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Security And Energy In A Wireless Body Area Network: A Protocol Evaluation

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ABSTRACT

Wireless sensor networks, often known as "WSNs," are networks that collect data from sensors that are embedded in the surrounding environment and put it to specific uses. The base station (BS) in the sensor network is responsible for the collection of data and the subsequent wireless transmission of that data to the sensors. Each sensor has a central processing unit (CPU) that has memory, a source of electricity, and actuators. The proliferation of wireless sensor networks (WSN) in recent years has been nothing short of spectacular. Applications for wireless sensor networks (WSN) that use body area networks (BAN) are varied and appealing. Through the use of wireless body area networks, medical professionals are able to keep track of their patients' fitness levels, chronic conditions, and overall health. Sensor devices and diagnostic software or hardware are the two components that make up the Internet of Things. Over the course of the last 10 years, much research has been conducted on this topic. There have been a number of procedures, guidelines, and suggestions developed. In hospitals and other medical facilities, a system known as the Wireless Body Area Network (WBAN) uses coordinating devices like smart phones or personal digital assistants to collect and wirelessly transfer the data that is collected from other sensor nodes. Apps designed for medical use may now continually monitor key signal data and capture biological signs at the receiver end. The collection, analysis, and transmission of data are all capabilities offered by these applications. Last but not least, they will provide the user with feedback. The surge in popularity of wireless body area networks may be attributed to the fact that they are simple to use.

Keywords: Wireless SensorNetwork, Medical Server, Wireless Wearable Body Area Network (WBAN), Energy Consumption, applications, research trends.

1. INTRODUCTION

Several aspects of medical treatment, such as diagnosis, therapy, and patient monitoring, have been demonstrated to have benefited significantly by advances in biomedical technology. The biomedical system is more effective than other ways for preserving human lives. As time passes, these systems get smaller, more dependable, and more patient-friendly. Utilizing these methods will increase productivity. In the biomedical field, wireless technology is currently gaining popularity. It enables patients and staff members to convey information, resulting in more autonomy. Body Area Networks that operate over the air (WBAN).

There has been an increase in the number of persons utilising wireless communication networks. This opens the door to a vast array of opportunities in the medical and healthcare fields. Body area network particularly developed for wireless usage. A sensor network that permits the placement of a variety of sensors either within or outside the body. These sensors are implanted into the patient's body and may simultaneously communicate with one another and the physician. Wireless body area networks enable the development of solutions that are both adaptable and economical. WBAN is used because of the benefits provided by sensor nodes, including the patient's enhanced mobility. Because of this, people are able to carry out their daily tasks without any limitations, including mobility. In addition, WBAN offers a location-independent monitoring system that allows the physician to monitor the health of the patient remotely. The sensor captures and communicates samples to the attending medical personnel after being applied to the patient. Internet connectivity is required for WBAN in order for sensor nodes to send data remotely and maintain data.

A wireless body network is a technology used to monitor people's health and find early warning signs of possible danger. There is interaction between medical personnel and caregivers. This system is capable of segmentation based on the operating configurations. The implanted area network is used inside the body, whereas the wearable area network is utilized outside.

2. Wireless Body Area Networks (WBAN)

Wireless Body Area Networks are a new technology that allows for real-time health monitoring and diagnosis of life-threatening diseases. WBAN supports many medical and nonmedical applications and operates in close proximity to, inside, or on the human body. IEEE 802 has formed a TaskGroup known as IEEE 802.15.6 to standardize WBAN. This task force is charged with creating a standard for communication which is low-power, and can be used in many applications, both medical and non-medical.

IEEE 802.15 Task Group 6 BAN is currently working on a protocol for communication that is optimized for devices that use low power. IEEE 802.15 TG6 is a group formed on November 7, 2007 when it has since begun operations in Taipei as TG6. The group had received 34 suggestions. They were then combined into one candidate. A draft of the standard was created at the beginning of March in 2009. The draft has gone through thorough editing. It was later followed with five Letter Ballots. The Letter Ballot #79 was approved on July 13, 2011. It was authorized on July

22nd to begin the Sponsor Ballot. It is expected to be finalized in November 2011 during the TG6 conference in Atlanta, USA.

WBAN technology allows individuals to instantly exchange digital business cards or profiles through social networking by simply shaking their hands. WBAN architectures are used in medical applications. Fig.1.

