

A Critical Investigation of Routing Protocol for WSNs

Ved Prakash
Research scholar,
Deptt. of CSE,
KNIT, Sultanpur
vedprakashknit@gmail.com

Suman Pandey
Associate professor,
Deptt. of CSE,
KNIT, Sultanpur
sumanuptu@gmail.com

Sohit Shukla
Research scholar,
Deptt. of CSE,
KNIT, Sultanpur
sohit009@gmail.com

Article Info
Volume 82
Page Number: 4216 - 4222
Publication Issue:
January-February 2020

Article History
Article Received: 18 May 2019
Revised: 14 July 2019
Accepted: 22 December 2019
Publication: 21 January 2020

Abstract

Handling of dynamic and remote situations quickly with time by use of sensor devices is going to seem easy. Due to increase in technology sensor devices are communicating with each other and formation of sensor network. Sensor network may be classified in two categories: Wired Sensor Network (infrastructure) and Wireless Sensor Network (infrastructure less). Out of enormous applications of WSNs, some of the applications required a very fast data transfer rate with minimum interruption. Numerous applications provide significance to throughput and that they did not pay good attention with delay. It is very important to understand the first network structure then select routing protocol and it ought to be suitable for the need for use in a different area. Ultimately, cutting-edge the long run, a standard overall routine evaluation of distinct routing protocol is being made the usage of a ZigBee and W-LAN initially based on WSN.

Keywords: *Wireless Sensor Network (WSN), OLSR, SPIN, DSR, W-LAN, AODV, ZigBee.*

I. Introduction

In modern technology new advancements are emerging in the field of hardware, are evolving small size, high capacity sensors with a limited embedded system processing unit that is able to talk wirelessly. But, loads of sensor networks also obviously introduce a substantial amount of information in WSNs (wireless sensor networks), that may process acquire and transmit data/signals [1]. While various sensor nodes that are independent of each other are employed in the focused vicinity or in its vicinity, its referred to as sensor network [2]. Now WSN is a self-organizing, is designing network, with the help of sensor nodes is use to spatially allotted and is

tracking physical environmental. Considering that WSN is typically dynamic in nature, its topology is changing regularly. This will cause adding a new node or leaving exist node into the network because of lack of connectivity. In order to avoid the failure because of a single node, and improve network connectivity clustering methods are used, as they execute regionally within partial nodes. On comparing protocols, clustering protocols are better than over centralized protocols are greater strong and scalable. To gain prolong the existence of the system (network), energy-efficient protocols are designed according to the traits of WSN, by efficaciously organizing the sensor nodes in clusters [3]. Now going to focusing on routing technique, the routing is

a method to choose an appropriate route for data to move from source to destination. The manner finds out many problems whilst deciding on the path, which relies upon channel, the type of network and the overall attributes. The data observe by nodes in the sensor network is naturally promoted to base station, which connected with another sensor network (perhaps internet) here data is gathered, examined and a few motions is being to take consequently. In sensor networks implemented with usage of motes (very small nodes) and the base stations, some of nodes directly communicated with base stations which are in the communication range. These communications know as single-hop communication but as number of nodes to cover large area then single-hop communication is not possible. To improve utility of wireless sensor network and collecting data from remote location multi-hop data communication take place. In Single-hop communication is known as direct communication likewise known as direct communication possible and in multi-hop verbal exchange with multiple intermediate hops (senor node) is called indirect communication. The way of locating an appropriate route from source device to a destination device is known as routing methodology and network layer perform routing communication system [4].

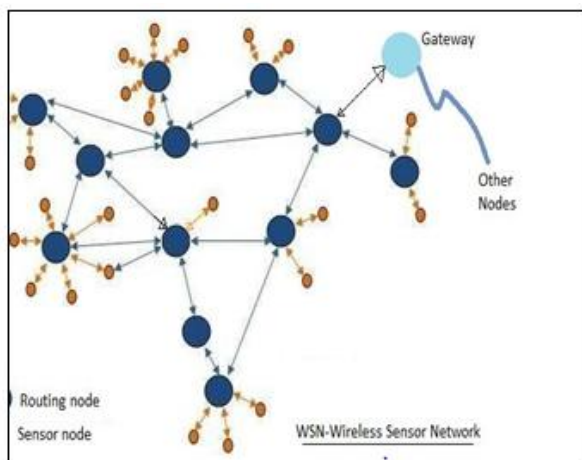


Fig.: 1 Wireless Sensor Network

II. Characteristics of WSN

It changed into determined that there were many similarities among the sensor network and ad hoc

networks, both are dynamic and on demand. a few different similar traits are mobility, switching and the restriction functionality of the battery power. WSN also has some distinct properties listed under [5]:

1. Power efficiency: Motes are often facing a hassle of energy to battery power run down. In addition, as per many kinds of research, the energy consumes by the nodes in sending records over the communication is more than the computing power of the nodes. Therefore, maximize life of network in WSNs [5].

