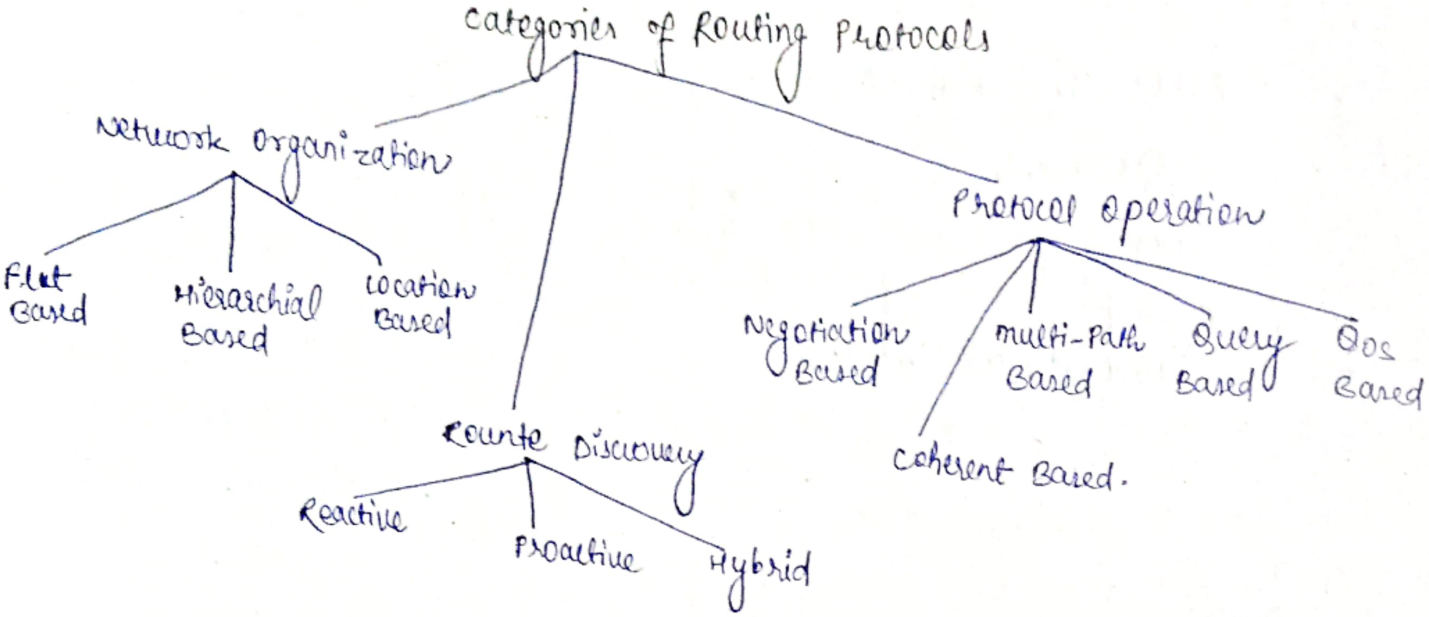
Unit-4

Routing protocols can help computer networks communicate effectively and efficiently. Regardless of network size, these protocols can help securely transfer data to its destination.



Proactive Protocols

These protocols are also called as table driven routing protocols since they maintain the routing information even before requiring of this information. Each and every node maintain routing information to every other node in the network. Routes information is generally kept in the routing protocols tables and is periodically updated as the network topology changes. The protocol under this category maintain different number of tables. Furthermore, they are not suitable for large networks, as they need to maintain entries of each node in the routing table. Some of the existing proactive routing protocols are DSDV, WRP and OLSR.

Reactive Routing protocols

These protocols are also called as On-demand routing protocols as in these kind of routing protocols node searches for route on-demand i.e whenever a node wants to send data it searches route for destination node and establishes the connection.

Hybrid Routing Protocols

The combination of both reactive and proactive is called hybrid routing protocols. It consists of proactive and reactive routing protocols for data communication over the n/w.

Difference b/w proactive & Reactive routing protocols

Parameter	Proactive	Reactive
1 Delay level	Small as routes are predetermined	High as routes are computed on demand.
2 Control Traffic	Usually higher than reactive	Increases with the mobility of active routes.
3 Periodic updates	Always required	Not required.
4 Route availability	Always available	computed on-demand
5 Scalability	Nearly upto 150 nodes	Higher than proactive
6 storage requirement	Higher than reactive	Depends on the number of required routes.
7 Bandwidth requirement	High	Low
8 Power requirement	High	Low.
9 Route structure	Flat / Hierarchial	Flat, except CBRP.

