Review on Energy Efficient Routing Protocols in WSN

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Abstract- Recent development in wireless sensor network has led to a number of new protocols which are designed for energy efficiency in sensor network. In wireless sensor network (WSN), mostly the attention is given to the routing protocols which depend on the architecture of the network and application. This paper presents the different types of routing protocols and classification approaches. The main focus of this paper is to review energy efficiency and use of IpV6 in location based, hierarchical and data centric protocols in WSN.

Index Terms- WSN, Routing, Optimization, Networkflow

I. INTRODUCTION

WSN are the application based networks which consist of a number of sensor nodes. WSN is a composition of hundreds of sensor devices which communicate with wireless networks with the help of limited energy consuming routing protocols. In WSN, there are small networks which have inexpensive, low-power, distributed autonomous sensors. It can accumulate and propagate environmental data to monitor and control the physical environments from any remote location with accuracy. Generally, it is found that each sensor in a network has certain constraints with respect to its energy source, power, memory and computing capabilities. It has a gateway which can provide wireless connectivity to the wired world and distributed nodes.

WSN Architecture

WSN have three components known as nodes, gateways and software. In WSN, collected data is transmitted to gateway and operated independently. It is collected from host system where the nodes can further collect the data, process it, analyze it and present this data by using software. Special type of router nodes are used to enhance the reliability and extend WSN distance capabilities. WSN is widely used because of its low costs and high efficiency [1].

WSN contains sensor nodes which are used to sense, communicate and for processing of data. Sensor nodes are widely used in different areas such as in industries, military, agriculture and environmental monitoring. In these applications, adhoc arrangement of sensors is used as shown in figure 1. In the unattended environment, sensors can not be easily recharged or replaced. They have the problem of energy consumption, which is the most critical problem. The sensor is a small device which is used to detect the number of physical parameters, the event occurring, measures the presence of an object and then it converts the physical parameters to electrical signal value using electrical actuators.

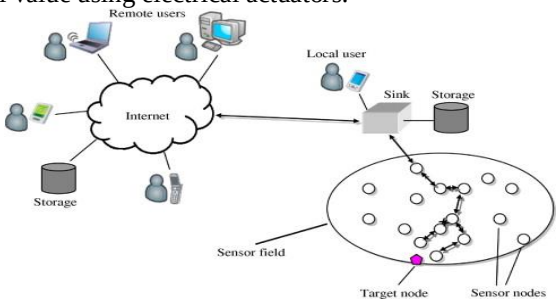

Fig.1: WSN Architecture

I. ADVANTAGES OF WIRELESS SENSOR NETWORK

- **Flexible:** Wireless sensor network is flexible in nature because it adapt to the changes easily and performs well.
- **Adding new Device:** It can easily accommodate the new devices in the network any time.
- **Economic:** It is more economic due to its wireless nature. It does not contain any additional hardware or wires for new connections. Passive infrared (PIR) detectors used in WSN are relatively available at low cost then wires.
- **Low Power Consumption:** Nodes used in the wireless sensor network consume very less power during communication.

II. CHARACTESTICS OF WIRELESS SENSOR NETWORK

- **Dynamic Network Topology:** Due to wireless connection network, there is no topology for the nodes that are connected or nodes that connects after an interval of time.
- **Less Communication Failures:** Communication failure rate is less in the wireless sensor network due to its dynamic nature, if a connection is failed then communication is not affected by it. It communicates with another connection.
- **Limited Power Consumption:** Nodes in the WSN can store very less amount of energy in it.

- **Heterogeneity of nodes:** Large numbers of nodes are able to connect in this network due to its wireless nature.
- **Deployment at large Scale:** It is easy to deploy in large area because no additional hardware is required.
- **Scalable node capacity:** In wireless sensor network capacity of nodes are scalable and only limited by bandwidth of gateway node.