2. Fault tolerance: The WSNs have the capacity to organize itself in the community as nodes have deployed in a random style far off the area and unreceptive environment. For preventing from fault sensor nodes have labored in collaboration to reorganize itself and used a distributed algorithm for forming automatically network [6].

3. Mobility of nodes: As it knows that WSN is collection sensor community in which some nodes are movable, and some are static. We say that the character of WSN is dynamic. Because of restrained sources, nodes can fail for battery fatigue or some different conditions, a communication channel may be disrupted. Topology is likewise affected by adding of node or failure of a node. Consequently, the WSN nodes have advanced the characteristic of self-governing and self-management [6].

4. Heterogeneity of nodes: Heterogeneous approach distinctive varieties of nodes, that are exceptional from every different by the communication range, mobility, and sensing parameters and work at distinct protocols, etc. Heterogeneous WSN is a set of numerous unique types of sensor nodes with have distinct functions, observe distinctive protocol, distinct computation capacity and one-of-a-kind sensing and monitoring variety. Deployment of a heterogeneous sensor network more traditional than homogeneous WSN [5].

5. **Responsiveness:** WSN has the capacity to speedy adapt itself to the adjustments inside the topology. It has taken into consideration its responsiveness. To get distinctly responsiveness inside the network. It wishes to compromise with the latency of network and as well as scalability [7].

6. **Communication failures:** Wireless Sensor Networks work in freestyle fashion as ad hoc in nature. Sensor device has very low communication bandwidth and low communication distance range. And additionally, it has some mobility degree of freedom. The sensor network will also be laid low with the impact of an herbal catastrophe including mountains slid, buildings damage and storms and cyclones, heavy rainfalls and thunder lighting fixtures, the far-off vicinity obstacles, weather, and plenty of greater. That's why; it's far very tough to manage and hold WSN run easily. This is a vital effect of studies direction within the destiny [5].

III. Challenges in Routing for WSNs

Implementing and designing efficient routing protocol is quite hard due to various features that are exclusive to wireless sensor networks from wireless ad hoc networks. Numerous routing varieties in WSNs concerned with disturbing circumstances. Some of the primary challenges are given underneath [7]:

1. It is very difficult to allocate identifiers that are unique all around the entire gadget for a big range of nodes. So, the sensor node isn't capable of the usage of IP (internet Protocol) primarily based protocols.
2. The moment of data must be move from source nodes to destination nodes. But it has no longer befallen in general networks.
3. In the WSN nodes, generate a similar type of data traffic. Because when an event has occurred they sense data send to their neighbor node and they further transfer to other nearby nodes. So, it is very vital to handle such type of redundancy data by protocols, which efficiently utilize the existing bandwidth and save power of nodes.

4. Moreover, Wireless node is firmly constrained such as transmission energy node, a bandwidth of channel ability nodes, garage, and onboard system energy. Due to the heterogeneity of sensor devices, a lot of different routing protocols were existed as per demand in WSNs.

IV. Implement Problems in WSNs

Due to the absence of sources including insufficient energy, low bandwidth, and processing garage, there are some major design difficulties in WSNs. The subsequent needs must be met by using a network engineer when developing fresh routing protocols.

1. **Energy Efficiency routing:** In this network is created by sensor node and the sensor node usage non-replaceable battery for their power. Network performance reduces due to power fallen underneath. Energy gives the primary plan for implement for designers whilst conniving sensor networks. In WSN, a lot of sensor nodes (hundreds and thousands). Each node on the network has confined energy assets. So, energy aware and efficient protocol required [8].
2. **Complexity:** More complex algorithm required more hardware and computation energy, which affect the performance of existing network. The tenacity at the back of is that we've insufficient hardware abilities and that face excessive energy barriers in WSNs [8].
3. **Scalability of Network:** In WSNs, sensor nodes are capable of accumulating, processing, arranging, aggregating and sending statistics to a base station. As some of nodes will increase sensor community turns into very massive. Within the large network sensor nodes are capable of communicate with remote nodes however also produce traffic problem, tough to control and coordinate [6].
4. **Delay in Network:** A few applications require immediate reaction or reaction with none big delay together with a alarm sensor or temperature sensor and many others. So, it is necessary that routing algorithm claim minimal delay [8].