QoS Protocols

Clustering routing protocols for WSN have evolved. Indeed, the protocols combine several sensor or nodes and the resultant clusters translate into hierarchial management systems having integrated the features of different cluster members to the base stations and cluster heads. This study seeks to extend the literature and ensure efficient actions by proposing QoS based energy-efficient protocols for WSNs, which provide QoS via energy consumption and end-to-end delay.

The motivation of the study is to delop a protcols architeture that could extend network lifetimes, balance and reduce the energy consumption of networks, reduce redundency and increase information validity and itegrity.

→ The main function of Quality of services (QoS) routing in WSNs is to establish routes b/w different sensor nodes that ability to maintain QoS requirements such as bandwidth, end-to-end delay and to be able operate within the limited energy constraints.

Flat Routing Protocols

In flat routing Protocols node wants to send the data to the sink through several intermediate node or multi-hop. Flat routing protocol distributes routing information to routes that are connected to each other without any organisation or segmentation structure between them.

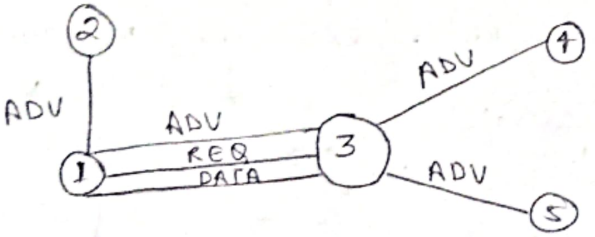
- Flat routing protocols are primarily those that don't work under a predefined network layout and perimeter. They enable the delivery of packets among routers through any available path without considering network hierarchy, distribution and composition.
- Flat routing protocol is implemented in flat networks where each router node routinely collects and distributes routing information with its neighbouring routers.

SPIN

- SPIN stands for sensor protocol for Information via Negotiation. There is family of protocols called as SPINs. These protocols are designed to address the deficiency of flooding and gossiping. So, we are implementing SPIN protocol in WSN to preserve the energy of the sensor nodes and increase the lifetime of the n/w.

→ SPIN node uses three types of messages for communication—

1. ADV – It is used to advertise new data.
2. REQ – REQ is used to recieve the actual data.
3. DATA – DATA is the actual message itself.



→ Node 1 sends ADV message to all its neighbors, 2 and 3. Node 3 requests for the data using REQ message, for which node 1 send data using message DATA to node 3.

After recieving the data Node 3 sends ADV message to its neighbors 4 and 5 and the process continues. It does not send to 1 because 3 knows that it recieved data from 1.

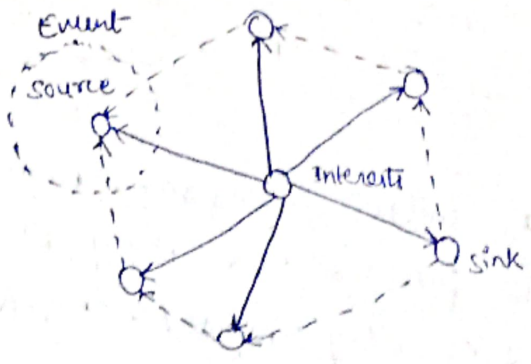
→ The data is described in the ADV packet using high level data descriptions, which are good enough to identify the data. These high level data descriptors are called meta-data. The use of meta-data prevents the actual data beng flooded through out the network.

Directed Diffusion

- Directed diffusion is a routing protocol, which enables communication b/w sink and source nodes in a WSN. This routing protocol is based on a data-centric approach, where intermidiate nodes are aggregate the data and send it to a sink node.

- The infrastructure of a network consists of three parts —
  a) a source, which ~~sense and track events in the area~~ initiate data transmission.
  b) intermidiate nodes, which sense and track events in the area.
  c) a sink, where data is transmitted as the final destination.

- Directed diffusion is a data-centric routing protocol where all the routes are selected based on application level data. Moreover, network nodes exchange messages and generate attribute-value pairs.



- when the matching event record is found, the source computes the highest outgoing event rate among all its gradients for that interests. The source node then tasks its sensor subsystem to generate event samples the event record to all its neighbors for which it has a gradient for this event. It continues to do so to each neighbor at the appropiate frequency, until the interests from that neighbor expires.

Hierarchial Routing protocols

In hierarchial routing, cluster made of group of nodes is used to send data out of cluster only cluster head sends data to other cluster heads. It reduces the energy consumption of the network. Hierarchial is also known as clustering routing protocols. It is more energy saving protocols of sensor node in WSNs.

