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Survey of Routing Protocols in MANET

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Abstract: ***MANET is set of different types of mobile node. MANET is mobile so they utilize wireless connection to attach with network. MANET can be deployed at low cost in variety of application. In MANET different types of routing protocols have been recommended. These protocols can be classified into three main categories reactive (on-demand), proactive (table-driven) and hybrid routing protocols namely AODV, OLSR and ZRP. This paper focus on the survey of reactive, proactive and hybrid routing protocols***

Keywords: MANET, REACTIVE, PROACTIVE, HYBRID.

INTRODUCTION

MANET Stands for "Mobile Ad Hoc Network." A MANET is a type of ad hoc network that can change locations and configure itself anywhere. Because MANETS are mobile, they use wireless connections to connect to various networks. This can be a standard Wi-Fi connection, or another medium, such as a cellular or satellite transmission.

Some MANETs are restricted to a local area of wireless devices (such as a group of laptop computers), while others may be connected to the Internet.

A Mobile Ad-hoc Network is a collection of independent mobile nodes that can communicate to each other via radio waves. The mobile nodes that are in radio range of each other can directly communicate, whereas others needs the aid of intermediate nodes to route their packets. Each of the node has a wireless interface to communicate with each other. These networks are fully distributed, and can work at any place without the help of

Any fixed infrastructure as access points or base stations. Figure 1 shows a simple ad-hoc network with 3 nodes. Node 1 and node 3 are not within range of each other, however the node 2 can be used to forward

Packets between node 1 and node 2. The node 2 will act as a router and these three nodes together form an ad-hoc network.

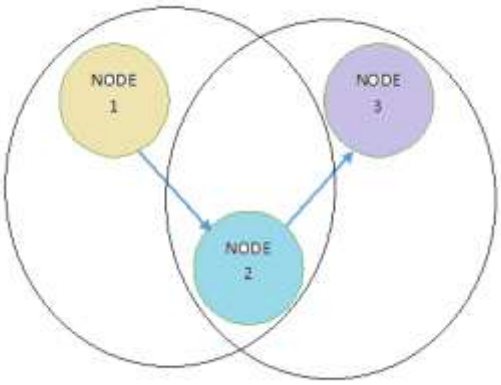


Figure 1

ROUTING PROTOCOLS

Definition of routing

In Mobile Ad-Hoc network routing protocols are commonly divided into three main classes; *Proactive*, *reactive* and *hybrid* protocols as shown in figure 2.

Figure 2

1) *Proactive Protocols*: Proactive, or table-driven routing protocols. In proactive routing, each node has to maintain one or more tables to store routing information, and any changes in network topology need to be reflected by propagating updates throughout the network in order to maintain a consistent network view. Example of such schemes are the conventional routing schemes: Destination sequenced distance vector (DSDV). They attempt to maintain consistent, up-to-date routing information of the whole network. It minimizes the delay in communication and allow nodes to quickly determine which nodes are present or reachable in the network.

2) *Reactive Protocols:* Reactive routing is also known as on-demand routing protocol since they do not maintain routing information or routing activity at the network nodes if there is no communication. If a node wants to send a packet to another node then this protocol searches for the route in an on-demand manner and establishes the connection in order to transmit and receive the packet. The route discovery occurs by flooding the route request packets throughout the network. Examples of reactive routing protocols are the Ad-hoc On-demand Distance Vector routing (AODV) and Dynamic Source Routing (DSR).

3) *Hybrid Protocols:* They introduces a hybrid model that combines reactive and proactive routing protocols. The Zone Routing Protocol (ZRP) is a hybrid routing protocol that divides the network into zones. ZRP provides a hierarchical architecture where each node has to maintain additional topological information requiring extra memory.

