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A COMPREHENSIVE STUDY OF ENERGY EFFICIENT ROUTING IN WSN TOWARDS QOS

SHAKEEL AHMAD[1], ASIMSHAHZAD[1] AND NATASH ALI MIAN[2]
[1]Department of Computer & Information Technology, The University of Lahore
[2]School of Computer & Information Technology, BNU, Lahore
natash.ali@bnu.edu.pk

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ABSTRACT. *The Wireless Sensor Network (WSN) is an emerging field of wireless network comprising of few to many autonomous tiny sensors nodes, with limited processing, limited memory, limited battery power, limited bandwidth and limited wireless transmission capabilities. The life time of the sensor node depends upon the battery power. WSN are commonly used to monitor environmental conditions like temperature, sound and pressure etc. WSN is an application of MANET. Wireless sensor node collects data and sends back to the sink or Base Station (BS). Data transmission is normally multi-hop among sensor nodes that enable these nodes to transmit data from hop to hop towards the sink or BS. Wireless sensor network requires robust and energy efficient communication protocols to minimize the energy consumption as much as possible. Main penalty area of researchers is to design the energy efficient routing protocol. Routing protocols should be energy efficient, scalable and prolong the network lifetime.But Quality of Service QoS is also a challenge for energy efficient routing protocols for researchers. QoSneeds a multi-layerlinespanning using the different layer protocol architecture. In this paper, we enlighten the energy efficient routing towards QoS in WSNs and proposes a solutionfor the QoS layer in energy efficient routing techniques in WSNs and finally, highlight some open problems and future direction of research for given that QoS in WSNs.*

Keywords: Wireless sensor Network, Protocols, Energy Efficient, Network lifetime, Multi-hop, QoS.

1. **Introduction.** A cutting edge technology Wireless Sensor Network (WSN) is a widely hot research area in the last decades. A multi hop (WSN) is the network of autonomous, tiny, limited resourced, and low cost wirelessly connected sensors nodes comprising limited computational power, limited memory, limited battery power, and short-range wireless communication radio waves which are scattered in the sensing environment for gathering data[1-7]. These nodes communicate with one another to attain a shared goal. Sensor nodes collect data and send to Base Station. Application of Wireless Sensors Network is going to implicated in emerging fields of life like: environment monitoring, temperature monitoring, sound monitoring, pressure monitoring, health monitoring, forest fire detection, area monitoring, machine health monitoring, industrial process monitoring and control, inventory control, disaster management, battle field monitoring, military surveillance, animal tracking, asset tracking, transportation and shipboard systems monitoring, agriculture monitoring, and security purpose in order to collect sensed data from the few to many sensor nodes and many more[4,6,8-14]. While data collection the sensor nodes send forwarded to a wireless communication network to a central base station or sink for further processing. Sensor nodes route the information to another sensor node or to the controlling station in the multi hop WSN. The routing schemes in WSN are different from wired network or

traditional network due to their changing topology structure and self-organizing in large scale. Traditional routing protocols do not take into explanation that a node comprises only a limited energy power. All sensor nodes are operated by battery power. It is a critical issue in WSN to save battery power for increasing lifetime of network. Energy Efficiency means that number of packets delivered to the sink for each unit energy. Routing against energy in WSN is Exponent function over the distance among the nodes. Energy efficient routing protocols attempt to make best use of the time over which the sensing activity can be achieved. When we talk about one way routing if link is let down all the information on that link will be dropped. To resolve this phenomena we prefer multipath or multi-way routing mechanism in which information is not lost if one of the link is down.In multi-hop routing, if one link let downthen substitutelink is automatic chosen. Routing protocols with less energy utilization and direct path to transmission of information with minimum delay is wanted. Scholars have been intended many of different routing protocols to meet the challenges. Those are Energy Efficiency, Responsiveness, Robustness, Self-Configuration and Adaptation.

In WSN some real time application needs to know about location of node before communication. The other Routing are also called directional, geometric, position-based or Location based routing. The routing protocol finds the position of node and then transmit the packet [1][3][7].

Each routing techniques have advantages and disadvantages. In general hierarchical routing are outperform than flat routing technique. One of the major issues in the design of routing protocol for WSN is energy efficiency due to limited energy resources of sensors.

The chief goals of researchers are to find the energy efficient routing techniques for WSN in multi hop network environment. Energy and delay are determining factors for performance of WSN towards Quality of Service[4][14].

QoS is the effective factor in WSN which is required by all applications of WSN. QoS defines the service quality measure of the network and application users which depends on service attributes in terms of network throughput, delay, packets loss and packet delivery ratio. Each measurement criteria has been exploredmethodically and a lot ofsolutions are planned. QoS parameters also include reliability, scalability, network availability and bandwidth. New QoS parameters like network area covered, disclosure, and energy price and network life time. Energy efficiency and network life is challenging issue in WSN towards quality of service. In section I we introduce the WSN. In Section II we enlighten different routing techniques. In section III we define the challenges of QoS. In section IV we define the requirement of QoS. In section V we purpose a solution. Section VI is conclusion.

