Performance of GPSR with different Routing Protocols in Wireless Sensor Networks

M.V.N.R. Pavan Kumar, R. Hariharan

ABSTRACT--- Wireless sensor Networks (WSN) are supposed for watching associate environment by sensing it, then collecting information,processing it and eventually transmitting information to final destination. These sensor hubs have a few requirements in view of their confined vitality, stockpiling ability and figuring power. Data is directed from one hub to various utilizing diverse steering conventions. There is assortment of steering conventions for remote sensor systems, where the vitality controlled by a hub is prohibited and visit correspondence between hubs may make the hubs exhaust their vitality assets rapidly. Therefore, we need appropriate routing protocols. Routing protocols are responsible of discovering and maintaining the routes within the network. This paper presents a parametric review of GPSR with routing protocols projected for wireless sensor networks.

Keywords— Wireless Sensor Networks, Routing Protocols DSDV, OLSR, STAR, AODV, DSR, ZRP, GPSR.

I. INTRODUCTION

A Wireless Sensor Network (WSN) comprises of an enormous number of sensor hubs executed in an impromptu way. Every sensor hub detects marvels inside the surroundings during which it's executed, plays out a local procedure on the distinguished data, at that point transmits it to a sink Node. WSNs have been utilized in numerous application areas, for example, shrewd houses, smart farming, front line reconnaissance, coordinated patient observing, condition checking, substance/natural identification and other business applications. The fundamental undertaking of a Wireless Sensor Network is to detect and gathering data, preparing data and in the end transmitting data to conclusive goal[1]. Fig. 1 shows the internal architecture of WSN sensor nodes. Each Wireless Sensor node consists of Sensing Unit, Processing Unit, Communication unit and a Power Unit.

Wireless Sensor Network consists of a significant number of nodes executed in an particular area in which all nodes may not be connected directly. In that case, Multi-hop

Communication is used for transfer of information between the nodes. But in direct communication, Node resources exhaust quickly. Therefore, we need appropriate routing protocols. Routing protocols are responsible of discovering and maintaining the routes within the network.

A wireless sensor node is an exceptionally little electronic gadget furnished with a restricted power source. Every sensor hub has a constrained inclusion for which it can dependably and precisely report the recognized data. A few wellsprings of intensity utilization in sensors are:

- Sampling the detected Signal
- Conversion of physical signals to electrical signals
- Conditioning the signal
- Converting the signal from Analog-to-digital

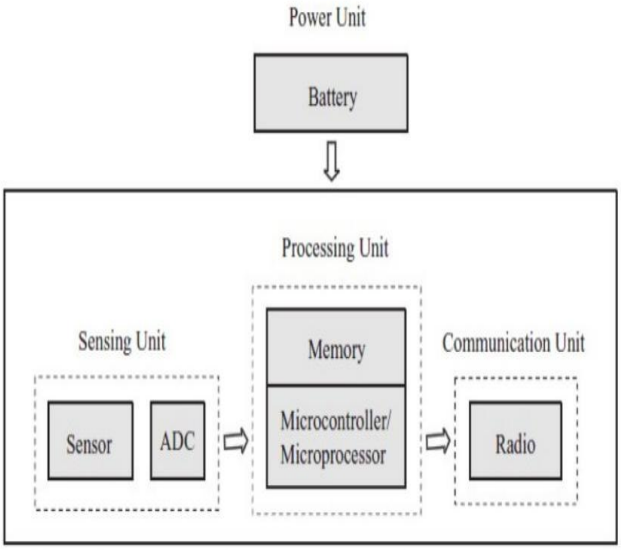

Fig. 1. Internal Architecture of WSN

II. CATEGORIES AND CHARACTERSTICS

WSN has its unique characteristics[1] from other kind of Ad-hoc networks such as MANET. There are three classifications of sensor nodes:

(I) Passive, Omni Directional Sensors:

Without controlling condition, passive sensor node detects the information by its dynamic examining. In this case, the energy is used only to amplify their analog signals. Therefore, there is no notion of "direction" in measuring the node's environment.

(ii) Passive, narrow-beam sensors:

These sensors are passive and they are particular about the direction when sensing the environment.

(ii) Active Sensors:

These sensors actively probe the nodes environment.

