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A Survey on Wireless Routing Protocols (AODV, DSR, DSDV)

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Abstract:

Due to rapid advance in communication technology, the current demand is for wireless network than wired network. Wireless communication technologies have brought in fundamental changes in telecommunication and computer networking. Wireless networks include MANETS (Mobile ad hoc networks) which is a collection of mobile nodes that communicate through wireless links and have no fixed topology or central administration. The task of sending packets between nodes called routing is done in MANET by some routing protocols. During last few years, a variety of different routing protocols that address multi-hop ad-hoc network have been developed. These protocols have been efficiently designed and their performances have been evaluated according to different performance parameters. Routing protocols vary according to network type. Some of the best known protocols are AODV, DSR and DSDV. While AODV and DSR are reactive i.e., they are on-demand; DSDV is proactive protocol i.e., they are table driven. This paper presents a survey on routing protocols namely AODV, DSR and DSDV to find the best suited for wireless networks.

Keywords: **MANET, AODV, DSR, DSDV**

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I. INTRODUCTION

Any communication network is either wired or wireless and many protocols have been designed for it. In wired networks, communication is done between the nodes through physical cables. TCP/IP protocol is best suited for the wired network. In wireless networks, wireless data connections are used for connecting nodes. There are two types of wireless network, which are infrastructure networks and ad-hoc networks .In an infrastructure network, base stations are connected through wires, also called cellular network. In an ad hoc network, also called infrastructure less networks, there is no base station, each mobile node acts as a router. The mobile nodes in an ad hoc network randomly move resulting in a dynamic topology [5].

MANET is a wireless mobile ad hoc network having no fixed routers wherein wireless nodes randomly move to form a network without any decided infrastructure or topology. Routing is task of forwarding packets from one node to another in a network. Routing in MANET is done for finding an optimized path between source and destination. MANET can be simulated using NS2 simulator. Many efficient routing protocols have been defined for MANETS for providing better performance. Routing protocols are classified into proactive and reactive protocols. In proactive protocols, the route is pre-decided in a routing table while sending packets from source to destination. Examples are DSDV (Destination Sequence Distance Vector) and OLSR (Optimised Link State Routing) protocol. In reactive protocols, routing is done on demand that is only when packets are to be sent and there is no pre-decided path in routing table. Examples are DSR (Distance Source Routing) and AODV (Ad hoc On Demand Distance Vector) protocol.

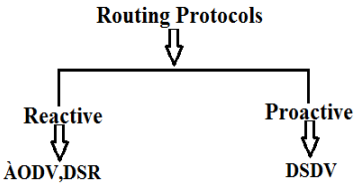


Fig. 1 Routing Protocols

The rest of the paper is organised as follows: Section II gives brief description of AODV, Section III gives a description about DSR, Section IV gives the description of DSDV and finally Section V discusses about the conclusion derived.

I. AODV

Ad hoc On Demand Distance Vector (AODV) is a purely reactive routing protocol which starts a route discovery process only when it has to send data packets to another neighboring node and has no information about the route to that particular node. This is called the route discovery process in AODV which is "on-demand" i.e., route to destination is found only when it is required. AODV makes use of a route discovery algorithm which is done in broadcast fashion for finding the route. The destination node then sends a route reply message to the source node in a unicast way [4]. AODV uses sequence numbers which are maintained at each destination node in order to determine freshness of routing information and to avoid any routing loops. These sequence numbers are carried by all the routing packets [1]. Ad-hoc On-demand distance vector (AODV) makes use of traditional routing tables, one route entry per destination that the node is communicating with.

It does not have to periodically exchange route information with the neighbouring nodes. In AODV, each node maintains a route table for the destination node. A route table contains the following information: active neighbours for the route ,destination address and its sequence number, hop count to the destination, and expiration time for the table which is updated each time the route is used[7]. For a specified period of time, if the route is not used, then it is discarded.

