Asian Journal of Science and Applied Technology (AJSAT)
Vol.3.No.1 2015 pp 17-23
available at: www.goniv.com
Paper Received :08-03-2015
Paper Accepted:20-03-2015
Paper Reviewed by: 1. R. Venkatakrishnan 2. R. Marimuthu
Editor : Prof. P.Muthukumar

ENERGY EFFICIENT ROUTING FOR BIOMEDICAL WIRELESS SENSOR NETWORKS

[1]M.AATHIRAI MEENA., [2]DR.R.VALLI

[1]PG Scholar, [2]Professor/Head

Department of Information Technology, Adhiparasakthi Engineering College, Melmaruvathur

ABSTRACT

Nowadays wireless sensor networks are mostly useful in the healthcare purposes such as E-healthcare through the wearable sensors in the body area network (BAN). BAN functions such as monitoring, measuring the medical terms such as blood pressure, glucose content, temperature, heart rate etc.,.by these wearable sensors the network is formed called BWSN which uses small size sensors in the wireless sensor networks. Generally in BAN the wearable sensors fixed in the patient's body and the data's are gathered using a centre node or a smart mobile or data concentrator. The main consideration in this type of network is the energy management to increase the lifetime of the BWSN. In the existing system the BWSN in constructed with small size wearable sensors without the data concentrator or a smart phone or server. in which the lifetime of the network is maintained using the energy aware routing protocol using the objecting function (OF) over the lossy and low power network. Using the OF the remaining energy of the node is calculated and the expected transmission count (ETX) is measured, by which the node which contains the highest remaining energy is decided as the sink node and from which the medical data is transmitted through the best path to the medical server.

Keywords: wireless body area network, RPL, energy aware objective function.

I.INTRODUCTION

Comparing to wireless sensor networks (WSN), BWSN is a small size WSN with biomedical sensors specially designed for medical and healthcare applications. The medical application includes the healthcare monitoring, patient monitoring, emergency services mainly for disabled and elderly peoples. A good indication of that demand is the growing use of personal monitoring devices such as glucose sensors for diabetics or the recently developed sensors for HIV detection. Biomedical sensors can also make medical care more personal and tailored to the individual needs of a patient. In the near future, a treatment procedure could be adjusted to address a patient's unique metabolism and biological rhythms.
In such a case, specialized application software would be capable of recognizing incoming health problems and could notify a person in advance of her or his health conditions .

A modern biomedical sensor is a device which consists of a biologically or biophysically-derived sensing element integrated with a physical transducer that transforms a measure and into an output signal. The requirements for any good biomedical sensor are specificity or the ability to pick out one parameter without interference of the other parameters, sensitivity or the capability to measure small changes in a given measured, accuracy or closeness to the true measurement, time response ,biocompatibility, aging characteristics, size, ruggedness and robustness, and low cost. In addition, the sensor must have compatibility with the chemical, optical, optoelectronic, or electronic integrated circuit (IC) technology. The above listed features have been researched comprehensively over the last two decades and critical knowledge has been accumulated and the challenges have been identified. One may claim that the biomedical sensor field has matured enough to be poised for commercial success. The three primary biomedical sensor technologies are electro-chemical, optical and acoustic are discussed along with many of the biomedical applications.

A body area network (BAN) is a base technology for wireless patient monitoring consisting of a set of wearable medical sensors in, on, or around a patient's body. These medical sensors send the patient's medical information (e.g. vital signs) to an external data aggregation device called a master node (MN) via short range data transmission technologies such as Bluetooth, Ultra Wideband (UWB), ZigBee, or Wi-Fi. The MN forwards the collected information to the medical server in the hospital through gateways such as base stations (BSs) and access points (APs), which are connected to the Internet. These BANs form an integrated large-scale wireless hospital sensor network (WHSN).To be able to transmit physiological parameters at any time from any location in the hospital, the MN must be able to communicate wirelessly with the medical server or the physician. One of the marks of modern lifestyle is that people have become virtually inseparable from personal electronic devices such as smart phones, personal digital assistants (PDAs),and tablet PCs, which has resulted in the MN becoming an add-on device or being integrated into a personal electronic device. However, a critical issue concerning power consumption is that MNs, which play multiple roles as data aggregators and gateways within BANs and integrated WHSNs, are battery-powered. In large-scale WHSNs, different types of medical data are generated, each with their own requirements. In urgent situations such as those described in the examples above, information regarding the patient's condition should be transmitted immediately to the medical server.