5. Robustness of Network: WSNs are applied in very essential and loss situations regularly. Every so often, a sensor node is probably expired or sendoff the network. Consequently, the routing protocol has to achieve success to simply take delivery of all varieties of environments at the side of immoderate and loss situations. The routing protocol's capacity should also be great [9].

6. Data transmission and transmission models: Here four types method of data transmission relying on the applications in wireless network as known:

- i. **Event-Driven**
- ii. **Continuous Type**
- iii. **Query-Driven**
- iv. **Hybrid Type**

A node is started to transmit monitor data simplest even as base station created the query or an occasion active inside the query-drive and event-driven system. The data are posted out intermittently in continuous transmission mode. The performance of routing protocol may affect due to network parameters as network transmission media and network scope [10].

7. Location of Sensor Node

Any other major task facing this to help WSN designers is to locate the sensor nodes correctly. Many routing algorithms use the Global Positioning System (GPS) to obtain insight into the place of the sensor node [10].

V. Taxonomy of Routing Protocol for WSNs

In the routing protocols outline how one node would be communicate with other node and how the data could be sent in network from one end to another end. The routing protocol can be classified in ways:

1. Node-centric protocols: The destination node has some specific number as Identifier and it isn't always predicted the form of communication in WSNs. E.g. LEACH Protocol. Low Energy Adaptive Clustering Hierarchy (LEACH) is a cluster-based routing protocol where cluster formation and power

are in a similar way separated in equal portions during the cluster nodes in the wireless sensor network. In this protocol, many clusters are developed and one of them selects the cluster head and works as a routing node in that cluster [11].

2. Data-centric protocols: In the most of WSNs, sense information or data is received from remote location. Here data travel instead of actual node moment itself. That why data-centric routing strategies takes high attention on the transmission of data by using positive attributes in preference to accumulating data from sure nodes. This routing, the base station generates inquiries to precise area forget data [12].

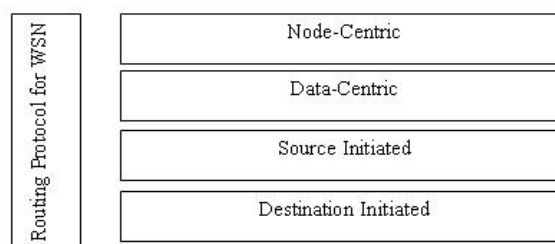


Fig.: 2 Classification of Routing Protocol

2.1 SPIN Sensor Protocol for Information via Negotiation is a protocol for sensor data via the negotiation system. It is indicated that the deficiency such as flooding and gossiping should be removed. The concept is that the sharing of documents, felt by means of the node manner, can also take additional sources compared to the meta-data, which is the easiest data descriptor detected by using the node. In each node video display device, the helpful resource manager displays its sources and thus adapts its functionality. There are three types of messages:

- i. **ADV**
- ii. **REQ**
- iii. **DATA**

The node broadcast associate degree ADV packet to all or any the distinct nodes that it's some data. This promoting node ADV message includes attributes of the records it's. The nodes having pursuits in statistics, that the advertising and promoting and marketing node have

requested via causing REQ message, to the advertising and promoting node. On receiving the REQ message the advertising node sends statistics to it node. This fashion keeps while the node on the reception of knowledge generate associate degree ADV message and ship it.

2.2. Directed diffusion (DD): Directed diffusion is a data-centric routing approach. It makes use of this data-centric approach for facts collecting and circulating. This routing protocol is additionally energy-green and power saving protocol so that's why the existence time of the network is elevated. Complete dialog inside the DD routing

protocol should be node to node so there is no want of bringing upon this protocol.

3. Source-initiated (Src-initiated): In these sorts of protocols, the supply node advertises even as it has data to percentage after which the route is generated from the source aspect to the destination. A sample is a SPIN.