These unique characteristics of wireless sensor networks are discussed as follows:

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A. High dynamic topology:

Due to mobility of Nodes, the topology of WSN changes continuously.

B. Frequent disconnected network:

Due to high mobility of nodes, frequent link failures occur between nodes when they share information.

C. Enough battery power and storage capacity:

Intelligent nodes carry sufficient battery power and storage capacity. So, it has sufficient storage to perform all communication and computation tasks.

D. Mobility modelling and prediction:

To plan the system convention for WSN, the versatility model and expectation assumes an imperative part. In addition, node hubs are typically compelled by prebuilt thruways, streets and lanes, so given the speed and the road outline, final position of the node can be anticipated.

E. Communication environment:

There are two typical communication environments one is highway scenario and other is city scenario. In highway scenario, the traffic flows in unidirectional, simple and straight forward. In city, the streets are usually separated by building, trees and other barriers.

F. Hard delay constraints:

The information passing to the neighbor nodes on time, there is no delay. The aim of this is that safety messages have given high priority and are communicated within time.

G. Localization:

The positions of the nodes within the network are detected by the Global Positioning System (GPS).

III. OVERVIEW OF ROUTING PROTOCOLS

Depending on the network topology, as shown in Fig.2 Routing Protocols are classified into Topology based routing and Position or location based routing. Based on the protocol operation these protocols can be classified into multipath-based, query-based, negotiation-based, QoS based, or coherent-based routing techniques. The routing protocols[2] are sub classified into the following seven classes: Location-based Protocols, Data-centric Protocols, Hierarchical Protocols, Mobility-based Protocols, Multipath-based Protocols, Heterogeneity-based Protocols and QoS-based protocols.

A. Topology based routing protocol

In the topology based routing protocol[3], it uses the data about the correspondence connect to settle on directing choices and worldwide data of system topology. This protocol uses node link information to forward the packets within the network, which determines the routes and preserve it in the table to do future processing. The category of topology routing protocols are as follows:

- Proactive or table driven convention
- Reactive or on request convention and
- Hybrid convention.

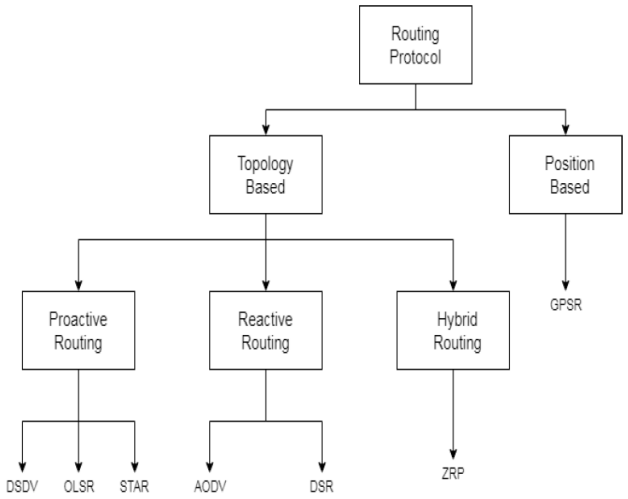

Fig.2 Classification of Routing Protocols in WSN

1) Proactive routing protocol or table driven:

This table driven protocol uses the shortest path algorithms such as Bellman ford's to calculate the shortest distance between two nodes. It updates the routing information and list of hops periodically and further distributes the routing information throughout the network. There are some proactive protocols named as Destination Sequenced Distance Vector (DSDV), Optimized Link State Routing (OLSR) and Source Tree Adaptive Routing (STAR).

a) Destination Sequenced Distance Vector (DSDV):

DSDV uses the Distributed Bellman Fords algorithm. In DSDV protocol, each node keeps routing table information of all the other nodes present in the network and counts the no. of hops to reach the target node is recorded. Every node will have a unique sequence number, which is assigned by the target node. Sequence number differentiates between new routes to the old routes. To maintain reliability of network, routing tables are updated periodically.

DSDV with different channels, it partitions the system layer into two planes, one is control planes and the other is information planes. Control planes are used to send routing updates packets and data planes are used to deliver the data packets.

b) Optimized Link State Protocol (OLSR):

OLSR protocol is the updated link state protocol of MANET. In link state protocol all the information of routes with the surrounding nodes are broadcasted throughout the network. OLSR minimizes the size of control information and acknowledges the subset of control packets to its neighbors packets which are in the multipoint relay selectors. This reduces the broadcasting of control information by selected nodes, called multipoint relays (MPR), to broadcast the message in the network. It performs intermediate routing within the nodes present in the network.