LEACH

- Low-energy adaptive clustering hierarchy (LEACH) is a TDMA based MAC protocol which is integrated with clustering and a simple routing protocol in WSNs.
- The goal of LEACH is to lower the energy consumption required to create and maintain clusters in order to improve the lifetime of a wireless sensor network.
- LEACH is a hierarchial protocol in which most nodes transmit to cluster heads, and the cluster heads aggregate and compress the data and forward it to the base station

- Nodes that have been cluster heads cannot become cluster heads again for P rounds, where P is the desired percentage of cluster heads. Thereafter, each node has a 1/P probability of becoming a cluster head again.

- LEACH also uses CDMA so that each cluster uses a different set of CDMA codes, to minimize interference between clusters.

Properties of this protocol include —

- Cluster based
- Random cluster head selection each round with rotation
- Cluster membership adaptive
- Data aggregation at cluster head.
- Communication done with cluster head via TDMA.

Shortcoming of LEACH

- Random and variable size cluster formations.
- Random and uneven distribution of cluster heads.
- Single hop communication in situation where energy use is less efficient from cluster head to base station.

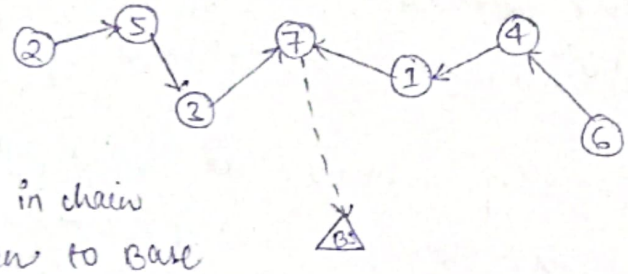
→ The cluster head selection is the core of LEACH protocol. Define a threshold (Tn) firstly and all nodes are given different random values in per round.

→ If the random value of the sensor node is no more than the Tn, the node acts as a CH in the current round.

PEGASIS

Power Efficient Gathering in Sensor Information System is one such Hierarchial routing protocol which follows a chain based approach and a greedy algorithm. The sensor nodes organize themselves to form a chain. If any node dies in between then the chain is reconstructed to bypass the dead node. A leader or a cluster head node is assigned and it takes care of transmitting data to the base station.

- The main goal of PEGASIS is to recieve and transmit data to and from the neighbour and take turns being the cluster head for transmission to the Sink Node.



⟶ communication in chain
- - - → communication to Base Station

- PEGASIS algorithm is implimented in Netsim by Interfacing with MATLAB for the purpose of mathematical calculation. The sensor coordinates are fed as input to MATLAB and PEGASIS algorithm that is implimented in MATLAB is used to dynamically form a chain b/w the nodes and to elect one of them as a head node.

- PEGASIS protocol has its major applications in environment monitoring. The nodes sense various environmental factors such as temperature, humidity, pressure etc. Each node fuses its sensed data with the adjacent node. The CH finally has all the sensed data, which is then sends to the BS. PEGASIS

protocol has its main application in characterizing and monitering the quality of environment.

- As it uses greedy algorithm for formation of data chain, it results in the inevitable long chain thus consuming more energy due to which nodes die early. EEPB protocol tries to overcome the drawbacks of PEGASIS by using distance threshold.

Location Based Routing protocol

- Location Based Routing protocols are used in Wireless Sensor Network (WSN) in which the information about the location of nodes is used for communication. It is also known as geographic routing protocol. These protocols reduce the energy consumption and increase the lifetime of the network.
- In location-based routing, a node that has a packet to send adds a destination location in each data packet. Intermediate nodes in the path receive this packet and send it to next one-hop neighbours which are graphically closest to the destination. The process is continued until the data packets are received by the destination node.
- Location Based routing conserves both energy and bandwidth since route request and state propagation are not required after one-hop destination.
- Location-Based Routing usually uses a greedy forwarding mechanism to forward a data packet from source to destination. Greedy approach forward packets to the neighbour, which is closed to the destination.

Geographic and Energy Aware Routing

- Geographic Routing · provides the mechanism to deliver the packet in a destination location based on the location information only. There is concept of regions to which data divided to number of sub-regions and the target packet is delivered to that region and then it is delivered to that specific node to which is targeted to.
- Properties of geographical routing—
  a) scalability
  b) statelessness
  c) Low maintence overhead.
- As we knew all nodes in WSN are constrained with the energy so there is a need to provide an energy aware metrics for the purpose of making communication effective at geographical point of view.
- It include some key points that must have taken under consideration to develop a geographic and energy aware routing protocol.
  a) minimize energy consumed per packet.
  b) maximize time to network partition.
  c) minimize variance to node power level.
  d) minimize cost per packet.
  e) minimize maximize node cost
- GEAR uses this energy aware metrics to compute the neighbor selection in order to balance the energy consumption among the nodes.