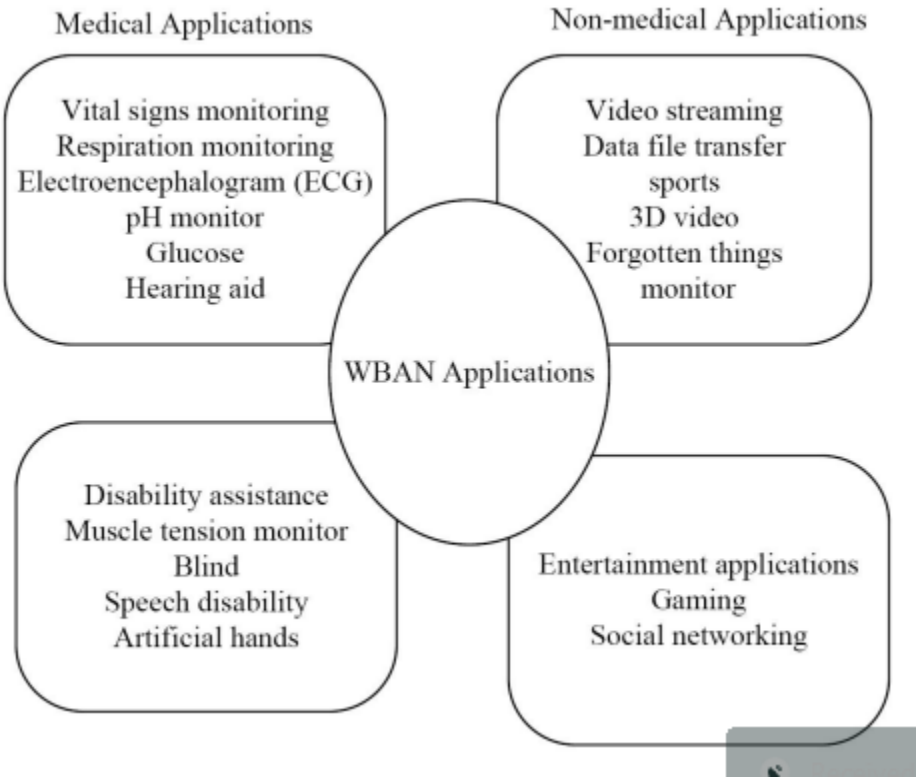

Fig 1: WBAN Applications targeted by IEEE 802.15.6

3 WBAN Security Issues and Requirements

WBAN presents a number of research issues that must be considered when designing radio frequency (RF), wireless systems. These include frequency band selection model of the channel, design and antenna, and designing PHY-related protocols. QoS reliability, QoS privacy and security are all significant concerns. These concerns, particularly security concerns [10were carefully studied and are now being addressed by a variety of emerging technologies.

Data Confidentiality - Data confidentiality is a key issue in WBANs. Data confidentiality is essential to prevent data disclosure. WBANs are not allowed to divulge crucial information to external or neighbouring networks. WBANs should utilize encryption with symmetric keys because public-key cryptography is costly for sensors with limited energy.

Data Integrity. Although data confidentiality is important, it does not guarantee that the data will be protected from outside modifications. An adversary will always be able to alter the data. He/she can add fragments to The data can be altered or changed to alter the information contained in the

packet. The packet is then transmitted to the coordinator. Data integrity issues can often be dangerous, especially for life-critical events or in cases where emergency data has been modified. Bad communication environment may also result in data loss.

Data authentication is the verification of the origin node's identity. In addition to manipulating Data packets that the adversary could also alter packet streams by adding fake messages. The coordinator must be able to confirm the source of the data. Data authentication may be accomplished using an Authentication Message Code. This is done to differentiate the two (from Medium Access Control) and is displayed with bold letters. It is typically determined with an encryption code that is shared with the user.

Data Freshness. To make the coordinator think twice In order to confuse the coordinator, an adversary may collect data while it is in transit , and then play them back in the future using an old key. Freshness of data refers to the fact that the information is not old and one is able to read through old messages. There are two kinds of freshness of data. The weak type ensures partial ordering of data frames, but it doesn't guarantee delays. The strong type assures that data frames are ordered without delay.

Secure Localization. A majority of WBAN applications require accurate localization. The absence of intelligent tracking techniques allows attackers to make false reports regarding the location of a patient via false signal strength reporting or replaying signals.