4. Destination-initiated (Dst-initiated): These protocols are referred to as destination initiated routing protocols when the route configuration technology originates from the target node. Samples are the protocol of Direct Diffusion (DD) and LEACH.

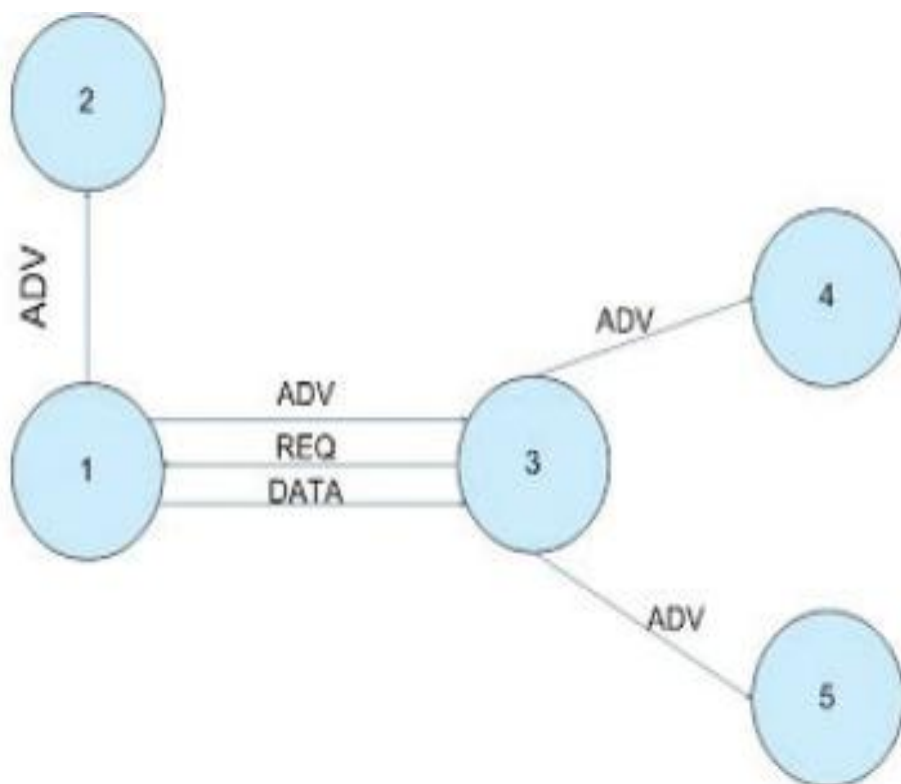


Fig.: 3 SPIN Routing Protocol

VI. Comparison of routing protocols of WSNs

Performance investigation of routing protocols

Network simulator is used to assess completely WSN-based AODV, DSR, and OLSR routing

protocols. These protocols are consistent with particularly WLAN-primarily based WSNs and former studies have shown that they have better standard efficiency. The efficiency of these protocols may be assessed in opposition to delay, throughput,

and network load in tiny, medium, and massive networks. Small-scale network holds different number of nodes on a large-scale network.

The precise comparison of the different routing protocols in respect of the power usage, scalability, Query base, Over head, Data delivery & QoS is provided in the following table.

Routing Protocol	Classification	Power Usage	Data Aggregation	Scalability	Query Based	Overhead	Data delivery model	QoS
LEACH	Hierarchical/Dst-initiated/Node-centric	High	Yes	Good	No	High	Cluster-head	No
SPIN	Flat/Src-initiated/Data-centric	L.td.	Yes	L.td.	Yes	Low	Event-driven	No
DD	Flat/Data-centric/Dst-initiated	L.td.	Yes	L.td.	Yes	Low	Demand-driven	No
RR	Flat	Low	Yes	Good	Yes	Low	Demand-driven	No
PEGASIS	Hierarchical	Max	No	Good	No	Low	Chains-based	No
SPAN	Hierarchical/Location	L.td.	Yes	L.td.	No	High	Continuously	No
SPEED	Location/Data-centric	Low	No	L.td.	Yes	Less	Geographic	Yes
GEAR	Location	L.td.	No	L.td.	No	Mod	Demand-driven	No

Fig.: 4 Comparison of different Routing Protocol

In the network there are three metrics [14]:

1. End to End delay: E2E delay is defined by using an envelope to communicate through a network from source to destination. It includes delays in re-transmission on media access layer (MAC), time-transfer of packet and delay of broadcast plus other delays in course discovery and conservation.