Each route entry keeps track of the following fields:
i. IP Address: The IP address of the destination node to which the packets has to be sent.
ii. Destination sequence number: The sequence number of the destination node.
iii. Next Hop: The next intermediate node to which the packets are to be forwarded.
iv. Hop Count: The number of nodes between the source and the destination.
v. Lifetime: The time in milliseconds for which nodes receiving the RREP message.
vi. Routing flags: The state of the route which can be valid or invalid. [5]

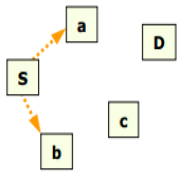
AODV routing allows mobile nodes to respond to the link breakages and changes in network topology in a timely manner. The main objectives of the protocol is quickly adapt to the changes on the network links. Control messages used in AODV are:

- Route Request Message (RREQ)
- Route Reply Message (RREP)
- Route Error Message (RERR)
- Route Reply Acknowledgment (RREP-ACK) Message
- HELLO Messages [8]

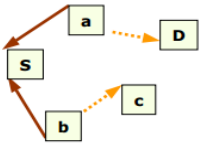
A. Working of AODV

The AODV protocol consists of following two main processes:

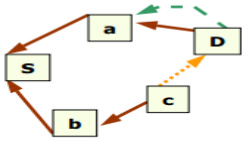
1) Route discovery:
Whenever the source node has to send data packets to the destination node, the source node broadcast a RREQ message to all the neighbouring nodes. This message is then forwarded to all the intermediate nodes till it reaches the desired destination node. If the destination is found, it replies back with a RREP message and hence a route is established between the source and destination. A Hello message indicates presence of the nodes, if not received from particular node then the neighbouring node can assume that the node has moved away[6].
2) Route Maintenance:
A route that has been discovered between a source node and destination node is maintained only as long as it is needed by the source node. In case if the link is affected by any break, then a RERR message is generated and broadcasted. After receiving the RERR message, the source node generates a new RREQ message and broadcasts it [3].



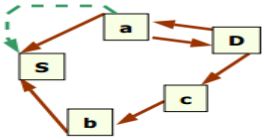
(1) S wants to send a packet to D
S broadcasts an RREQ



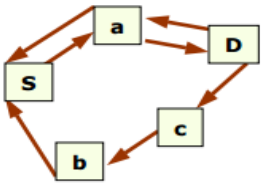
(2) a & b establish Reverse Route
a & b rebroadcast RREQ



(3) c & D establish Reverse Route
c rebroadcasts RREQ
D unicasts RREP



(4) D establishes Reverse Route
D drops duplicate RREQ
a establishes Route
a reunicasts RREP



(5) S establishes Route

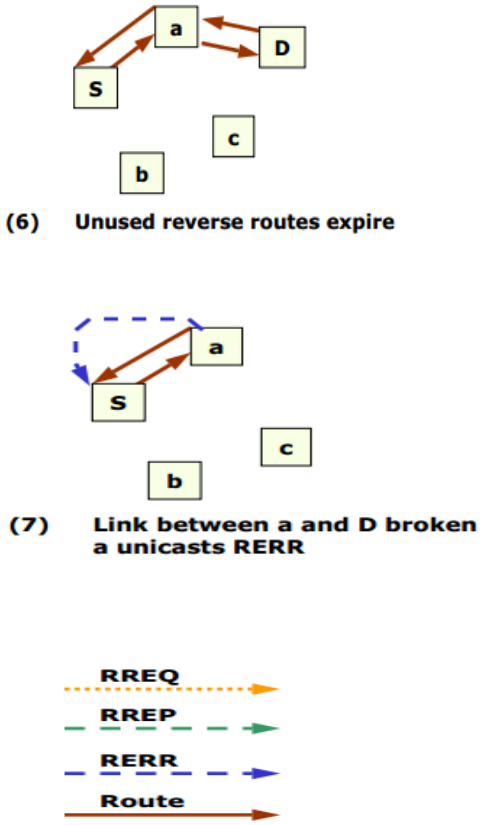


Fig. 2 AODV Algorithm

Advantages

In AODV routing protocol there is no central administration system to control the routing process. Reactive protocols like AODV tend to reduce the control traffic messages. AODV dynamically updates according to the changes in network topology. The AODV protocol reduces storage and energy consumption.

C. Disadvantages

AODV gathers limited amount of routing information and route learning is limited only to the source of any routing packets being forwarded. These causes AODV to rely on a route discovery flood .Uncontrolled flooding may cause the broadcast storm problem. The performance of the AODV protocol is poor in larger networks and also AODV is vulnerable to various kinds of attacks in network [2].