Availability: A physician's information must be available at all times. An adversary may attempt to disable or capture a node in WBAN, which could lead to loss of lives. A good way to avoid losing control of a network node that is being attacked is to change it to a different node.

Secure Management: The coordinator must ensure key distribution to all nodes in order to decryption and encryption operation. The coordinator secures the addition or removal of nodes during association and disassociation.

4. ADOPTING PROTOCOLS FOR WBAN

With new technology in healthcare, WBANs are now available. Wearable sensors collect vital information from patients and send it to the sink with the sink using short-range wireless communication methods (9the sink by using short-range wireless communication methods [9. WBANs are classified into three categories three levels: master nodes; power sensor nodes, as well as the Internet or local. The sensor nodes with low batteries have to function for prolonged periods without charging [10]. They can be implanted, or placed in the body. Second-level nodes, sometimes referred to coordinator or gateway nodes, can be used to control all sensors. They also consume less power because of their use. This last level, the Internet or local level, is used to monitor. These three levels require energy, and energy consumption remains a challenge for WBANs. There are many routing protocols that can be used to route data. This has an impact on the energy consumption of WBANs [11]. The life span of sensor nodes is limited and it consumes energy.

1. Each path is designed for data routing. They should be aware of their energy and not generate a lot of heat as nodes are located in the human body.
2. Complex algorithms are the main obstacle to energy efficient routing.

Although many routing protocols are designed to be efficient, there are still some flaws. Some do not address delay tolerance and postural information. [10].

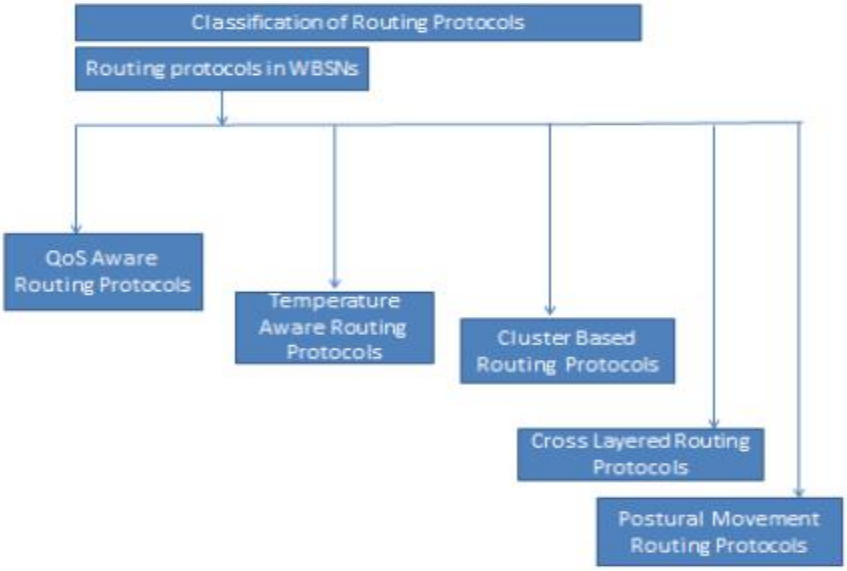

Fig 2 : Classification of WBANs Routing Protocols

Many protocols are not concerned with temperature rise. There has been a lot of research into routing protocols. Liang and other [11] proposed the idea of a Prediction that is based on Secure and Reliable(PSR) routing system that is safe and secure routing.

Khan, et . al. [12] An Energy Aware Wearing Routing Protocol, (EPR), has been suggested to reduce the load on energy and traffic. The proposed model is an energy-conscious and QoS aware routing protocol for communications devices within health care. But, these protocols aren't without their flaws.

Nadeem and others Nadeem, et. al. stable and can increase throughput. It is able to improve the efficiency of links in WBANs. To minimize heat generated by sensors, thermally aware routing protocols have been proposed. Cluster-based routing has been suggested to cut down on the amount of power and delay required in addition to enhancing longevity of the network and link quality. [14].

Postural-Movement-based routing protocols were proposed for handling the link disconnection that occurs due to the body movement. The cross-layered routing protocol has been suggested to solve the issues of the network as well as MAC Layer [15]. Following a brief overview of the protocols, we'll go over the protocols in the section on routing.