There are two types of control messages one is hello message and other is topology control message. Hello messages are sent to check the status of link information and their neighbors. Topology messages are sent for circulate the information with the next intermediate nodes.

c) Source Tree Adaptive Routing Protocols (STAR):

STAR is another proactive routing protocol. Every node portrays and stores the topology of system which fabricates the most limited way tree to the objective node. The primary point of this convention is to send data among nodes. This protocol uses two types mechanisms to determine the surrounding nodes:

• *Hello message:*

Hello message is used by all the nodes periodically to update about its presence and it doesn't contain any routing information. When the node receives a hello packet from previously unknown node, then it update neighbors list else if a node doesn't get any message from neighbor node from a certain amount of time then updates the information of link broken.

• *Neighbor protocol:*

In this protocol, no hello message is required to support and it is implemented at link layer. It declares about the new neighboring nodes and loss of connectivity to the existing neighboring nodes.

This protocol is effectively applicable to large scale networks to decrease the overhead and bandwidth consumption and not good enough for the high mobility networks.

2) Reactive routing protocol or on-demand:

In this reactive routing protocol, it opens the communication only when a node needs to speak with the other node. so it lessens the system overhead message. Route discovery is done by flooding a query messages throughout the network and this phase is completed only when the connection is established. The examples of on-demand routing protocols are Ad-hoc On-demand Distance Vector (AODV), Dynamic State Routing (DSR).

a) Ad-hoc On-demand Distance Vector (AODV): In this AODV routing protocol is started with source node. It is an enhanced protocol over DSDV and DSR. It lowers the broadcast as it doesn't store routes from every node and contains those routes that are currently in use. It mainly projects on link breakages and changes in network topology.

There are four types of message formats Depending on the network topology, we find flat-based routing, hierarchical based routing and location-based routing. Based on the protocol operation these protocols can be classified into multipath-based, query-based, negotiation-based, QoS based, or coherent-based routing techniques. The routing protocols are sub classified into the following seven classes: Location-based Protocols, Data-centric Protocols, in AODV:

• *Route Requests (RREQs):*

RREQ request is sent to the destination node via intermediate nodes to inform about readiness of source for transmission.

• *Route Replies (RREPs)*:

After receiving RREQs message, the target node will transmit RREPs packet back to the origin node.

• *Route Errors (RERRs):*

If there is any link failure in active route is detected, this RERR message is overflowed in the system to educate about the connection inability to all the dynamic nodes present in the system.

• *Route Reply Acknowledgement (RREP-ACK):*

RREP-ACK message is sent back to the sender to recognize the receipt of RREP message.

AODV includes:

• *Path Discovery:*

This process will be started when the source node needs to connect with the newly found node. Each node is having unique sequence number and broadcast identifier. Source node starts discovering process by transmitting RREQ message to the next intermediate node. The RREQ message is having the following entries such as source address, source sequence number, destination address, destination sequence number, broadcast id and hop count. Broadcast id will be incremented with new RREQ issued by the source node. If the node gets multiple replicas of RREQ from next immediate nodes, it will simply drop redundant RREQ and doesn't re-broadcast it.

• *Route table management:*

Route table is maintained at that time as it is used by any of its active neighbor node. The routing entries consists of following entries: Route request expiration timer is the timer which removes the entries of reverse path routing from the inactive nodes. It depends on the network size. Route caching timeout is the time taken after which the routes are declared as inactive or dead. Active timeout period in the route table is the entry which is entertained to inform all the nodes from source to destination about the failure of the link.

• *Path maintenance:*

Path maintenance is done among the nodes is due to high mobility of nodes. When the source changes its location from previous place then the route discovery procedure will be re-initialized and finds the new path. If any of the destination node changes its position, a special RREQ is sent back to source node. Hello messages are sent periodically to ensure the connectivity of link as well as link failures.