2. Throughput: The number of documents transmitted in a specified specific amount of moment from the source to a destination network node. It's far dignified in byte in line with the second.

3. Network Load: Network load (NL) suggests an internet - load, which indicates, in bits steady with the second. The workload is from time to time, moreover, called network Congestion. While traffic load exceeds the connection ability, it is nearly impossible for the network to deal with traffic because of increasing congestion in the network.

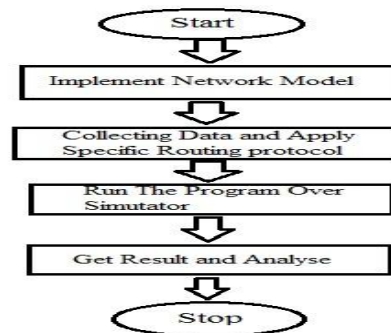


Fig.: 5 Network Simulator Modelling

In simulations, with one restore station, WLAN server, their sensor networks are regarded, first off in a tiny scale network, 20 nodes are determined on. The nodes are interconnected in a star topology. Working of network is 1000 x 1000 mtr (meter). The IPv4 system is executed with nodes and FTP is used as a heavy traffic load. In addition, a medium scale community is with 40 nodes and large-scale network is consisted of eighty nodes.

VII. Conclusion

Routing protocols play a very large component to provide much less disruption and exchange the different supply and vacation place nodes in a green

verbal way. In peak instances, a network's general efficiency, carrier, and reliability depend on choosing a true routing protocol. Sphere-free protocols used in wireless sensor networks and ad hoc networks.

References

1. Di, Ma, and Er Meng Joo. "A survey of machine learning in wireless sensor networks from networking and application perspectives." 2007 6th international conference on information, communications & signal processing. IEEE, 2007.
2. Akyildiz, Ian F., et al. "A survey on sensor networks." *IEEE Communications magazine* 40.8 (2002): 102-114.
3. Chan, Haowen, and Adrian Perrig. "ACE: An emergent algorithm for highly uniform cluster formation." *European workshop on wireless sensor networks*. Springer, Berlin, Heidelberg, 2004.
4. Shabbir, Noman, and Syed Rizwan Hassan. "Routing Protocols for Wireless Sensor Networks (WSNs)." *Wireless Sensor Networks-Insights and Innovations*. IntechOpen, 2017.
5. Singh, Mandeep. "Extended stable election protocol with advance probability method in wireless sensor networks." (2014).
6. Zheng, Jun, and Abbas Jamalipour. *Wireless sensor networks: a networking perspective*. John Wiley & Sons, 2009.
7. Prakash, Ved, Suman Pandey, and Ashish Kumar Singh. "Basic Introduction of Wireless Sensor Network." Available at SSRN 3351024 (2019).
8. Yin, G., et al. "An energy-efficient routing algorithm for wireless." *International Conference on Internet Computing in Science and Engineering (ICICSE'08)*, IEEE, China. 2008.
9. Zang, Zhe, Jian-Dong Qi, and Yong-Jie Cao. "A robust routing protocol in wireless sensor network." (2010): 276-279.
10. Ehsan, Samina, and Bechir Hamdaoui. "A survey on energy-efficient routing techniques with QoS assurances for wireless multimedia sensor networks." *IEEE Communications Surveys & Tutorials* 14.2 (2011): 265-278.
11. Bakr, Bilal Abu, and Leszek Lilien. "LEACH-SM: A protocol for extending wireless sensor network lifetime by management of spare nodes." 2011 *International Symposium of Modeling and Optimization of Mobile, Ad Hoc, and Wireless Networks*. IEEE, 2011.
12. Shabbir, Noman, et al. "Routing protocols for small scale WLAN based Wireless Sensor Networks (WSNs)." 2015 9th *International Conference on Sensing Technology (ICST)*. IEEE, 2015.
13. Nawaz R. Performance analysis of WLAN based routing protocols [thesis]. Lahore: GCU; 2015. Available from: <http://library.gcu.edu.pk/theses.htm>.
14. Khan AA. A survey of routing protocol in wireless sensor networks [thesis]. Lahore: GCU; 2016. Available from: <http://library.gcu.edu.pk/theses.htm>.