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A review on Routing Techniques in Wireless Sensor Networks

Avni Kaushik

M.Tech Student, Computer Science & Engineering, NGFIET, India

Abstract: Wireless sensors network (WSN) consist of homogenous, self organized nodes known as sensor nodes. The sensor nodes have the capability to sense an event and to process the data.In this paper,we give an overview on routing techniques in WSN.The focus has been given on their classification.The routing protocols are broadly classified into two categories as route selection based routing protocols and network architecture based routing protocols.The two sub categories are further classified, that is presented in this paper.As we know each protocol has some advantages as well as some disadvantages so we compare them in this paper by using recent research.

Keywords: Wireless sensor network, Routing protocol, DSDV, OLSR, DSR, AODV

I. INTRODUCTION

A WSN is a network of devices that is known as nodes. The nodes sense the environment and then share the collected information with other nodes via wireless link. The sensor nodes first sense and then process the data. If the destination node is not a neighbour node then the data have to be passed through multiple hops to a sink node that is also known as controller. The sink node act as a bridge between user and the Internet. A user can collect information by asking the queries and collecting the response from sink node. The nodes that is used to send the data may be fixed or mobile. If a user want to send the data then he expect that all the data should be sent successfully with no delay and with minimum number of hops. It can be achieved by using proper routing protocols for a particular environment. Because the performance of different routing protocols may vary in varying environments. The selection of a routing protocol can be done on the basis of its maximum throughput, minimum delay, mimimum network load and minimum number of hops etc. The components of Wireless Sensor Network are sensor field, sensor nodes, sink and task manager. The components of Wireless Sensor node are sensing unit, power unit, memory unit and processing unit.

II. APPLICATIONS OF WSNs

- Sensor nodes are used for warehouses products tagging so that users can track the exact location of the products.
- The wireless sensors are used to monitor the state of the physical plant and control device.
- Wireless sensor nodes are used to measure the pulse and respiratory rate of gym members.
- The human habits and behaviour can be studied by collecting the physiological data by sensor nodes.
- Sensor nodes can monitor the temperature of soil and moisture for a given area.
- Sensor nodes can detect seismic activities such as earthquakes, volcanic eruptions or tsunami.
- It is used for security and military purposes.

III. ROUTING PROTOCOLS IN WSNs

Routing protocols are classified as route selection based routing protocols and network architecture based routing protocols.

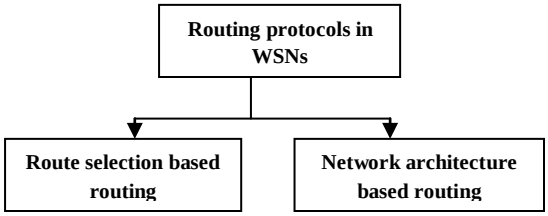

Fig.1 Classification of routing protocols

A. Route Selection Base Classification of Routing Protocols

The route selection based protocols can be further classified on the basis of the way of finding routes by the source node to the destination as Proactive routing protocols and Reactive routing protocols.

1) Proactive routing protocols

In Proactive routing protocols, a table of connected nodes is maintained at each node.

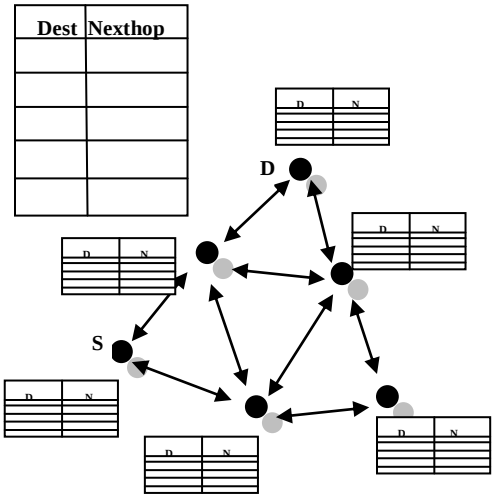

Fig2. Proactive routing protocols routing scheme

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The examples of proactive routing protocols are Destination Sequence Distance Vector Routing (DSDV) and Optimized link state routing (OLSR).

- **DSDV:** In this routing, each node maintains a table.It is based on the Bellman-Ford algorithm. Its objective is to avoid loop formation. In case of topology change each node give its routing status . The latest sequence number are always preferred for forwarding the messages. In the messages with same sequence number going to the same destination, the one with lower distance is preferred.

- **OLSR:** In this protocol, Routes become available immediately.It reduces the size of control packets and reduces the flooding of packets by using multipoint relays(MPR). A HELLO message is broadcasted to all of the neighbors. After receiving HELLO message, each node maintain its MPR selector table.

2) Reactive routing protocols

Reactive routing protocols reduce burden on network because nodes maintain route only when it is needed.