• *Local connectivity management:*

The updation of nearby network data is done when a node communicates the message to its neighbors. It guarantees that the neighbor node is considered as dynamic

b) Dynamic Source Routing (DSR):

DSR protocol receives a comparative on-request approach like AODV protocol in regards to the course disclosure and upkeep routing tables. DSR utilises the source steering,

where the source hub indicates the entire grouping to achieve its goal. The source-course data is intimated by the header of the information bundle. The favorable position of source directing is done at existing system and it is expected to distinguish steering circles. The obvious inconvenience is that information bundles must convey source courses.

DSR uses exceptionally forceful utilization of the source directing data. The accompanying improvement principles to DSR have additionally been proposed as follows:

• *Rescuing:*

In the event that a center node finds that the accompanying skip in the source course is difficult to reach, at that point it can supplant the source course in the information packages with a course from its very own store.

• *Unwarranted Route Repair:*

A source node is instructed to be screw up concerning the packs as it starts incites the bungle cautioning to its neighbors by piggy-sponsorship it on its next errand. This helps clean up the stores of various nodes in the framework.

• *Unbridled Listening:*

At the point when a node gets a group that is directed to another node, it incorporates the source data into its own specific data. The node in like manner checks if the information bundle could be guided by methods for itself to get a shorter course.

3) Hybrid routing:

Half and half routing consolidates the highlights of Proactive directing method and additionally receptive directing method. It will take out the control overhead message of proactive directing and limits the postponement of introductory route revelation of responsive routing method. Half and half directing is utilized to accomplish the elite in thickly populated systems (substantial number of hubs). The examples of hybrid routing protocol are Zone Routing Protocol (ZRP) and Zone-based Hierarchical Link State (ZHLS).

a) Zone Routing Protocol (ZRP):

ZRP into a Hybrid method, taking the advantages of proactive exposure inside a center point adjacent neighborhood node, and using a responsive Protocol for communicating between these zones. The inportant crossover directing methods are zone based; it implies the number of nodes is partitioned into various zones to make route disclosure and support more dependable nodes. Proactive routing techniques are utilized as a part of this methods among neighboring nodes working locally; in any case, responsive routing is utilized all around to search for the required nodes by questioning the required system nodes as opposed to broadcasting the question to every one of the nodes in arrange. Adaptable route disclosure and route support utilizes "Intrazone" and "Interzone" routing. Interzone directing method accomplishes worldwide course revelation through receptive directing convention however intrazone controlling method is seen as proactive coordinating remembering the ultimate objective to keep up the course data locally within its own neighbors nodes. The general typical for ZRP is that it lowers the framework overhead.

B. Position based routing protocol

As the topology of WSN changes as a rule with no prior notice, so directing in such systems is basic assignment. Position based routing[4] uses the position data to find the precise data of source and goal nodes and neighbor nodes. The correct area of node is controlled by utilizing GPS (Global Positioning System) or some other area administrations. Routing is done in bounce to jump mold to send the data table. The position data of every node is found by area administrations and sending procedures which are utilized to forward the parcel to whole system. The example of position based routing protocol is Greedy Perimeter Stateless Routing Protocol (GPSR) and others are considered for study of parameter comparison.

A. Greedy Perimeter Stateless Routing Protocol (GPSR):

Geographic routing is also called georouting or position-based routing. GPSR is a routing protocol that relies on geographic position information of the node. GPSR[5] calculations exploit the area data to make directing system increasingly flawless. It is for the most part proposed for Wireless Sensor Networks and Here in GPSR Protocol, source makes an impression on the geographic area of the goal node as opposed to utilizing the system address. In this GPSR directing Protocol each node gets its position data through GPS and furthermore keeps up the learning of its one jump neighboring nodes data by trading HELLO messages. Nodes decide the position of the goal node through area administrations plans proposed for geographic steering. Every node in GPSR has a local node table of its own. At whatever point a message is sent, the GPSR attempts to discover a node that is nearer to the goal node than from itself and advances the message to that node. This system is called greedy forwarding. The area of nodes is acquired through HELLO messages sent to the neighboring node. At the point when a node gets a HELLO message from its neighboring node, it will set the HELLO clock for every one of its neighboring nodes for the following receipt of the HELLO message. In the event that it neglects to get HELLO message from a neighboring nodes before the HELLO clock lapses, it expect that the neighboring nodes isn't in its range. A model for greedy next hop decision is given in Fig.3. Here, x gets a bundle bound for D. x's radio range is signified by the spotted hover about x,and the circular segment with sweep equivalent to the separation among y and D is appeared as the ran bend about D. x advances the packet to y, as the separation among y and D is not as much as that among D and any of x's other neighboring nodes. This insatiable sending procedure rehashes, until the packet arrives at Destination Node D.