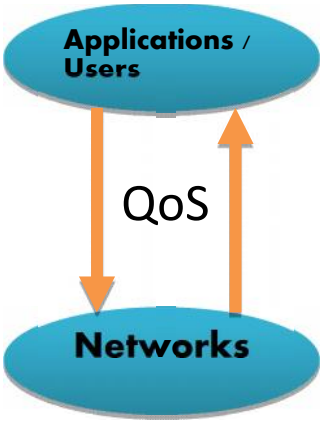

Fig. 1 Quality of Service Scenario

2. ROUTING METHODOLGY IN WSN. Efforts are being made to design routing protocols for WSN which are energy efficient for different application but not for all. The routing protocols for WSN are energy efficient with less QoS support. Following are some energy efficient routing protocols proposed for WSN

A. Data-centric routing. In this method different devices play similar part. Every device disseminatesinformationto the accessible node with in network. Flooding, Gossiping and SPIN are example of flat routing protocols. When we talk Flooding, device A transmit information to connecting devices. Neighbors of A devices transmit information to its all connecting devices.In short information is just

transmitted to just one arbitrarilydesignated neighbor. In this wayenergy is saved while we compareto broadcasting the information. Sensor Protocols for Information via Negotiation (SPIN) before conveyinginformation, devise communicate among themselves in order to controlfailure and overlay ofdevices. In this way just useful data is disseminated [1].

- Flooding and gossiping
- Sensor protocols for information via negotiation
- Directed Diffusion
- Energy-aware routing
- Rumor routing
- Gradient-based routing
- CADR
- COUGAR
- ACQUIRE

These are examples of Data Centric Routing Protocols.

B. Hierarchical based Routing

In Hierarchical routingenergy utilization is saved in the wireless sensor network. In this routing mechanism a routing groupis originated and one controlling node is allocated to each group. The controlling device is played role as frontrunner of its cluster and take information form their groups and disseminate collectively data to the controlling station. The data collection in WSN will importantlydecrease the energy utilization in the network resulting to enhance life of a sensor node in wireless sensor network. Focus behind creating cluster is to use different foreign protocols while minimizing network traffic while network is congested.It is stated that cluster-based protocols show comparatively good energy utilization while we compare to the flat technologies.

- LEACH
- PEGASIS and Hierarchical-PEGASIS
- TEEN and APTEEN
- Energy-aware routing for cluster-based sensor networks
- Self-organizing protocol

These are examples of Hierarchical Based Routing Protocols.

C. Location Based Routing

In location based routing, wireless sensor devices transmit data using physical locations.The detachment between devicesis judged by signal power .Comparativeorganizes of adjacent devicescan be attained by swapping such data between adjacent nodes [1].

- MECN and SMECN
- GAF
- GEAR

These are examples ofLocation-based protocols

D. Quality of Service Based Routing

Quality of Service based routing, the network has to maintain balance between energy consumption and data quality. Broadly speaking, the network has to satisfy certain QoS constraints, End to End delay, energy consumption, data loss bandwidth, etc. when delivering data to the BS.
Network flow and QoS-aware protocols [15].

- Maximum lifetime energy routing
- Maximum lifetime data gathering
- Minimum cost forwarding
- SAR
- Energy-relevantQoS protocol
- SPEED

These are the examples of Quality of Service based Routing protocols.
Wireless sensor networks (WSNs) are demanded to provide different stages of energy efficient routing towards Quality of Services (QoS) based routing in different type of applications. Wireless sensor networks are an

emerging area of research that is demanding QoS in energy efficient routing. Due to resource constraints like processing power, memory, bandwidth and power sources in sensor networks, QoS with energy efficient routing in WSNs is a challenging task[15].

II. QoS CHALLEGES IN WSN

WSNs have unlike characteristics then other wireless network towards QoS. WSN has significant challenges. Some of all are as follows [14,15].

A. Resource Limitations

It present power consumption, memory, computation power, radio power, and bandwidth. Therefore, QoS procedures require to be energy efficient and less processing. They also require to give bandwidth guarantees.

B. Energy Balancing

In different application the Wireless sensor nodes have time periods of activities. In WSN some sensors have to remain active for long period of time while others have low activity and are mostly in sleep mode. Energy is consumed when they are in active mode. Therefore, as long as time period will pass; additional energy will utilize. Its outcome will energy reductionof some devices generating dumps in networks. This problem may be controlled by equalizing energy distribution among different node in the network.

