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Comparative Study of Traditional Routing Protocols in Mobile Wireless Networks

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Abstract: Mobile adhoc network is an anonymous system of nodes connected by wireless links. Every mobile node is act as mobile, i.e., peer to peer connectivity between the nodes. No permanent or pre existing equipment is needed for MANET. A traditional wired network protocols does not suitable for wireless data transmission because, the characteristics of both differ from one another. In MANET topology of wireless nodes dynamically change and free to move. In this study, we are going to compare traditional routing protocol performance Such as proactive (DSDV), reactive (AODV, DSR) and hybrid Routing Protocols (ZRP). The packet delivery ratio, end-to-end delay, throughput, jitter are the simulation parameters which are used to measure the different protocols.

Key words: Mobile adhoc networks, peer-to-peer, AODV, DSDV, DSR

INTRODUCTION

The mobile adhoc network is self configuring infrastructure less networks with autonomous system of nodes. In MANET, every node act as client and server each node will have its own transmitter and receiver. In self-organized network, the data cannot be send directly to its destination. The entire node follows store and forward manner in which the information is transmitted or received from every node. Mobile adhoc network is applicable in dense applications, disaster times, etc. The two types of mobile wireless networks are infrastructure network and infrastructure less network. In infrastructure network, network with fixed and wireless gateway (e.g., GSM). MANET is infrastructure less network in which autonomous system of nodes connected by wireless links. A problem with mobile adhoc network is asymmetric capability of nature such as lifetime, speed, radio range, etc. Also, the traffic characteristics of mobile adhoc networks such as bit rate, reliability, speed differ for every node.

Literature review: Rodas and Luis *et al*. (2015) proposed a topology control protocol for wireless mesh networks to reduce protocol overhead and interference. In this method, constructed a most dominant set act as forwarder for relay a packets. Since, every node acts as client and server which lead to overhead in network.

Srivastava and Sudarshan (2015) proposed a optimized zone based routing for mobile sensor networks for selecting cluster head to minimize the packet flooding to all nodes. For this, initial cluster head is elected based on the energy, density and speed. The final choice is made by the generic fuzzy system.

Salamanca *et al*. (2015) proposed a envelope based admission control to determine whether the bandwidth is more enough for packet forwarding. Before sending the original packets, a node will send probing packets along with route to receiving node. The receiver will decide whether to admit the packet flow or reject by seeing the incoming packet flow.

Omar *et al*. (2015) proposed reduced packet protocol with demand source routing. In this method, the source node embed the data packets, routing information and send the same to the intermediate nodes to reach the destination. The header of each packet includes only reduced integer value instead of complete sequence of intermediate node address.

Basarkod and Manvi (2015) proposed anycast routing protocol embedded with dynamic source routing for selecting intermediate nodes having less congested, high route stability, high link expiration time for transmitting any packets. These will simply eliminate the frequent path failures and improves the packet delivery ratio.

Basurra *et al*. (2015) proposed and investigate parallel collision guided broadcasting protocol with zone routing. It simple minimizes the unwanted flooding of route request message for the same route path. The zone routing protocol comprises the features of both proactive

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and reactive routing protocols. In ZRP node will check whether the destination is within the zone. If not it will send the RREQ message to their peripheral nodes. Now the peripheral nodes will follow the similar steps until reaches the destination.

Rani *et al*. (2015) proposed and investigate hierarchical clustering by forming sub clusters among all the nodes in the network. This will give good reduction of energy consumption and transmission time using multi-hop aggregation.

Chatterjee and Das (2015) proposed an enhanced dynamic source routing based Ant Colony Optimization (ACO) which gives high packet delivery ratio, less energy consumption, less overhead, etc. Before data transmission, it checks the cache as like DSR. If there is no route in the route request cache sender, the route request message will send locally to its neighbors. Neighbor node checks the destination. If the destination is not available then, it will rebroadcast the ant request message to its neighbors.

Li and Leu (2015) proposed ant based on-demand clustering in which the node status information is received from forward ant node. The ant node will broadcast the information to all cluster head thus, minimizes the overhead needed for transmit any ant packets.

MATERIALS AND METHODS

A report

Routing protocols: In MANET traditional routing protocols such as proactive, reactive, hybrid protocols commonly used for data transmission between the nodes. If the route is already known then the node will forward the packet using proactive routing protocol. Proactive routing is also known as like Destination Sequenced Distance Vector (DSDV), Cluster Head Gateway Switching Routing (CGSR), etc. In reactive routing, protocol determine the route only when there is data to send. Reactive routing is also known as source initiated protocol such as Adhoc On demand distance Vector routing (AODV), Dynamic Source Routing (DSR), etc.

