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Study on Energy Efficient WSN Protocols.

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ABSTRACT

In the world of vast amount of data, it is necessary to collect the real time information and update them in a proper manner such that efficient analysis could be performed. Though traditional networks are able to fetch the information, on considering the scalability they fail to do its part. Here, Wireless Sensor Networks (WSN) comes into practice. In WSN, energy efficiency plays a crucial role as failure of a node would make the entire network to go down. Various routing protocols have been used such that the data is transmitted to the destination with least amount of energy. Each protocol has its own pros and cons which has to be used according to the situation or implemented in a hybrid fashion. This study gives an overview of several protocols that has energy efficiency, security and lifetime as its characteristics.

Keywords: Energy Efficient, Wireless Sensor Networks (WSN), Residual Power, Malignant node.

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INTRODUCTION

The future of ubiquitous computing can be made possible unless a device that collects data is present everywhere. Those devices have to be powered through batteries. They consume power in order to sense and process the data. WSN is enacted in seamless transport, target tracking, healthcare, quality support and industries. Direct communication of each node to the base station (BS) consumes a lot of energy. Hence the data are transferred to a sink and then to the BS. Several clustering protocols are implemented in providing a stable network. Various challenges have to be met with such as high data rate sampling, time synchronization, precise reading. These can be achieved through clustering protocols. The Fig. 1 shows the classification of efficient WSN protocols. The protocols namely LEACH, DEEC, SEP, ESEP, EESEP, APTEEN and its subversions are used to tackle the huge power consumption and precise data management.

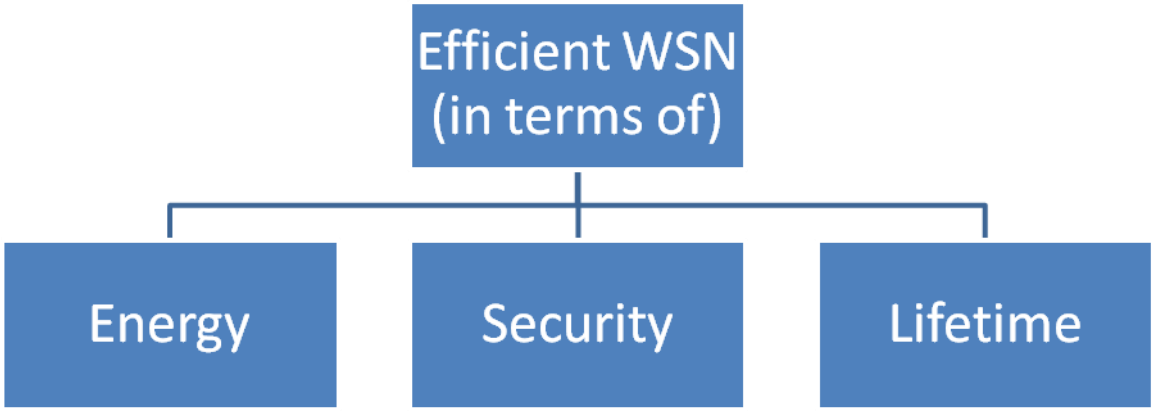

Fig 1: Block diagram of Efficient WSN protocols

ENERGY EFFICIENT PROTOCOLS

The various protocols used in the conservation of energy are:

LEACH

M. Malik *et al.* [16] states that Low Energy Adaptive Clustering Hierarchy(LEACH) is the technique in which nodes are clustered towards the cluster heads(CH). They are grouped in a fashion such the communication between the CH and the BS are done with the minimal amount of energy. Since CH processes more computation, energy spent by it is far higher than other nodes. Hence CH is constantly changed by generating a random value for a node and if it is below the selection threshold, the corresponding node is selected as CH. It consists of two phases. In the first phase, the CH is elected and the CH allots TDMA schedule to each of its members. In the second phase, data transmission takes place. The clusters communicate between them through CDMA codes. Though this protocol is energy efficient, it has various drawbacks. LEACH presumes all nodes can communicate with sufficient power to arrive BS and time synchronization has to be met.

DEEC

Ritu Kadyan *et al.* [11] stated the Distributed Energy Efficient Clustering is a technique used for nodes with different energy levels in WSN. This follows a different way of electing CH. CH is selected by a probability based on the ratio between the unconsumed energy of anode and the average energy of the network. The nodes with high energy at the origin and remaining energy have more chances of becoming CH than lower energy nodes. This protocol estimates the ideal value of network life-time and it is used to compute the reference energy that each node should expend during a round [20].

SEP

Akyildiz *et al.* [10]suggested that Stable Election Protocol(SEP)mainly focuses on extending the lifetime of a network. In other words, it can be said as increasing the interval time before the fall of the initial node. The nodes are categorized into minimal energy nodes and maximal energy nodes. Low energy nodes are called normal nodes and high energy nodes are known as advanced nodes. Probability of advanced node becoming a CH is more than the normal node.

ESEP

It is learnt from Mannepalli Sreehari *et al.* [8]that Extended Stable Election Protocol (ESEP) is enhancement of its predecessor. It has an additional type of node known as moderate node. CH is elected on the basis of battery power and vestigial energy of a node. Comparing to SEP, the number of dead nodes have been decreased in ESEP.

EESEP

C. Divyaet al. [9]considered Energy Efficient Stable Election Protocol (EESEP). In this, the CH is elected based on the Optimal Threshold value which is calculated based on the initial power of the node rather than considering the remaining power of each node. This results in the increase of more number of alive nodes when compared with SEP.