1. REACTIVE ROUTING PROTOCOLS

Reactive or on-demand routing protocols route is discover when needed. Reactive protocols tend to decrease the control traffic messages overhead at the cost of increased latency in discover a new routes. Source initiated route discovery in reactive routing protocols and less delay. In reactive protocols there is no need of distribution of information. It consumes bandwidth when transfer data source to destination. Reactive Protocols are AODV (ad-hoc on demand distance vector), DSR (distance vector routing) and ABR (Associatively Based Routing) protocols. MANET is also called Mesh network. It is high adaptable and rapidly deployable network. MANET has a dynamic *AODV*

1.1 AODV

AODV stand for **Ad-hoc On-Demand Distance Vector** Routing .AODV is meaning that it establishes a route to a destination only on demand. AODV is capable of both unicast, broadcast and multicast routing. AODV have some join feature of DSR and AODV.

AODV avoids the counting to-infinity problem of other distance-vector protocols by using sequence numbers on route updates. AODV reacts relatively quickly to the topological changes in the network and updating only the hosts that may be affected by the change, using the RREQ message. Hello messages, be dependable for the route maintenance, are also imperfect so that they do not create unnecessary overhead in the network. The RREQ and RREP messages are responsible for the route discovery.

Advantages

- The AODV protocol is basically flat routing protocol so it does not require any inner organizational method to handle the routing process.
- In AODV routes established on demand and that destination sequence numbers are applied for find the latest route to the destination.
- The connection setup delay is lower.
- The AODV protocols are a loop free and avoid the counting to infinity problem.
- At most one route per destination maintain at each Node.

Disadvantages

- It can lead to heavy control overhead.
- In AODV unnecessary bandwidth consumption.

1.2 DSR

This is an **On-demand source routing protocol**. In DSR the route paths are discovered after source sends a packet to a destination node in the ad-hoc network. The source node initially does not have a path to the destination when the first packet is sent. The DSR has two functions first is route discovery and the second is route maintenance.

Assumptions:

a) A, B, C, D and E form ad-hoc network.

b) C is the source node.

c) E is the destination node.

Figure 3. DSR algorithm routing process.

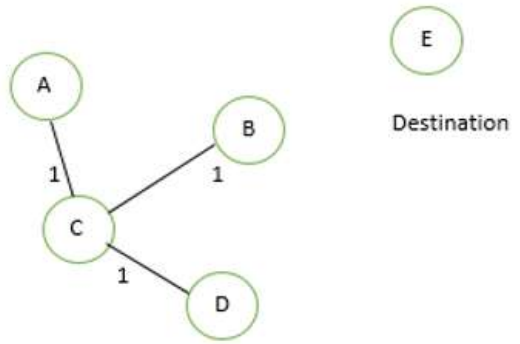
Figure 4. Showing re-broadcasting by nodes A, B, D.

Route discovery algorithm

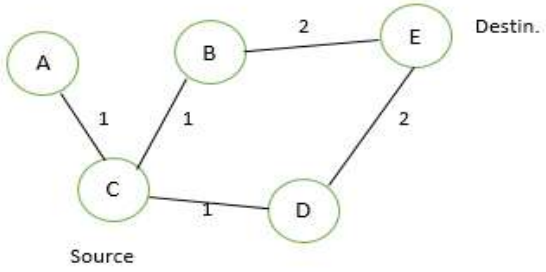
a) C broadcasts a Route Request Packet with the address of destination node E.

b) The intermediate nodes A, B, D receive the Route Request Packet from C, as shown in Figure 3.

c) The receiving nodes A, B, D each append their own address to the Route Request Packet and broadcast the packet further as shown in Figure 4.



d) The destination node E receives the Route



Request packet. The Route Request packet now contains information of all the addresses

of nodes on the path from the source node C to the destination node E.

e) On receiving the Route Request Packet the destination node E sends a reply called the Route Reply Packet to the source node C by traversing a path of addresses it has got from the Route Request packet.

f) DSR caches the route information for future use.

Route Maintenance algorithm

a) In DSR algorithm a link break is detected by a node along the path from node C to node E, in this case node B.

b) Then node B sends a message to source node C indicating a link break.

c) In this case, node C can use another path like C-D-E or it must initiate another route discovery packet to the same destination node, in this case 'E'.