It would be preferable for data regarding emergency events to be sent via the BS since its coverage is wider than that of the AP. In our scheme, due to the high cost of cellular access links, non-urgent data is sent via Bluetooth or Wi-Fi.
Body area network (BAN), is also called Body sensor networks (BSN) and wireless body area network (WBAN). it is being very popular in society because patient's data monitoring is a leading issue for health & disease management, the core concept behind Wireless body area networks is to remove all wires connecting sensors on the patient and developing wireless network between sensors. All these devices are connected without cables and without reducing patient comfort. Moreover, patient could be monitored remotely.

2. DESIGN ISSUES IN BIOMEDICAL WIRELESS SENSOR NETWORKS:

While important technologies being considered, WSNs and their applications still present challenge to the industrial and research community because of the irintrinsic characteristics, such as low energy resources, limited bandwidth, unstable wireless links, low computational power and small memory. These characteristics present a major obstacle to the development of reliable, easy-to-implement routing protocols As a special set of WSNs, BWSNs share the above- mentioned challenges and they add some others, depending on their purpose and application.

2.1 Wireless link

Harsh environments like hospital facilities are prone to radio- frequency interference and shadows due to the presence of medical equipment, obstacles and human bodies. Such adverse conditions make the Signal to Noise plus Interference Ratio (SNIR) experienced by the network node slow and unstable. Combined with the low modulations-coding adaptability of the sensor net- work technologies, this fact leads to link shaving high and variable Frame Error Ratio (FER).In turn, the instability of wireless links leads to path instability, which also contributes to an increase of the Packet Error Ratio(PER) that makes communications unreliable or prone to large delays, depending on the retransmission policy in use. The routing protocol, which is the component in charge of selecting network paths, must address this instability in order to maintain communication paths reliable without over- reacting to temporary link instability.

2.2 Network deployment and topology

Network deployment in BWSNs depends on their applications or on the scenario. In its turn, the network topology may be called deterministic or random. Deterministic deployments are used in AAL and patient monitoring applications; in these cases, the sensor nodes are manually placed in locations that have a mini- mum level of radio coverage and link quality (to this end, some connectivity tests should be performed in advance). Random deployments are used in disaster or emergency response scenarios where the sensor nodes are required to create an ad hoc, possibly multi-hop network. In both situations, and since from a medical viewpoint it is indifferent whether the former or the latter deployment scenario is on the ground, the network must guarantee adequate levels of reliability and Quality of Service (QoS).

2.3 Nodes mobility

Patients under monitoring may have some degree of mobility. Mobility could result in link quality degradation, isolation of the sensor node, or topology changes. The network should be able to cope with some degrees of mobility so that sensor nodes are not isolated and communications can be provided with satisfactory levels of QoS.

2.4 Network lifetime

BWSNs are typically composed of dozens of battery powered nodes and they are required to work as long as possible (depending on the target application, a network lifetime from 24ht o several days is required).Thus, energy efficiency is a key requirement for such networks to maximise their lifetime. Routing protocols should select the best network path for data delivery. Since communication is one of the most energy consuming tasks in WSNs some nodes (of the most used paths) may quickly reach low level so f energy, which will turn them off and cause harm to the QoS provided by the network and ultimately compromising its lifetime. Since routing protocols obviously play an important role to guarantee energy efficiency and balance to the network, the routing algorithm must take in to account several metrics and/or constraints on the process of path creation, the remaining energy of the node being one of them.

2.5 Data heterogeneity and reporting

In many situations, WSNs are assumed homogeneous regarding the data generated by each node. In their turn ,BWSNs are highly heterogeneous .In patient monitoring applications ,it is usual to have several nodes ,each one generating different data types, depending on the specific application(e.g., heart rate ,blood pressure and oximetry, or body temperature).In order to gather the data generated by the network k it is necessary to define how they will be collected ,i.e. the data report method .It depends on each application and also on the temporal requirements of the generated data. Data reporting can be classified as time-driven, event-driven, query-driven or a combination of these methods. Time-driven networks are used in applications that require periodic monitoring .An event-driven network reacts to unexpected and abrupt changes in sensed variables. Query-driven networks respond to queries generated by the network. In realistic applications we have a hybrid of all these methods. The routing protocol should be able to deal with different data types and reporting methods.