III. DSR

The Dynamic Source Routing protocol (DSR) is a simple and efficient routing protocol used in multi-hop wireless ad hoc networks of mobile nodes [9].The DSR protocol is a reactive In routing protocol which means it requests routes only when needed. It is an on-demand routing protocol which is based on source routing. Source routing means that the source nodes have complete information about hop sequences to the destination[5].Also each node maintain route caches DSR allows self-organising and self -configuring networks according to topological changes without any central administration There are mainly two "on-demand" mechanisms in DSR protocol:- Route discovery and Route maintenance. These mechanisms work together in an ad hoc network to allow the discovery and maintenance of source routes and are requested only when the two nodes have to send packets to each other [6], [7].

In the source routing technique, the source decides the complete hop sequence of intermediate nodes through which to forward the packets to the destination. This information about the intermediate nodes is stored in the packet header. In DSR, each node in the network maintains a route cache where it stores all the source routes information that it has known. When a node has to send data packets to another node, it first finds a route by checking its own route cache. The route discovery process is started only when the desired route is not found in route cache. This is done by sending Route request message .If the nodes have not received the messages or their addresses are not present in route cache, then the nodes processes only the required route request message to limit the number of route requests sent [5], [7].

A. Working

The DSR protocol consists of following two processes:

1) Route Discovery: When a source node wants to send data packets to the destination node, it finds a route to the destination. This process is used only when source node wants to communicate with destination and has no path information to the destination. This is called Route Discovery process.
2) Route Maintenance: The pre-decided routes are not used in case of network topological changes. In this case, the source nodes generate another route to the destination or else start the route discovery process again. This is called Route Maintenance. Route maintenance basically handles breaks in route. In case of transmission errors, it generates route error messages [6], [9].

B. Advantages

DSR can easily handle load balancing by allowing multiple routes to any destination. DSR leads to increased robustness. Another advantage is that intermediate nodes can learn about the routes from the source through the packets they receive. Source routing avoids the need for updating routing information in the intermediate nodes .Also it avoids routing loops as complete routes are determined by a single node. Also in situations wherein mobility is low, DSR reduces bandwidth consumption. DSR supports rapid rates of mobility [8].

C) Disadvantages

As DSR makes use of source routing in which source determines complete address to the destination which is stored in each packet headers. As a result every packet has to carry a routing overhead. Also finding routes in DSR is a costly in terms of time, bandwidth and energy [5].

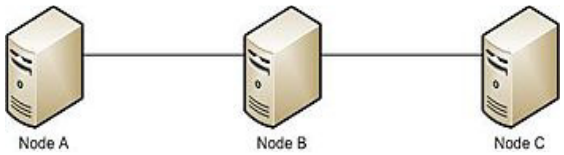
IV. DSDV

Destination-Sequenced Distance Vector Routing protocol (DSDV) is one of the proactive protocols in demand. It is a typical Table-Driven Routing Protocol, which is based on Bellman-Ford routing mechanism [10]. DSDV is one of the earliest routing protocols proposed and provides a baseline proactive distance vector algorithm for performance comparison. MANET contains number of nodes and each node maintains a routing table which has a list of all known destination nodes within the given network and with number of hops which are required to reach particular node. In DSDV, each route is marked with a sequence number which is originated by the destination itself which indicates how old the route is.

Each node has unique sequence number, this is done by assigning two greater than the old one (i.e. an even sequence number) every time. As soon as the route update with a higher sequence number is received, the old route is replaced. These numbers are generated by the emitter and the emitter needs to send out the next update with this number. It uses Full dump or Incremental update to reduce network traffic generated by route updates. The broadcast of route updates is delayed by settling time [11].