Advantages

- This protocol uses a reactive approach which eliminates the need to periodically flood the network with table update messages which are required in a table driven approach.
- A route is established only when it is required and hence the need to find routes to all other nodes in the network as required by the table-driven approach is eliminated.
- The Intermediate nodes also utilize the route cache information efficiently to reduce the control overhead.

Disadvantages

- The route maintenance mechanism does not locally repair a broken link.
- Stale route cache information could also result in inconsistencies during the route reconstruction phase.
- The connection setup delay is higher than in table-driven protocols. Even though the protocol performs well in static and low-mobility environments, thus performance degrades rapidly with increasing mobility.
- Routing overhead is involved due to the source-routing mechanism employed in DSR. This routing overhead is directly proportional to the path length.

2. PROACTIVE OR TABLE DRIVEN

In Proactive routing protocols every node store information in the form of tables and when any type of change accrue in
Network topology need to update these tables according to update. The node swaps topology information so they have
Route information any time when required. There is no route discovery delay associated with finding a new route. In proactive routing fixed cost generate, as normally greater than that of a reactive protocols. Proactive protocols traditional distributed shortest-path protocols based on periodic updates high routing overhead. Proactive routing protocols are DSDV (destination sequenced demand vector), OLSR (optimized link state routing protocols)

2.1 OLSR

Optimized Link State routing protocol is a proactive link state routing protocol, which uses hello and topology control (TC) messages to discover and then disseminate link state information throughout the mobile ad-hoc network. Individual nodes utilize this topology information to work out next hop destinations for all nodes in the network using shortest hop forwarding paths.
Being a proactive protocol, routes to all destinations within the network are known and maintain before using it. Having the routes available within the standard routing table can be useful for some systems and network applications as there is no route discovery delay associated with finding a new route. The routing operating cost generates, although commonly greater than

that of a reactive protocol and does not increase with the number of routes being created. Being a link-state protocol, OLSR requires a reasonably large amount of bandwidth and CPU power to compute optimal paths inside the network.

MESSAGE

OLSR makes use of "Hello" messages to find its one hop neighbors and its two hop neighbors through their responses.
OLSR uses two kinds of the control messages: Hello and Topology Control (TC). The uniqueness of OLSR is that it minimizes the size of control messages and rebroadcasting by using the MRP (Multipoint Relaying). The basic concept of MPR is to reduce the loops of retransmissions of the packets. Only MPR nodes broadcast route packets. The nodes within the network maintain a list of MPR nodes. MPR nodes are selected within the environs of the source node. The selection of MPR is done by the neighbor nodes in the network, with the help of HELLO messages.TC messages are used for distribution information about personal advertised neighbors which includes at least the MPR Selector list. The TC messages be broadcast occasionally and only the MPR hosts can forward the TC messages.

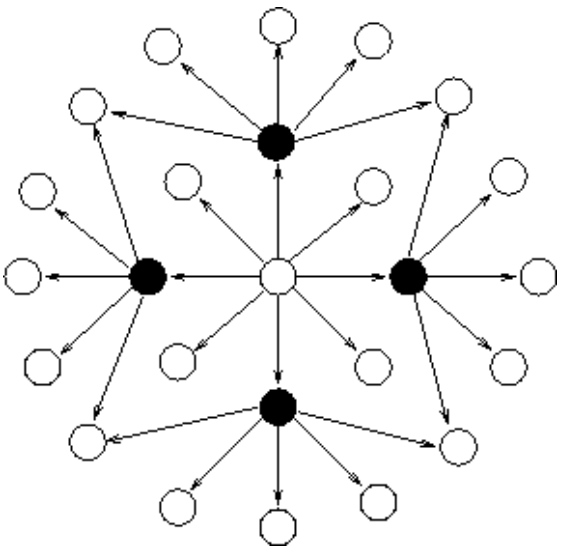


Figure 5: OLSR Multipoint Relay

Advantages

- OLSR is moreover a flat routing protocol. It does not need central administrative system to handle its routing process.

- OLSR provides all the routing Information to all participated hosts in the network.

- OLSR protocol does not need that the link is reliable for the control messages, since the messages are sent at regular intervals and the delivery does not have to be in order.

