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STUDY & ANALYSIS of DSDV, AODV & DSR

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Abstract: Mobile means random and perhaps constantly changing or moving and ad-hoc means for this or temporary without any centralized administration. Mobile ad-hoc network is a collection of mobile nodes forming an instant network characterized by wireless links, dynamic topology and easy deployment. The wireless links in this network are highly prone to error. Routing is a challenging task for networks that do not offer fixed infrastructure, like in ad-hoc wireless networks that offer unrestricted mobility. Based on Routing Update Mechanism, there are two broad categories of Routing Protocol viz. Table- Driven Routing Protocols includes; protocols like DSDV & WRP and On-Demand Routing Protocols include protocols like DSR, AODV & LMR. In this paper, an attempt has been made to analyze three well known protocols namely, DSR, AODV and DSDV.

Keywords: Ad Hoc Networks, DSDV, DSR, AODV, Comparison between different Routing protocols.

I. INTRODUCTION

Unlike traditional networks in mobile ad-hoc network (MANET) all nodes can be mobile while communication and any node can disappear or join anytime at any location in the network. It is an infrastructure less having no base station. Mobile ad-hoc network is characterized by dynamic topology having low power consumption & bandwidth. The nodes which are in the transmission range of each other can communicate directly otherwise communication is done through intermediate nodes.

The wireless network can be classified into two types: infrastructure and infrastructure less network. In infrastructure networks, the mobile node can communicate with each other as the base stations are fixed and if the nodes get out of range of a base station, it gets into the range of another base station as the nodes are mobile[1]. In infrastructure less network the node can move freely while communicating, as there is no fixed base station and all the nodes in the network act as routers. The mobile node in the network dynamically establishing routing among themselves to form their own networks [1].

Some of the challenges of MANET are Limited bandwidth, battery constraints, routing overhead, asymmetric link, speed, scalability, packet loss and quality of services.

We have made an attempt to compare and analyze on some performance parameters on our own network scenario. Our network consists of 9 nodes placed randomly.

II. ROUTING PROTOCOLS

Routing is the process of selecting paths in a network along which to send network traffic [2]. Routing in ad-hoc network is different then wired network due to mobility of the nodes. Routing protocols are basically classified as following:
Fig. 1 represents the classification of different routing protocol.

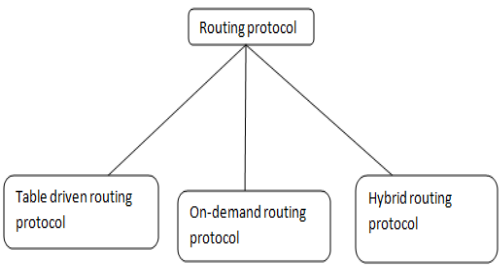

Fig. 1. Classification of Routing Protocol

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A .Table Driven Routing Protocol

These protocols are also known as proactive routing protocol. Each and every node maintains information about every other node [3]. Routing information is generally kept in routing table and is periodically updated as the network topology changes. Some of the exiting table-driven or proactive protocols are: - DSDV (destination sequence distance vector), WRP (wireless routing protocol), GSR (global state routing), STAR (source tree adaptive routing), DREAM (distance routing effect algorithm for mobility) and OLSR (optimized link state routing protocol).

B. On-Demand Routing Protocol

These protocol are also known as reactive routing protocols, routes are created as and when required. When transmission occurs from source to destination, it invokes route discovery procedure [1]. Source node sees its route cache for the available route from source to destination if the route is available then it use that route to send data packet otherwise it initiate route discovery process.
Some of the existing on-demand or reactive routing protocols are:-DSR (dynamic source routing), LMR (light-weight mobile protocol), TORA (temporally ordered routing protocol) & ABR (associativity-based routing).

C. Hybrid Routing Protocol

Hybrid protocol is presented to overcome the shortcoming of both proactive and reactive routing protocols [4]. It uses the route discovery mechanism of reactive routing protocol and table-maintenance mechanism of proactive routing protocol. So, as to avoid latency & overhead problem. Some of the existing hybrid routing protocols are: - ZRP (zone routing protocol) and IARP (intra-zone routing protocol).