III. LITERATURE REVIEW

Shekle et al. proposed a congestion-aware routing protocol in the wireless sensor network. It works on the opportunistic theory and selects the optimized route. For scheduling on the network, it uses sleep mechanism. The proposed protocol reduced the congestion on the network and enhances the node's life and entire network life time. It also reduced the partitioning of the network. It mainly used to provide the appropriate path on the wireless network to the nodes [1]. Jumira et al**.** describe about a routing approach named as energy efficient beaconless geographic routing with energy supply (EBGRES). It provides source to sink loop free routing. It reduces the communication overhead without using neighbor. It can determine the duty cycle of the each node and estimates the budget for each node. Every node send data packet and then control the message. This technique works on the handshake and timer assignment function. In this paper, lower and upper bounds estimated hops are used to count the energy consumption [2]. Luo, H. et al formulatethe energy efficient data gathering algorithm. In this paper, a novel routing algorithm termed as adaptive fusion steiner tree (AFST) is designed. It gives an optimization on cost for data transmission and fusion. It also helps to evaluate the benefits and cost of data fusion along information routes. It adaptively adjusts weather fusionon a particular node. AFST performs better than existing algorithms like secure localization technique (SLT), shortest path routing tree (SPT) and minimum fusion steiner tree (MIFST). It has been concluded based on analytical and experimental results [3]. Chang, et al presented a routing protocol named as maximum energy cluster head (MECH). It has the properties of self-configuration and hierarchical tree. In several aspects, MECH has improved Low-Energy Adaptive Clustering Hierarchy (LEACH). In MECH, clusters are formed based on radio range and number of cluster members. The topology of the cluster network is distributed more equally and based on construction of cluster. It also propose a hierarchical tree routing method that can reduce the distance of the cluster-head to the base station [4]. Zhang et al. define a novel approach based on geographic routing called as Energy-Efficient Geographic Routing (EEGR). In this, geographical information and power characteristics are used for forward decision making. It is a loop-free protocol and based on hop count for sensor to sink packet delivery. This paper analyzed the energy dissipation and energy consumption. The simulation results of this paper show that EEGR provides better results by using the local information [5]. Wu, Shibo et al. presented the geographical power efficient routing (GPER) for wireless sensor network. In this routing process, each node is able to make local decision based on how far to transmit the data. It works in very scalable and power efficient way. Each node establishes a sub-destination in its maximum radio range. The node, however, may decide to relay the packet to this sub-destination through an intermediary node, if it preservethe power. The simulation result of this paper shows that it saves the energy and provides more efficient results [6]. Hein Zelman et al focused on a communication protocol, which have significant impact on overall energy dissipation of WSN network. LEACH, a clustering based protocol is proposed in this paper which can be used to utilize the randomize rotation of local cluster based on station (cluster-heads) to evenly distribute the energy load among the sensors in the network. To enable scalability and robustness in dynamic networks, LEACH used localized coordination and incorporatesthe data fusion into the routing protocols which can reduce the amount of information that are transmitted to the base station. Simulated result shows that there are reductions in energy dissipation as compared with conventional outing protocols [7]. Da Silva et al. implemented the wireless sensor network gateway with the help of IPv4 and IPv6. This gateway is used to interconnect the wireless sensor networks and enable them to communicate with other nodes. In this experiment IPv6 host is able to communicate directly with sensor nodes. To validate the performance of the proposed system a testbed is also created and show that gateway is enabled to handle the bidirectional communication between client and sensor nodes [8]. Granjal et al. worked on the security of network layer by using IPv6 protocol on the wireless sensor network. In this IPv6 adds the additional header on the data packet to provide the security feature. These headers are also able to work smoothly with other headers of the adaption layers. This protocol is able to integrate the sensing application with internet and provides end to end security [9]. Jonathan et al. formulated the use of IPv6 with Wireless sensor network in low power. This protocol works effectively and efficiently. The message delivery rate in this work is improved and also average-hop latency is effective in different environments [10]. Wang, et al. proposed hierarchical and IPv6 wireless sensor network having low power which is based on cluster-tree architecture. In this, WSN is divided into multiple clusters and an algorithm for cluster generation.WSN network layers are created for cluster head and cluster member. It also integrates the stateful and stateless address configuration strategy to develop effective IPV6 protocol. IPv6 address mechanism is used to provide the security from duplicate address problem. The issue of mobility failure is also considered in this work and solve by using IPv6. The result of the proposed experiment reduced the delay time and

configuration cost [12].Tsiftes et al. introduced the concept of low power routing in the wireless sensor network by using IPv6 routing protocol of low power (RPL). RPL provides the feature of providing of effective topology formation by making one or more instances of the topology. RPL instances create the directed acyclic graphs (DAG) of the nodes. DAG needs to be change only when the network is restructured. IPv6 with RPL provides the effective traffic management by its feature point-to-point traffic [13]. Durvy et al. worked on the concept of interoperability of the sensor network and sensor hosts on the internet and presented the IPv6 stack for memory constrained devices. The performance evaluation of the proposed system is done on simulation environment and it performs effectively [14]. Gara et al. proposed an efficient intrusion detection system in IPv6 based wireless sensor network. The proposed work is done to enhance the security in the WSN by providing the detection defend against the attackers. This approach detects the clone and selective forwarding attack and also provides the security against them by using intrusion detection system (IDS). This approach also works effectively on sybil and wormhole attack [15].Granjal et al. proposed a model for secure interconnection which is IP enabled and provides the security in the wireless communication network. This model adds the additional headers to the data packets and provides the security to the hosts and networks layer [16].

IV. CONCLUSION

This proposed work mainly focuses on the routing process in sensor networks that is a challenging task in wireless network. This paper summarize the research result of packet sending in WSN and describe the classification on the basis of six main categories, namely QoS, Network Flow, Data Aggregation, Data Centric, Hierarchical and Location Based. The classification of the protocols covered in this research work is given below in Table 1.

Table 1 Classification of protocols in wireless sensor network.

Routing Protocols	QoS	Network Flow	Data Aggregation	Data Centric	Hierarchical	Location Based
CAORP		√		√		
FADS	√			√		
Transmission power control	√	√				
DCGF	√	√				
CSMA		√		√		√
FUCA		√	√	√		
IW-MAC	√					√
IPv6	√	√				

V. REFERENCES

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