Disadvantages

- Each host periodic sends the updated topology information throughout the whole network, this raise the protocols bandwidth usage.

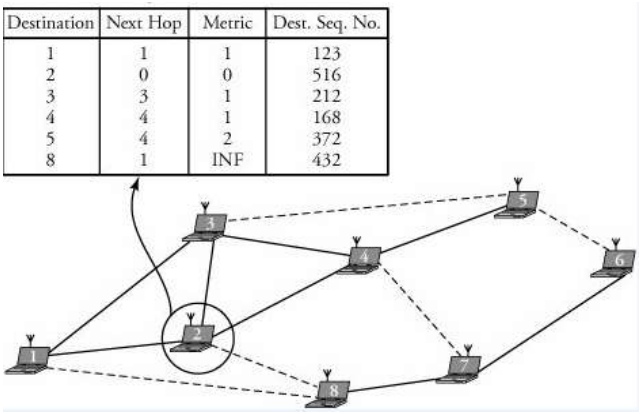
- Large amount of bandwidth and CPU power to compute optimal paths inside the network

2.2 Destination Sequenced Distance-Vector Routing Protocol

The **destination sequenced distance-vector** routing protocol (DSDV) is one of the first protocols proposed for ad hoc wireless networks. It is an enhanced version of the distributed Bellman-Ford algorithm where each node maintains a
Table that contains the shortest distance and the first node on the shortest path to every other node in the network. It incorporates table updates with increasing
Sequence number tags to prevent loops, to counter the count-to-infinity problem, and for faster convergence. As it is a table-driven routing protocol, routes to all destinations are readily available at every

Node at all times. The tables are exchanged between neighbors at regular intervals to keep an up-to-date view of the network topology. The tables are also forwarded if a node observes a significant change in local topology. The table updates are of two types: incremental updates and full dumps. An incremental update takes a single network data packet unit (NDPU), while a full

dump may take multiple NDPUs. Incremental updates are used when a node does not observe significant changes in the local topology. A full dump is done either when the local topology changes significantly or when an incremental update requires more than a single NDPU. Table updates are initiated by a destination with a new sequence number which is always greater than the previous one. Upon receiving an updated table, a node either updates its tables based on the received information or holds it for some time to select the best metric received from multiple versions of the same update table from different neighboring nodes. Based on the sequence number of the table update, it may forward or reject the table.



Destination	Next Hop	Metric	Dest. Seq. No.
1	1	1	123
2	0	0	516
3	3	1	212
4	4	1	168
5	4	2	372
8	1	INF	432

Figure 6. DSDV routing table

In the above Figure, shows a routing table for node 2 whose neighbors are 1, 3, 4 and 8. Here the dashed lines indicate no communications between any corresponding pair of nodes. Hence node 2 has no information about node 8. DSDV is suitable for small networks.

Advantages

- The availability of routes to all destinations at all times implies that much less delay is involved in the route setup process.

- The mechanism of incremental updates with sequence number tags makes the existing wired network protocols adaptable to ad hoc wireless networks. Hence, an existing wired network protocol can be applied to ad hoc wireless networks with many fewer modifications.

- The updates are propagated throughout the network in order to maintain an up-to-date view of the network topology at all the nodes.

Disadvantages

- The updates due to broken links lead to a heavy control overhead during high mobility.

- Even a small network with high mobility or a large network with low mobility can completely choke the available bandwidth. Hence, this protocol suffers from excessive control overhead.

- In order to obtain information about a particular destination node, a node has to wait for a table update message initiated by the same destination node. This delay could result in stale routing information at nodes.