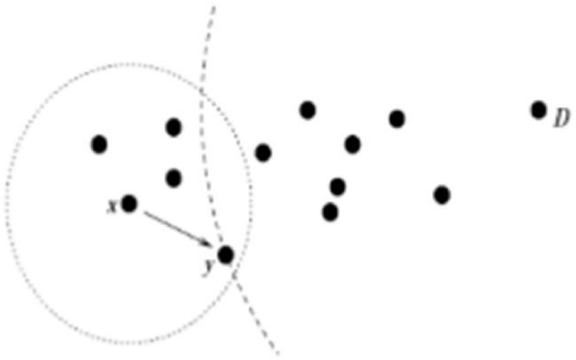

Fig.3 Greedy routing and perimeter forwarding

IV. RESULTS

Comparison of GPSR with different routing protocols in wireless sensor networks is shown in the Table 1. After parameter comparison of GPSR protocol along with other routing protocols in WSN, GPSR protocol is a location based routing protocol which can support multipath communication with limited node mobility and power management system. While other routing protocols are good at other parameters but they are not supporting multipath communication in WSN.

Parameters	Type of Protocol	Availability of Routing Information	Distribution of Topology	Selection of path	Updates on Periodic Route	Route Maintenance	Route Matrix	QoS Support	Advantages	Limitations
AODV	Topology based Reactive Routing Protocol	When Required	On Demand	Source	Not Needed	Routing Table	Shortest	NO	* Used in Large area Networks * Reduce Route Redundancy	*More Bandwidth Required
DSR	Topology based Reactive Routing Protocol	When Required	On Demand	Source	Not Needed	Node Cache	Shortest	NO	*No need to Update Periodically *No need to discover New Routes	*More Packet Loss *Not Suitable for high Mobility
DSDV	Topology Based Proactive Routing Protocol	Always required	Periodical	Hop Count	Needed	Routing Table	Shortest	NO	*Requires no route discovery *Provides Loop free routing	*Generate lot of Control Messages
OLSR	Topology Based Proactive Routing Protocol	Always required	Periodical	Based on residual energy of nodes	Needed	Routing Table	Shortest	YES	*Reduces number of packet retransmissions in broadcast scenario	*More Bandwidth Required *Requires CPU Power for computing Optimal Path
STAR	Topology Based Proactive Routing Protocol	Always required	Periodical	Using Source Tree	Needed	Routing Table	Shortest	YES	*Suitable for Large area Network *Reduces Overhead Messages	*More Storage space and processing is required to maintain the tree
ZRP	Hybrid Based Routing Protocol	When Required	Periodical and On Demand	Based on routing individual node's Minimum battery cost	Not Needed	Based on Local Connectivity	Shortest	YES	*Combines On-Demand and Table driven to make efficient routing	*Zone size is the major Problem
GPSR	Position Based Routing Protocol	Always required	On Demand	Hop Count	Needed	Perimeter lists	Shortest	YES	*Uses Greedy Technique to forward packets	*Does not perform, If GPS Fails.

Table 1. Comparison among different routing protocols in WSN

V. CONCLUSION

Routing in wireless sensor networks is significant area of research. Since Wireless Sensor Networks are intended for explicit applications, it is essential to characterize routing methods into proactive, reactive and hybrid based on their method of working and kind of objective applications. Likewise, these routing protocols are separated as direct communication, flat communications and clustering protocols, as indicated by the style of nodes participation. Contingent upon the system structure, the routing protocols are arranged as hierarchical, data centric and location based. In this paper, a parametric similar investigation of GPSR alongside different Routing protocols in WSN is exhibited utilizing various parameters for these calculations are considered. Since the wireless sensor networks are applications explicit and wide, we can't state GPSR convention is better. In Future points of view of this work we can center towards adjusting one of the above location based routing protocols, with the end goal that the altered convention could be more energy proficient for the whole Wireless Sensor Networks.

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