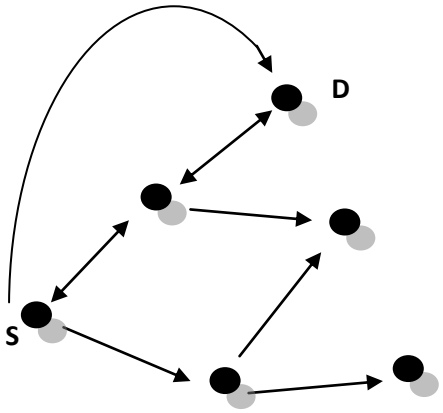

Figure 3: Reactive routing protocols routing scheme

The examples of Reactive routing protocol are AODV and DSR.

- **AODV:** To send data, the node forward Route Request (RREQ) message, on receiving the message by destination, Route Reply message is sent back to the source. It uses three mechanisms: route discovery phase to establish a route, route table management phase to avoid loop and route maintenance phase to inform about invalid route.

- **DSR:** In Dynamic Source Routing, source has the complete knowledge of entire route before sending data. It use two mechanisms: Route discovery mechanism to find route when it is not found in route cache and Route maintenance mechanism to aware source about link failure.

B. Network architecture based routing protocols

These Protocols are further divided into three subcategories according to their functionalities. The protocols are: Flat based, Hierarchical based and Location based routing.

A. Flat-based routing

It is used when amount of sensor nodes is very large where role of each node is same.It uses a data-centric routing approach in which Base station sends query to a group of nodes in a region then wait for response. Examples of Flat-based routing protocols are:

- Energy Aware Routing (EAR)
- Directed Diffusion (DD)
- Sequential Assignment Routing (SAR)
- Minimum Cost Forwarding Algorithm (MCFA)
- Sensor Protocols for the Information via Negotiation (SPIN)
- Active Query forwarding In sensor network (ACQUIRE)

B. Hierarchical-based routing

It is also known as cluster based routing.It randomly selects the high energy nodes for processing and sending the data while the low energy nodes for sensing and sending the information to the cluster heads.It generate energy efficient clusters for sensor nodes. Examples of hierarchical-based routing protocol are:

- Hierarchical Power-Active Routing (HPAR)
- The Threshold sensitive energy efficient sensor network protocol (TEEN)
- Power efficient gathering in the sensor information systems (PEGASIS)
- Minimum energy communication network (MECN)

C. Location-based routing

It uses the information about location for routing. The nodes collect the signal strength and use it to estimate the distance between the sensor nodes.It reduce energy consumption and optimize the network. Location-based routing networks are:

- Sequential assignment routing (SAR)
- Ad-hoc positioning system (APS)
- Geographic adaptive fidelity (GAP)
- Greedy other adaptive face routing (GOAFR)
- Geographic and energy aware routing (GEAR)
- Geographic distance routing (GEDIR)

IV. COMPARISON OF ROUTING PROTOCOLS

On the basis of recent research we have compared different routing protocols with respect to several metrics, it is shown in table 1 and table 2 .

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TABLE I
COMPARISON OF ARCHITECTURE ROUTING PROTOCOLS

Routing protocols	**Classification**	**Power usage**	**Data Aggregation**	**Scalability**	**Query based**	**Over head**
GEAR	location	limited	NO	limited	NO	Mod
DD	Flat/Data centric	limited	Yes	limited	Yes	Low
LEACH	Hierarchical/node centric	High	Yes	Good	No	High
SPIN	Flat/Data centric	limited	Yes	limited	Yes	Low
GAF	Hierarchical/location	limited	No	Good	No	Mod
PEGASIS	Hierarchical	High	No	Good	No	Low
TEEN & APTEEN	Hierarchical	High	Yes	Good	No	High

TABLE 2
COMPARISON OF ROUTE SELECTION BASED ROUTING PROTOCOLS

Metrics	**DSDV**	**AODV**	**DSR**
Muticasting	No	Yes	Yes
Routing metric	Shortest path	Freshest & Shortest path	Shortest path
Mobility	Does not Perform well in High mobility	Perform well in High mobility	Does not Perform well in High mobility
Loop free	Yes	Yes	Yes
Communication	Unidirectional	Bidirectional	Bidirectional
Resource consumption	Maximum	Lesser than DSR	Greater tha AODV
Suitable in WSN	No	Yes	No
Delay	Least	Lesser than DSR	Greater than AODV
Network size	Not Suitable in large network	Suitable for Large network	Suitable for Network of less than 200 nodes
Repair of Broken links	Handled in Least time	Time consuming	Consumes less time
Routing overload	Least	Greater than DSR	Lesser than AODV

V. CONCLUSION

In this paper, we have given an overview on different routing protocols, their classification and their comparison .Although a lot of research have been done on routing but still there are a number of things that need to be explored such as Fault tolerance in routing, to adapt to topology changes quickly, to maximize the network lifetime and secure routing etc.

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