2.6 Bandwidth

Bandwidth is a limited resource in all wireless applications, and even further in BWSNs. In the IEEE802.15.4 technology (2.4GHz), for instance, the bit rate is limited to250kbps .In typical applications of BWSNs, this limit can be easily reached; e.g., a BWSN for a 12 leads EC G monitoring of a single patient needs approximately 40kbps to transmit The raw samples (using a16-bit ADC with a sampling rate of 250Hz).Despite such intensive network use, the routing protocol must contribute to the network performance, regardless of additional control and sign a ling traffic.

2.7 Computational power and memory*:*

The limited memory and computational capabilities of WSN sensor nodes present new challenges to the design of routing protocols. These limitations will be reflected on the protocol complexity and performance thus, light weight routing protocols with low computational requirements and low energy demands are required

II.RELATED WORK

Considered a WSN with five sensor nodes and one sink, where sensor nodes send periodically their messages to the sink. Since SN3, SN4 and SN5 are the only ones in the sink radio range they have to forward the messages from SN1 and SN2. Each node has three attributes: Rank, link ETX, and Remaining Energy (RE) .Using the MRHOF and the ETX metric to build the route path to the sink, SN1 and SN2 will choose SN4 as their best parent (it is the one with the lowest ETX).Consequently, SN4 will soon become inactive due to the energy depletion, and the network might not respond properly to subsequent messages. To avoid this, a method takes into account not only the ETX metric but also the available energy on each node. The EAOF uses the link ETX and the RE on each node to compute the best path to the sink. This is the working principle: each node selects from its neighbours the nodes that have more reliable links (lowest ETX) to the sink. Then from that subset, the node having the maximum RE is selected to become the node's best parent..The parameters MAX_ETX and MIN_ENER are reconfigurable and dependent on the target application. The MAX_ETX represents the maximum ETX value that each neighbour can reach in order to be considered a best parent candidate .It is related with the Packets End-to-End Delay (E2ED), and depends on the application QoS requirements. The MIN_ENER is the minimum difference in the RE for a node to switch its best parent. It introduces some hysteresis in order to control how often the network will be reconfigured. It is used to improve the links stability there by increasing the network performance. Finally, to avoid loops, each node rules out the neighbours with greater rank from being its best parent. The EAOF configuration depends on the WSN application and its QoS requirements. Using the MAX_ETX and MIN_ENER parameters, the EAOF could be configurable to meet the specific requirements of each individual application. Regarding the routing challenges and design issues faced when developing BWSNs ,as presented in the EAOF it is designed with the minmind. To mitigate the effect of the electromagnetic interferences faced by BWSNs when they are deployed in harsh environments as hospital facilities ,the EAOF uses the ETX as metric to select the node within the most reliable path to the sink (i.e.the DODAG root)to be its best parent.

In this way ,the EAOF pursues the reduction of both the PER and the end- to-end delay, depending on the retransmission policy in use. Furthermore, in cases where in the nodes have some mobility, the routes are restored when necessary, while maintaining the criteria of choosing the most reliable paths to the sink. Unlike the existing implementations of the OF0 and the MRHOF, the EAOF uses the RE on each node to introduce energetic considerations when forming paths to route the data through the network. Being aware of the RE of each node, the routing protocol is able to promote the energy balance in the network while choosing the most reliable and most efficient paths. The use of these two metrics, the ETX and the RE made possible an increase in the network lifetime while maintaining high levels of QoS as required by BWSNs and their applications. Regarding the extra bandwidth required to broadcast the metrics across the network, only 2 bytes are added to the DAG Metric Container used to report metrics throughout the DODAG. In other words, both the additional traffic used and the computational complexity introduced by the EAOF are negligible.