5. Design Issues Of Routing Protocols

WBANs need to be linked to control, monitoring and remote systems. Thus, the systems need to offer high reliability and low latency. Network-specific requirements make it difficult to create an appropriate routing protocol effective for WBANs. In the next article, we will be discussing the routing issues that are related to WBANs.

a) Dynamic Nature of Network WBANs network is dynamic because of the dynamic topologies and mobility of nodes. The dynamic nature and duration of the network reduces its lifespan [16]. Link quality is also affected by body postural and bodily movement. So routing protocols need to be adaptive in order to deal with topological changes within the network.

b) Heterogeneous Environment Different types of heterogeneous environments can be used to analyze various parameters with WBANs. These NODES that are heterogeneous are utilized to calculate, store data, as well as power consumption. WBANs are often challenged by the heterogeneity and complexity of the environment.

c) Topological Partitioning WBANs have another problem: topological partitioning. This is because of body movement and the limited distance of communication devices. It is crucial to use a reliable routing protocol in place to handle this challenge. The protocol can be one-hop, multihop or cluster-based depending on how large the network is.

d) Energy Efficiency WBANs face major challenges when it comes to energy utilization. Patients are often uncomfortable and find replacing batteries difficult. Sensor batteries' life spans depend on the applications and batteries used. Overheating can cause tissue damage and death. WBANs are very concerned about energy consumption and network life expectancy. These networks still have to deal with energy consumption problems due to limited energy resources.

e) Interference and Temperature Another issue when designing routing protocols in WBANs is temperature rise. Temperature rise can be attributed to two factors: energy consumption by nodes and antenna radiation absorption. It is therefore important to develop and design energy-efficient routing protocols that use minimal energy and have less interference.

f) Limited Resources WBANs need limited resources. They have a narrow bandwidth of communication, a limited amount of storage and energy, as well as limited bandwidth. These constraints must be taken into account when routing protocols are designed.

g) Security and Privacy WBANs are also concerned about privacy and security. All tires should have security and devices must be able to authenticate and remain intact. Security must be maintained at both the data and system levels [11Security must be at both the data and system levels [11. There are numerous security measures that you can employ to safeguard your personal data. Privacy is, however is the term used to describe patients' rights to restrict the collection of personal data as well as their usage. WBANs must meet all security requirements in order to protect patient data.

h) Quality of Services (QoSs) For data transmissions within WBANs that are different from those described above, QoSs may be required. The [18] author describes The patient's data can be classified into three categories three types: sensitive, critical and normal. EEG, heartbeat as well

as other important information is collected by sensors. Sensors for sensitive data collect data using images processing, video streaming vital signals, as well as monitoring the rate of respiration. The data on body temperature is the foundation of regular data. It is crucial for routing protocols to be developed to meet all QoS requirements. QoSs need to have high speed of packet delivery, minimal transmission delay , and no collisions. QoSs may also be assessed at lower levels of protocols.

Protocols	Goal	Delay	Temperature Rise	Address Scheme	PDR	Discarding Mechanism
TARA	Reduce possibility of over heating	Very high	Very high	Global	Very low	No
LTR	Reduce energy consumption and temperature rise	High	High	Global	Low	Yes
ALTR	Reduce end to end delay	Medium	Low	Global	High	No
LTRT	Find route with minimum temperature	Low	Very low	Global	Very high	Yes
HPR	Prevent formation of hotspot, and reduce end to end delay	Low	Very low	Global	High	Yes
RAIN	Reduce temperature rise and average delay	Low	Very low	Local	High	Yes
TSHR	Medium	Very low	Low	Very High	No	No
M-ATTEMPT	Low	Low	Very low	High	Yes	No

Fig 3 : Comparison of Protocols

6. CONCLUSION

Wireless body area networks, more often referred to as WBANs, are a rapidly developing field that provide a diverse variety of advantages. It is difficult to send the information that the sensors pick up back to the drain because of the movements of the human body as well as other restrictions. WBANs categories the routing protocol into the following five primary groups: methods for routing that are based on QoS, which include temperature-based, cluster-based (cross-layer), postural movements, and base QoS. In this study, we will focus on and critically examine several temperature-aware routing techniques for wireless body area networks (WBANs). Temperature-aware protocols do not consider other aspects of routing, such as energy consumption or utilization delay, packet delivery, or energy use. This review will help researchers design an efficient temperature-sensitive WBAN routing method, which is one of the benefits of reading it. The next step is to do research on the primary requirements and challenges related to environmentally conscientious routing systems (WBANs).

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