III. **WORKING of TABLE-DRIVEN ROUTING PROTOCOL**

Destination sequenced distance vector (DSDV) protocols is based on bellman-ford shortest path algorithm. Each node has a table, which contains the shortest path to every other node in the network. These tables are constantly updated and forwarded to other nodes in the network whenever a change is detected. When a node receives an update it can either update the tables or hold it for a while in order to select shortest route [4].
Periodically or immediately when network topology changes are detected, each mobile node advertises routing information using broadcasting or multicasting a routing table update packet. The update packet starts out with a metric of one to direct connected nodes. This indicates that each receiving neighbor is one metric (hop) away from the node. It is different from that of the conventional routing algorithms. After receiving the update packet, the neighbors update their routing table with incrementing the metric by one and retransmit the update packet to the corresponding neighbors of each of them. The process will be repeated until all the nodes in the ad hoc network have received a copy of the update packet with a corresponding metric. The update data is also kept for a while to wait for the arrival of the best route for each particular destination node in each node before updating its routing table and retransmitting the update packet [6]. If a node receives multiple update packets for a same destination during the waiting time period, the routes with more recent sequence numbers are always preferred.

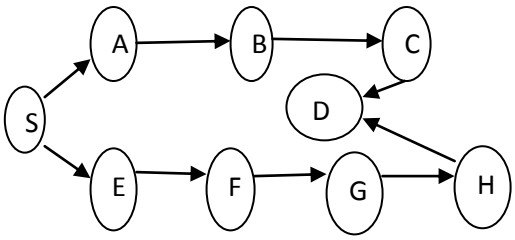

Fig. 2: An example of the DSDV

Fig. 2 illustrates the example of DSDV routing protocol.

Destination	Next	Metric	Seq. no.	Install Time	Stable Data
A	A	0	A-500	001000	Ptr_A
B	B	1	B-100	001200	Ptr_B
C	B	2	C-550	001200	Ptr_C
D	B	3	D-312	001200	Ptr_D
E	E	1	E-160	001000	Ptr_E
F	E	2	F-200	001200	Ptr_F
G	E	3	G-280	001200	Ptr_G
H	E	4	H-300	001200	Ptr_H

Fig. 3: Table Entries of DSDV Protocol

Fig. 3 represents the table entries of DSDV protocol. Under this we have sequence number, install time and stable data which is defined as:

- *Sequence Number*: It originated from destination. Ensures loop freeness.
- *Install Time*: when entry was made (used to delete stale entries from table).
- *Stable Data*: pointer to a table holding information on how stable a route is. Used to damp fluctuations in network.

IV. **WORKING OF ON-DEMAND ROUTING PROTOCOL**

A. DSR (Dynamic Source Routing)

DSR is an on-demand routing protocol. It uses source routing. In source routing only source is responsible for providing information of whole path; intermediate node does not provide any information about destination. If any source has more than one path in its Cache, which path to choose will entirely depends on the source.

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DSR is working in two parts Route Discovery and Route Maintenance. Whenever a node finds a new path towards destination, it stores that path in its Cache for future use.

B. Route Discovery Process

When a source is ready to send data packet to destination D it put source route in the header of the packet. Here source route is a sequence of hop between source and destination. So, node S first searches in its route Cache. If in Cache it doesn't found any route to destination D than it start route discovery. At starting of route discovery Source S send a Route Request (R.REQ) with source address, destination address and ID attached with the request [12]. Any intermediate node checks for ID, its address in route record. If found then simply discard this packet otherwise append its address in route record. When finally this R.REQ reaches at destination D it responds this query with Route Reply (R.REP) to source S. At destination there is more than one R.REQ to propagate from different path; they reply all R.REQ by R.REP [9]. So, as result of single route discovery a node can learn multiple routes. For example we take our own network scenario for Route Request in DSR protocol.