Updates are transmitted periodically when there is any change in the network topology. If there are different route with same sequence number, the route with better metric is used with the most recently updated time. Stale entries are those entries that have not been updated for a while. Such entries as well as the routes using those nodes as next hops are deleted[11], [12].While DSDV itself does not appear to be much used today, Babel is an attempt at making DSDV more robust, more efficient and more widely applicable while staying within the framework of proactive protocol

A. Working



For example the routing table of Node A in this network is:

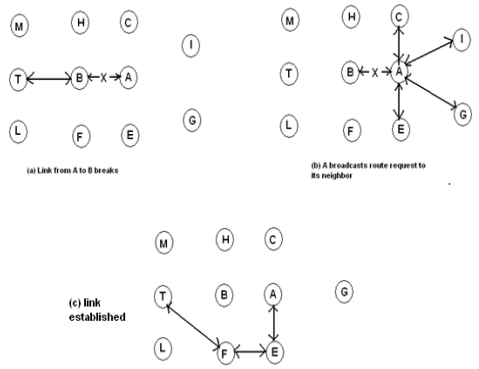
Destination	Next Hop	Number Of Hops	Sequence Number	Install Time
A	A	0	A46	001000
B	B	1	B36	001200
C	C	2	C28	001500

Naturally the table contains description of all possible paths reachable by node A, along with the next hop, number of hops and sequence number. The list which is maintained is called routing table. The routing table contains the following:

(1) All available destinations' IP address
(2) Next hop IP address
(3) Number of hops to reach the destination
(4) Sequence number assigned by the destination node
(5) Install time

The sequence number is used to distinguish stale routes from new ones and thus avoid the formation of loops. The stations periodically transmit their routing tables to their immediate neighbours. A station also transmits its routing table if a significant change has occurred in its table from the last update sent. So, the update is both time-driven and event-driven. It has few drawbacks which are been corrected such as (reconstruction of broken or invalid routes, freedom from loop in routing table and less convergence time.

The process flow from the source to destination is shown below in Fig. 3.The figure shows how Host 'A 'creates a provisional route to destination 'T' when the intermediate link from 'A' to 'B' breaks [4]. Host 'A' then broadcasts ROUTE-REQUEST packets to its intermediate one hop neighbours. After getting the request the Adhoc hosts C, E, I, G then responds with ROUTE-ACK packets which have hop count and the Route update time to the Adhoc host 'A'. Host A then resumes sending packets to the destination node T after selecting the lowest Hop count metric and the path which has most recent routing update time. Later as any Adhoc host moves in the range of host A then the routing table of host A gets updated by regular DSDV routing process. After which the updated route is taken for forwarding the packet to the destination host T [4].



B. Advantages

DSDV is a loop free routing protocol which is distributed in nature. Also routes are maintained in route table. DSDV is computationally more efficient i.e. it requires less resource as compared to other routing protocols.

C. Disadvantages

DSDV overhead increases as the node density increases. DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle. Whenever the topology of the network changes, a new sequence number is necessary before the network re-converges; thus, DSDV is not suitable for highly dynamic or large scale networks. There is low delivery ratio in DSDV due to fact it uses stale routes in case of broken links, existence of stale route doesn't mean that there is no valid route available to destination. The packets can be forwarded through other neighbors who have route to the destination

V. COMPARISON OF AODV, DSR, DSDV

Table 2

Comparison of Routing Protocols

Sr no	Parameters	AODV	DSR	DSDV
1	Protocol Types	Reactive	Reactive	Proactive
2	Routes Maintained in	Route Table	Route Cache	Route Table
3	Route Cache	No	Yes	No
4	Distributed	Yes	Yes	Yes
5	Multicast	Yes	No	No
6	Unidirectional Link Support	No	Yes	No
7	Periodic Broadcast	Yes	No	Yes
8	Dropped Packets	Highest	Least	Acceptable
9	Received Packets Consistency	Most	Least	Average
10	Jitter Performance	Average	Low	High
11	Throughput	Most	Average	Least
12	Energy	Average	Most	Least
13	Latency	Yes	Yes	No
14	Overhead	Less	Less	Yes
15	Effectiveness	Less Computation Intensive	Computation Intensive	Computationally More Efficient

VI. Conclusion

This paper presents a survey on the three routing protocols namely AODV, DSR and DSDV to find the best suited for wireless network. Different papers were reviewed and comparative analysis on the protocols was done. In this paper a brief description and working of all the three protocols is given. It is seen that each protocol have their own merits and demerits. Hence, this paper concludes that the AODV protocol performs better than DSR and DSDV with respect to many performance parameters.

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