APTEEN

Basma M. Mohammad El-Basioni, Sherine M. Abd El-kader[2] proposed a hierarchical cluster-based routing protocol. The clusters formed have a CH which is responsible for receiving, aggregating and transmitting the data to its members. The heads have several parameters such as attributes, thresholds, schedules and count time. It has various features for efficient transmission. APTEEN combines proactive and reactive policies. TDMA schedule enables the node to enter the sleep mode when not in use. It supports query handling mechanism.
Various versions have been proposed to overcome the challenges faced in LEACH protocol .They are:

LEACH-C

Sarbjeet Kaur and Ravi Gupta[1] proposeda Centralized protocol in which BS elects the CH based on the location of a node via GPS. This protocol plays an upper hand by choosing a deterministic approach of selecting a cluster head in a given time.

LEACH-F

P. Manimala and R. Senthamil Selvi [13] proposed a fixed protocol in which once a cluster is formed, CH is selected only from the initial cluster for the future iterations. It has a drawback on adding or removing a node from a network or on the event of death of a node [17].

TL-LEACH

R.Kaur*et al.* [14] stated a two level hierarchy protocol that adds an additional CH to receive the data from the overall CHs, which aggregates the data from each of its cluster nodes. This proves to be more efficient than its predecessors [18].

LEACH-E

M.Usha and.N.Sankarram [15] suggested a protocol portrays that the nodes are selected as the CH based on the unused energy after each iterations [18]. More the residual power of a node, more the probability of becoming a CH.

SECURITY BASED PROTOCOLS

Some of security based protocols that is used to provide secure transmissions are:

SLEACH

Y. Zhang and L. Xu proposed that SLEACH [3] is the first of its kind in security based LEACH protocol. Hao Chi Wong et al. proposed it doesn't provide confidentiality and availability, it provides protection from sinkhole, selective forwarding and HELLO flooding. It protects the network from the intruders but decreases the network in terms of performance and measures.

SecLEACH

B. Shanthini and S. Swamynathan proposed SecL EACH [4] which provides secure node-to-node communication with the concept of symmetric key and one way hash chain. It provides confidentiality, integrity and freshness but fails to protect from compromised CH attack.

EECBKM

Mohamed Elhoseny *et al.* proposed EECBKM [19],a technique where CH is selected on the energy basis, processing capacity and area coverage. The node-capturing attacks are reduced and packet delivery ratio is maximized with minimal amount of energy in EECBKM. Each CH receives EBS key and cluster key is distributed to its cluster [5].Despite of its secure measures, it is prone to several active attacks.

SRPSN

J. Yin and S. Madria proposed SRPSN [7] is a cryptography based method in which a symmetric key is distributed among the CH and BS. It uses a group key management scheme. Since this mechanism doesn't provide any authentication, it fails to defend attacks such spoofing, modifying, looping and Sybil attack. Malignant node can lead to a sinkhole attack.

SecRout

Y. Cheng, D. Agrawal urged SecR out [6] protects the node from compromised node attack and it is capable of detecting the data modification in the malignant nodes at the period of transmission. Symmetric cryptography is implemented with two ways : the master key which is distributed between CHs and sink, the distribution of cluster keys is done with the clusters. The advantages of SecRout are it guarantees the freshness of data, reduces the communication overheads, and decreases the memory usage and bandwidth.

MODES FOR PROLONGING THE LIFETIME OF A NETWORK

An object can be sensed with the following parameters such as light, temperature, seismic and acoustic. This can be used for various purposes mainly in military, remote sensing and environmental monitoring. Batteries cannot be replaced in hazardous environments and this technique plays a vital role in extending the lifetime of the network. S. Anandamurugan, C.Venkatesh [12] proposed a method in which two types of modes exists, sleep and active. Nodes wake up only at the time of necessity and become idle when it is pointless in order to save power. Acoustic and photoelectric sensors are being used for efficient target tracking systems. Distributed approach is preferred over centralized approach as it avoids wastage of energy. Though dynamic clustering is efficient, it leeches a huge amount of energy for new CH selection and cluster formation. Hence static clustering is used in this system. Location of a sensor is traced mainly on three physical variables. The variables are Direction of Arrival (DOA),Received Signal Strength (RSS) and Time Delay of arrival (TDOA). Based on the association between sound level and position of the sound source, one can estimate the sensor locations. This system mainly focuses on precise detection and event tracking. The neighboring sensor can be communicated with the minimum distance of 2R, as communication range is two times the sensing range. Sensors that detect light are kept at the edges of the field and it is active all the time for sensing the target. CH is considered as the Processing Node(PN). The sensed data from acoustic and photo detecting sensors is collected by PN. All the nodes go to idle state once the target moves out. Sensors in the active state

leeches more energy than the sensors in the idle state state. Once the photo detecting sensors senses the target, it notifies the PN and all the acoustic sensors switches to the active state. If the RSS at acoustic sensor exceeds its threshold, it concludes that the intruder is in the network. The sensor that detected the target sends the corresponding RSS value with receiving time is sent to the PN. Energy based acoustic source localization of a target is done using trilateration method. The PN choose the three highest RSS values, computes trilateration and it discloses the intruder's signature to BS. If the movement of the intruder is within small area, then the PN remains unchanged. Else the target information is passed to the next PN. Target information includes location, time and velocity and BS estimates the movement of the target using this information. Atlast, BS conveys the target tracking information to the users through internet.

CONCLUSION

This survey showcases the knowledge inferred from a collection of research articles. The cluster has to be chosen in a prompt way, such that conservation of energy is achieved. Based on the circumstances, various protocols have been used. In order to tackle robust situations, one can use a collaborative way of protocol implementation *i.e.* Hybrid protocol can be deployed.

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