3. Hybrid protocol

3.1 ZRP

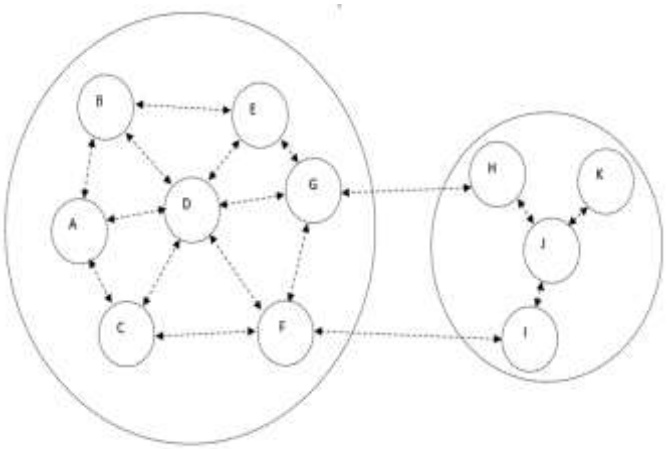


Figure 7.

A ZRP scenario showing the zones of node A and node J using a *r* value of 2. Within the zones a pro-active routing protocol is used while a re-active protocol is used between zones.

Hybrid protocols seek to combine the proactive and reactive approaches. An example of such a protocol is the *Zone Routing Protocol* (ZRP). ZRP divides the topology into zones and seek to utilize different routing protocols within and between the zones based on the weaknesses and strengths of these protocols. ZRP is totally modular, meaning that any routing protocol can be used within and between zones. The size of the zones is defined by a parameter *r* describing the radius in hops. Figure 7 illustrates a ZRP scenario with *r* set to 1. Intra-zone routing is done by a proactive protocol since these protocols keep an up to date view of the zone topology, which results in no initial delay when communicating with nodes within the zone. Inter-zone routing is done by a reactive protocol. This eliminates the need for nodes to keep a proactive fresh state of the entire network.

ZRP defines a technique called the *Bordercast Resolution Protocol* (BRP) to control traffic between zones. If a node has no route to a destination provided by the proactive inter-zone routing, BRP is used to spread the reactive route request. Figure 8 illustrates the different components of ZRP.

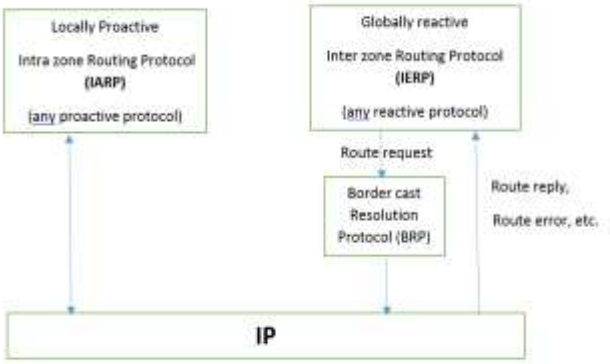


Figure 8: The different components of the Zone Routing Protocol.

3.2 TORA

Temporally Ordered Routing Algorithm (TORA). TORA is a highly adaptive loop-free distributed routing algorithm based on the concept of link reversal. TORA is proposed to operate in a highly dynamic mobile networking environment based on a "link reversal" algorithm. It discovers multiple routes to a destination, create routes quickly, and diminish communication overhead. Nodes have routing tables, so it helps the sending node to find the route to destination with the help of given tables. Routing tables also maintains the longer routes to avoid discovering newer routes. When a node finds that a route to a destination is no longer valid, it adjusts its height so that it is a local maximum with respect to its neighbors and transmits an UPDATE packet. If the node has no neighbors of finite height with respect to this destination, then the node discover a new route. When a node detects a network partition, it generates a CLEAR packet which resets routing tables and removes invalid routes which does not exist from the network. The protocol performs three basic functions of Route creation, Route maintenance, and Route erasure.

CONCLUSION

In the study of reactive, proactive and hybrid routing protocols, the main feature of AODV is less connection delay and loop free and DSR is similar to AODV However, it uses source routing instead of relying on the routing table at each intermediate device. In OLSR routes to every destination inside the network are known and maintain before use. There is no route discovery delay associated with finding a new route in OLSR and DSDV is a table-driven routing scheme, the main contribution of the algorithm was to solve the routing loop problem. ZRP provides framework to other routing protocols
And each component of ZRP works independently to give efficient result and in TORA when a link fails the control messages are only propagated around the point of failure.

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