wireless sensor network is always an important factor to decide its operation time and hence its reliability. Design of MAC layer dictates network efficiency and resource utilization. Conclusively, reliability, power consumption and scalability are most important factors which determines performance of WBAN. Network security is equally important as additional care needs to be taken regarding privacy of personal data of users when is to be transferred over public networks.

2.1 Reliability

Reliability is directly related to probability of packet loss and delay in the transmission of packets. Packet loss probability and transmission delay depends on bit error rate of channel and transmission protocol used in MAC layer[8]. By using appropriate modulation and coding technique along with transmission channel condition bit error rate may be controlled. Various factors like channel access technique, packet size and retransmission strategy at MAC layer may also have an impact on the reliability of WBAN. In case of interference and noise over the network, higher power signal need to be transmitted to enhance probability of error free transmission.

2.2 Power Efficiency

Efficient use of power becomes most critical aspect for the successful implementation of WBAN using battery powered sensor nodes [7]. Various factors like size and weight of sensors are significant in efficiency of power consumption; accordingly selection of sensor on the basis of such parameters is also critical to the power consumption of WBAN. Selective use of implantable WBAN sensors and wake up radio technique may also

improve efficiency in power consumption in response to requests. Traditional wireless mechanism to respond to request may not be as power efficient as updated technologies, so selection of response mechanism may be done on basis availability exploration and should be upgraded with future changes.

2.3 Scalability

Scalability is one of the important aspect for sustainability of any system and on that part same applies to WBAN as well. As protocols for wireless personal area network may be adapted to work efficiently for WBAN network[4]. A scalable network can easily be reconfigured, it should be possible to add or remove sensor node from WBAN without disrupting its working. Network should be robust enough to meet various types of requests for information that may be periodic or non periodic. Any WBAN system should be programmed to operate in different power and channel constraints environment.

2.4 Security

As clear from the very prospect of the idea of WBAN that the data produced by this type of network is highly sensitive and critical to health and privacy of a person, in all aspects every possible measure needs to be taken to ensure security and privacy [2][3] of data generated. Mostly security measures lags behind security attacks, security concerns of WBAN should be addressed at the level of architecture of the network as in case banking system. In addition, best possible authentication measures should be taken. Only authenticated and standard nodes may be used in the network. Usage of WBAN proposes diagnostic as well as preventive health related measures, real time network infrastructure and resources should be made available for its operations.

3. CONCLUSION

As Wireless Body Area Network may be considered a special case of Personal Area Network (PAN) so most of the issues related to network design and related solutions may be inherited. However as WBAN is used on human beings and that too particularly in the field of healthcare in addition to other prominent fields of application, so many additional issues arises like accuracy in real time, privacy & confidentiality, reliability of network. Wherever diagnostic health measures are to be taken, like in case of heart patients, dedicated network may used, along with secure authentication and validation mechanism. Wireless body area network may prove to be very helpful in providing a human centric individual specific physiological services along with its own issues in raised concerns to be resolved for being reliable and particularly being trusted technology.

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