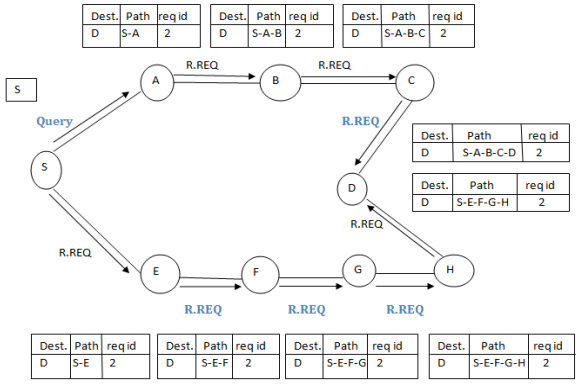

Fig. 4: Route Request phase in DSR

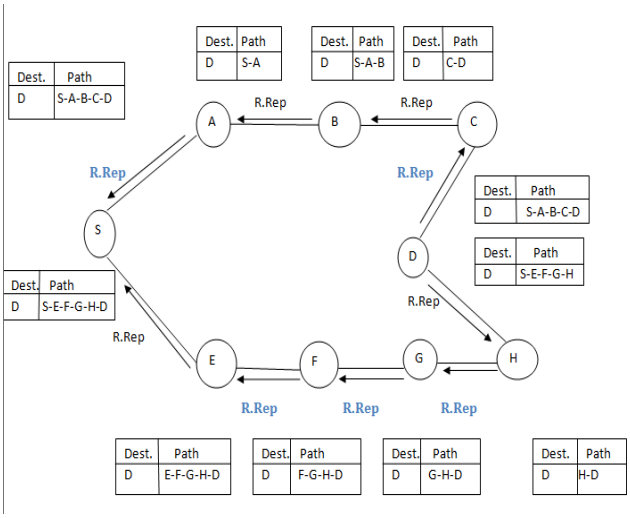

Fig. 5: Route Reply phase in DSR

This is the network case scenario for Route Reply in DSR. Fig. 4 & 5 represent Route Request and Route Reply phase in DSR.

C. Route Maintenance Process

As we know that due to the mobility and high interference in wireless network, life time of link between two nodes no longer exists. It may be possible that link present now must not be working in future. For this purpose Route Maintenance procedure is introduced. Whenever an intermediate node finds a broken link in between the path from source S to destination D it sends a Route Error (R.ERR) message back to the source S [12]. When this Route Error message arrives at source it remove that link from its Cache and find another route for sending data of the specific destination [10-13]. If there is no route found in Cache of specific destination then Route Discovery process is initiated. Fig. 6 represent Route Maintenance phase in DSR.We take our own network scenario.

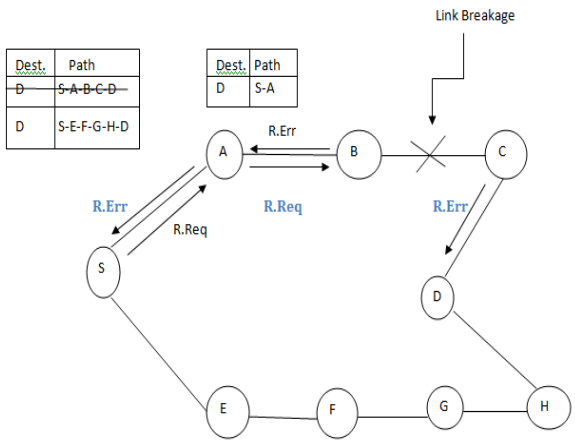

Fig. 6: Route Maintenance phase in DSR

V. AODV (ADHOC ON-DEMAND DISTANCE VECTOR ROUTING PROTOCOL)

AODV is also a reactive routing protocol. It is also a variation of Destination-Sequenced Distance Vector (DSDV) routing protocol which is collectively based on DSDV and DSR. In AODV, routes are not maintained from each node to every other node in the network rather they are discovered as and when needed and are maintained only as long as they are required. Major difference between AODV and DSR is that DSR uses source routing in which a data packet carries the complete path to be traversed, whereas in AODV, the source node and the intermediate nodes store the next-hop information corresponding to each flow for data packet transmission [13].

A. Routing Discovery

When a route is not available for the destination, a route request packet (R.REQ) is flooded throughout the network. The Route Request contains the following fields:

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Source address	Request id	Source sequence No.	Destination address	Destination sequence No.	Hop count

Fig. 7: Format of Route Request

The request id is incremented each time the source node sends a new R.REQ, so the pair (source address, request id) identifies a R.REQ uniquely [15]. On receiving the Route Request each node checks the source address and request id. If the node has already received the Request from the same source with same request id the packet will be discarded. Otherwise the R.REQ will be either forwarded or replied with a R.REP message: if the node has no route entry for the destination, or it has one but this is no more an up-to-date route, the R.REQ will be rebroadcasted with incremented hop count and if the node has a route with a sequence number greater than or equal to that of R.REQ, a R.REP message will be generated and sent back to the source [13]. Every R.REQ carries a time to live (TTL) value that specifies the number of times this message should be re-broadcasted. This value is set to a predefined value at the first transmission and increased at retransmissions. Retransmission occurs if no replies are received [14, 15].