5. ROUTING PROTOCOL FOR LOW POWER AND LOSSY LINKS

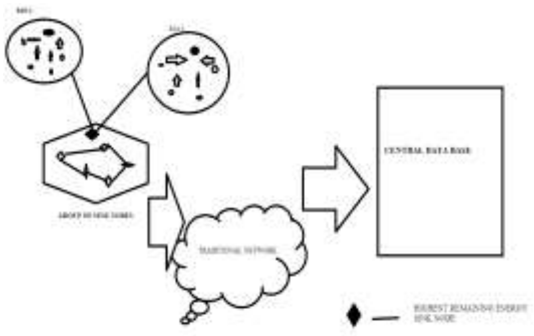
The IETF ROLL working group has approved the new standard "IPv6 Routing Protocol for Low-power and Lossy Networks" in short, the RPL. The RPL introduces a series of novel mechanisms to allow efficient routing in resources constrained WSNs. The RPL is a Distance Vector routing protocol that specifies how to form a Direct Acyclic Graph (DAG) by using an OF and a set of constraints and metrics. Each DAG may be composed of one or more Destination Oriented Direct Acyclic Graph (DODAG),one per sink node. The DAG can be considered a logical topology over a physical network built to meet application specific criteria.RPL uses four identifiers to define and maintain a topology. RPL Instance ID, which identifies each possible RPL instance running in the same WSN; DODAGID, which uniquely identifies one DODAG within one RPL instance; DODAG Version- Number, which is incremented each time the DODAG is rebuilt; Rank, which reflects the distance from each node to the DODAG root. To dynamically form and maintain a topology, the RPL uses a set of messages to disseminate information: the DODAG Information Solicitation (DIS), the DODAG Information Object (DIO), and the Destination Advertisement Object (DAO). These messages are broadcasted periodically by each node, and to control and minimise signalling overhead RPL uses the trickle algorithm, in each node, to trigger them. DIO messages play an important role in RPL.

They carry information about the DAG that allows the network nodes to discover a RPL instance and its configurations, such as RPL Instance ID, Version Number, Rank, OF and metrics. The Options field allows the DIO to carry several RPL Option Objects, two of which are the Metric Container and the DODAG Configuration The DODAG Configuration field OCP (Objective Code Point) identifies the OF used in the RPL instance. The Metric Container is used to disseminate metrics throughout the DODAG. In order to build the RPL DAG, each node configured as DODAG root starts sending to its neighbours DIO messages with Rank equal to one. Upon DIO reception, each node assesses whether the message should be processed or discarded. If the message is valid, the node updates its Rank and its cost to the root, and it updates its neighbour stable and preferred parent. The node preferred parent must have to avoid loops and it is selected according several possible OFs .Currently, there are two OFs specified as Internet Drafts by the ROLL working group, the Objective Function Zero (OF0) and the Minimum Rank Objective Function with Hysteresis (MRHOF).The OF0 uses a hop count-based metric and the MRHOF uses hysteresis while selecting the path with the smallest metric value, e.g. ,the path ETX.

There are two main implementations of the RPL protocol for real and simulated WSNs ,it supports neither security features nor the dissemination of multiple metrics. Concerning the dissemination of multiple metrics, the necessary enhancements were made. The EAOF, designed to be used by the RPL protocol, makes use of two metrics, the ETX and the remaining energy on each node.

6. PROPOSED SYSTEM

The body area network is constructed with five sensor nodes and a sink node. There is separated sink nodes group. In which the objective function, EXT, Rank and energy are calculated. After calculating the remaining energy, the highest remaining energy sink node polls the BAN that it is ready to transmit the data in best path. The BAN sends the data to that sink node, from where the data reaches the medical server through the traditional network.



Figuer:1 proposed system

7. PERFORMANCE METRICS

In order to make a qualitative analysis the following parameters are to be analysed

Packet Reception Ratio:

Due t o the nature of their applications, BWSNs have to fulfil strong QoS requirements. Among such requirements, the application-level PRR is one of the most important. In this context, the EAOF has to achieve the same degree of performance when compared with the MRHOF.

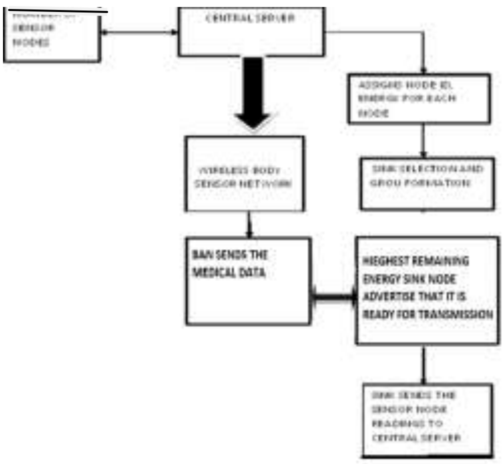
Energy efficiency:

In order to quantify and compare the energy balance and the efficiency of both objective functions, the time that each node spent transmitting or receiving data has to be measured. The energy consumption of a node strongly depends on its radio activity but it can be estimated using a line ar model, E ¼Σtipi, where ti and pi stand for the time and the power consumption of each component of the node. At the routing layer, the energy optimization is mainly done by acting on the radio activity. In this way, the time spent in communications may be used as an indirect measure of the energy consumed by each node, which will allow such time to be used in the study of the network energetic efficiency.