C. Rapid change in Network and size

Mobility is another challenge in WSN. A typical WSN is comprised thousands of wireless sensor nodes. Sensor node movement, node and link failure may change the network topology. Self-Organizing and rapid change of node in WSN is challenging issue. Since the nodes are mobile in nature; it is common to change the physical layout of the network rapidly.

D. Data Redundancy

In WSN, many network devices which are also called network nodes are organizedin different manner in the environment. It is possible to have data redundancy which can improve datadependability, detecting, transmission and dispensationutilizes more energy. Dependable data combination decreases the data redundancy but creates difficulty in QoS design.

3. QoSREQUIREMENTS. Quality of Service (QoS) provision in WSNs is still continued as an open field of research from various angles. QoS is understood by different ways in different fields of application by different technical communities. Generally speaking, QoS refers to quality as supposed by the user or application. In network communication community, QoS is supposed as a measure of service quality that the network offers to the end user or application. We can also define the QoS that it is a set of service requirements to be satisfied when communicating a stream of data packets from sender to receiver.

In wired and wireless unlike WSN, QoS defines specific constraints such as delay, throughput, jitter, packet loss, and bandwidth etc. it is used to judge the level of fulfillment of any network services which are offered by the network service providers. QoS in wireless sensor networks can also be characterized by reliability, timeliness, robustness, availability, and security between user and network.

However, in WSNs such as accuracy of data collection, delay, fault tolerance and network lifetime etc. They are application specific and they are different from the unlike WSN end-to-end QoS requirements due to the difference in application domains and network properties. Researchers have been working continuously towards QoS in WSNs and have proposed some methodologies for that purpose. To name a few, Network Layer based QoS support in terms of routing protocols Cross Layer based QoS support and Middleware layer based QoS support are the most prominent types of approaches for QoS support in WSNs. It is intended that WSNs will gradually become common in routine maters and will revolutionize the universe. This trend drives the WSN to provide QoS support to meet service requirement of its diverse applications. This motivates us to explore this challenging area and bring to the focus the possible research problems and their solutions.

4. PURPOSE SOLUTION. In this paper, we emphasis on the QoS supports at the NETWORK layer of communication protocol stack. We explore QoS requirements and challenges for WSN. We find that instead of designing deterministic QoS guarantees for WSNs at NETWORK layer of protocols stack. Majority of the energy aware protocols follow

a service according to type of application that is a differential approach. Which is differentiating the data packets according to applications. The different energy aware protocols are designed according to their requirements by changing the related network parameters at the NETWORK layer of energy aware protocols stack. Design trade-offs and open research problems are also explored to point out the further possible research directions in the field of WSNs at the NETWORK layer of energy aware protocols stack towards QoS. The major problem in WSNs is lack of resources.

Energy is most important constraint in WSN, lack of energy come to the resource constraints which will be impossible to use sensor device in network with exhausted batteries that becomes fully useless. First of all, we must design energy efficient network routing protocols after we should redesign them as energy efficient routing protocols towards QoS provisioning. Sensor nodes in WSN have also other resources limitation other than energy such as processing complexity, memory management, and radio power etc. for this reason the complex protocols are not feasible. Furthermore, the wireless path must be fully used due to give better QoS-provisioning. Bandwidth is also a challenging problem in WSNs.

The design of energy efficient WSN routing protocols must has scalability due to WSNs deployed to a large number of wireless sensor nodes. For this reason, be careful designing of energy efficient routing protocols towards QoS. The mobility, environmental effect and highly rapid change in topology are also a big problem in WSNs. These requirements must also be handled. It is the most effective method the concept of resource sharing in WSNs, especially when resources are limited. The network traffic must be control in efficient way due to achieve better QoS. The poor traffic control causes the wastage of resources. Designer of energy efficient must keep in mind that the Well-designed energy efficient routing protocols are not enough. We must take great care. Protocols must be energy efficient towards QoS.

5. Conclusion. Wireless sensor network is an emerging network era. Energy efficiency in wireless sensor network is hot issues while we have less network resources. In this research paper,we showed a comprehensive study of energy efficient routing methodology in WSN towards quality of service(QoS) that is stated in the literature review. The main aim is to increase the life of the sensor node in the WSN using different quality of services (QoS) attributes. According our study the routing approaches are categorized bydata centric based, hierarchical based, position based and QoS aware routing protocols and also depending upon protocol operation, these protocols are categorized into multipath-based, query-based, negotiation-based, or QoS-based routing. We also highlighted the advantages and disadvantages of each routing method. We try to purpose a solution for energy aware routing towards QoS in WSN based on our study. Still now there are many challenges for energy efficient routing techniques which require beingresolved in the sensor networks. We highlighted those challenges and recognized future research directions in this respect.

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