If a node is the destination, or has a valid route to the destination, it unicasts a Route Reply message (R.REP) back to the source. This message has the following format:

Source address	Destination address	Destination sequence No.	Hop count	life Time

Fig. 8: Format of Route Reply

Fig. 7 & 8 represent format of Route Request and Route Reply in AODV

The reason one can unicast R.REP back is that every node forwarding a R.REQ message caches a route back to the source node. Fig. 9 & 10 represent route establishment and descriptive table of AODV.

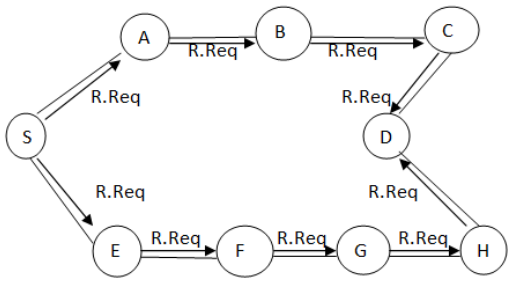

Fig. 9: Route establishments in AODV

TABLE I: AODV Scenarios

Step	Node	Action
1.	Node S	Source node, destination sequence number=3, source sequence number=1
2.	Node D	Destination node
3.	Node S Neighbors	A,E(no idea about destination) thus, forward the route request to B&F
4.	Node E	No idea about destination
5.	Node B	It has a route to d (C-D), destination sequence number=4.
6.	Node E	Forward the Route Request to F.
7.	Node F	It has a route to D(G-H-D), the destination sequence number=1.
8.	Node B	Reply because (4>3)
	Node F	Does not reply (1>3)
		That means that node F has an older route to D.
9.	Node S	will get route as S-A-B-C-D.
10.	Node B, C	Path breaks between B & C.
11.	Node B	Route error to S.
12.	Node C	Route error to D.
13.	Node D	Delete Route Entry from it's table.
14.	Node S	Delete the Route Entry from it's table.
15.	Node S	Reinitiate path finding with new broadcast identifier and the previous destination sequence no.

VI. **PERFORMANCE PARAMETERS**

TABLE II: Comparison of Proactive and Reactive Routing Protocols

Parameters	Reactive protocol	Proactive protocol
Routing Philosophy	Flat/Hierarchical	Hierarchical
Routing Scheme	On- Demand	Table-Driven
Routing Overhead	Low	High
Latency	High due to Flooding	Low due to routing tables
Storage Capacity	Low generally depends upon the number of Routes.	High, due to the routing tables.
Mobility Support	Route maintenance	Perodical updates

VII. COMPARATIVE ANALYSIS BETWEEN DSDV, AODV & DSR

In this paper an attempt has been made to study and analyze three different routing protocols DSDV, DSR and AODV. Generally on-demand protocols (DSR and AODV) perform better than DSDV. Especially when mobility increases. Even with lower mobility, DSDV suffer big packet loss. When it comes to power requirement proactive protocols has high power consumption than on-demand protocols.

A. Case 1: Number of Connecting Nodes varied.

1) End-to-End Delay: All three protocols show same delay for small number of nodes, but the delay decreases with increasing nodes for DSDV network.

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2) Packet Loss: It remains same for all three protocols, when numbers of nodes are less, but Comparatively DSR show maximum Packet Loss with increasing number of nodes.

3) Packet Delivery Ratio: Performance of AODV remains constant for increasing number of nodes, whereas for DSDV Packet Delivery Ratio is more than DSR.

4) Throughput: The performance of AODV, DSDV and DSR remains almost constant for increasing number of nodes but AODV and DSR provide better Throughput than DSDV.

B. Case 2: Pause time Varied.

1) End-to-End Delay: AODV serves the best among all the protocols.

2) Packet Loss: DSDV outperforms all other protocols in all conditions.

3) Throughput: DSDV outperforms the other two protocols but Comparatively AODV shows better performance than DSR protocol.

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