Network lifetime:

Related as it is with network deployment, coverage, availability, connectivity and energy balance, the net-work life time of a WSN can be defined in many ways, they have low redundancy. The network lifetime has been defined as the time when the First Dead Node (FDN) appears.

ARCHITECTURE LAYOUT



8. CONCLUSION

The emerging healthcare technologies mostly depend on the sensor devices present on the patient's body to monitor the health conditions. Since there are many technical issues to be considered, with the help of RPL and the EAOF the performance of the network and the energy of the network is obtained to provide the efficient energy level of the sink node to transmit efficiently to the healthcare centre and the central database.

REFERENCES

[1] De Couto DSJ, Aguayo D, Bicket J, Morris R. ,"A high-throughput path metric for multi-hop wireless routing." In: Proceedings of the 9th annual international conference on mobile computing and networking. NewYork, NY,USA:ACM; Mobi Com '03;2003.p.134–46.

[2] Hua-Pei Chiang , Chin-Feng Lai, Yueh-Min Huang ,"A green cloud-assisted health monitoring service on wireless body area networks" Department of Engineering Science, National Cheng Kung University, Tainan, Taiwan Department of Computer Science and Information Engineering, National Chung Cheng University, Chia Yi, Taiwan.

[3] Akyildiz I, MelodiaT ,Chowdury K. Wireless multimedia sensor networks a survey. Wireless Commun, IEEE2007;14(6):32–9.

[4] Anastasi G, ContiM, Francesco MD, Passarella A.," Energy conservation in wireless sensor networks: a survey. AdHoc Networks ",2009;7(3):537–68.

[5] Dietrich I,Dressler F.,"On the lifetime of wireless sensor networks. ACMTrans Sensors Networks" 2009;5(1):5:1–39.

[6] Min Chen," NDNC-BAN: Supporting rich media healthcare services via named data networking in cloud-assisted wireless body area networks", Huazhong University of Science and Technology, China.

[7] Abreu C, Ricardo M, Mendes P.," Framework for QoS performance assessment on biomedical wireless sensor networks". In: Biodevices 2012—international conference on biomedical electronics and devices. Vilamoura Portugal;2012.

[8] Yena Kim, SuKyoung Lee," Energy-efficient wireless hospital sensor networking for remotepatient monitoring", Yonsei University, Dept. of Computer Science, Soedaemun-gu, Shinchon-dong 134, 137-77,9 May 2014 Seoul, Republic of Korea.

[9] Winter T, Thubert P. Rpl: Ipv6 routing protocol for low power and lossy networks, RFC 6550; 2012

[10] Ehsan S, Hamdaoui B. A survey on energy-efficient routing techniques with qos assurances for wireless multimedia sensor networks. IEEE Commun Surv Tutorials 2011(99):1–14 [EarlyAccess].

[11] Vasseur J, Kim M. Routing metrics used for path calculation in low power and lossy networks, RFC 6551; 2012.

[12] Lai C C,LeeR G,Hsiao CC,LiuHS ,ChenCC .Ah-qos-demand personalized home physiological monitoring system over a wireless multi-hoprelay network for mobile home healthcare applications. JNetw Comput Appl 2009;32 (6):1229–41. Levis P,ClausenT, HuiJ, GnawaliO, KoJ. The trickle algorithm. RFC6206(Proposed Standard);2011. Liang X. QoS provisioning for wireless sensor networks: algorithms, protocols and modeling [Ph.D.thesis].Interventional Center, University of Oslo;2009.

[13]LindseyS, RaghavendraC. Pegasis: power-efficient gathering in sensor information systems. In: Aerospace conference proceedings, IEEE,vol.3; 2002.p.3-1125–30. Liu T, LiQ, LiangP. An energy-balancing clustering approach for gradient-based routing in wireless sensor networks. Comput Commun 2012;35 (17): 2150–61, http://dx.doi.org/10.1016/j.comcom.2012.06.013.

[14] Carlos Abreu a, ManuelRicardo, P.M .Mendes a Escola Superiorde Tecnologiae Gestão, Instituto Politécni code Vianado Castelo ,Portugal: Energy-aware routing for biomedical wireless sensor networks Journal of Network and Computer Applications 40 (2014) 270–278.