Table 1: DSDV routing table for node 'N1

Dest.	Next hop	Distance	Seq. no.
N1	N1	0	111
N2	N2	1	222
N3	N3	1	333
N4	N2	2	444
N5	N3	2	555
N6	N3	2	666
N7	N2	'3'	777
N8	N3	4	888
N9	N3	4	999

Proactive routing protocols

Destination Sequence Distance Vector (DSDV): In DSDV, each node maintains routing table 1. The routing table maintains the information such as next hop, distance and sequence number (Table 1). The routing table can be updated periodically to know its neighbors. The sequence number which filter new route with old route. Each node broadcast their table to its neighbor to aware of its neighbor. Destination address, number of hops to reach destination, sequence number, etc. will be available in new route broadcast (Fig. 1).

Some drawbacks of proactive protocols are, each node maintains own table which leads to wastage of memory space. Each node needs to update the routing table periodically which leads to energy loss.

Reactive routing protocols

Dynamic Source Routing (DSR): Based on the demand the routes are established in reactive routing. Whenever, the node needs to send some data, first discover the route. In route discovery phase, the route can be discovered by node by sending route request to all its neighbors. Unique id, a list of node, source address and destination address are the composite of route request. A node broadcast RREQ to all the radio range neighbors. The destination address will be checked by the node after receiving RREQ. Route reply message will be send if the destination address is equal to that node. Once determine the route, node can send the data. Route reply message will be send if the node finds its destination. Once node establishes a route can send data along with its route. Route error message is send to its source node whenever the route if failed. Then, the source node will reinitiate the route discovery process.

Assume that the source node S wants to send data packet to Destination (D). In Fig. 2, the source node S sends the RREQ message to the neighbor node N2 and N3. The destination address is checked after receiving the

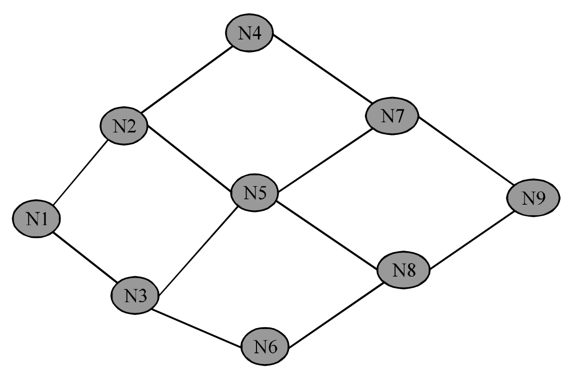

Fig. 1 Network formation

route request message. RREP message is send to the source node if the destination address matches with their address. As node N3 is not a right destination, so the RREQ message is rebroadcasted to its neighbors such as S, N5 and N6. The node S and N5 will receive the message and it comes to know that the RREQ is already received from another node. So, it simply eliminates its RREQ packet. Until, it reaches the destination the same procedure will be continued.

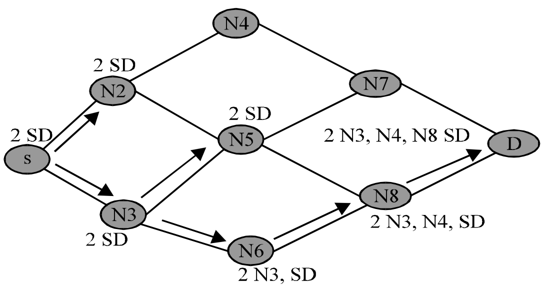

Fig. 2: DSR route request

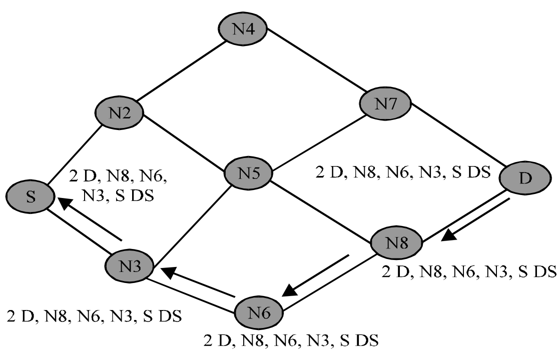

Fig. 3: DSR route reply

The node will send a route reply message to its source node through D->N8->N6->N3->S when the destination is identified (Fig. 3). The node will send RERR message to its source when the link is broken. So that, they will reinitiate the route discovery.

Adhoc On-demand Distance Vector routing (AODV): Whenever, a node need a path at that time route is established so that AODV is called reactive routing (Fig. 4). In AODV each node maintains only next hop information. In route discovery phase send RREQ message to discover the route. Route can be found by route request packet broadcast and route reply packet is used to setup the reverse path. Nodes lies on active paths only maintain routing information. If the routing table entry is not used recently it gets expired. The routing loop prevents old and broken routes by using destination sequence number. Broadcast id will differentiate the route request from new route request. Each node maintains the table contains its next hop information. The routing table contains the information such as destination address, sequence number, next hop information and hop count.

In AODV, the source node A will send a route request message to its neighbor node B (Fig. 5). Now a node B checks whether the destination is us. If not node B will rebroadcast RREQ message to the neighbor node C. Until, the destination is reached the same procedure is used. The nodes D receive the route request from node C and find itself as destination. The routing tables are updated after receiving a route request.

A route reply message is send by node D in the same way. The routing table gets updated when RREP query packet is send by the node D. Then, the reply query is passed to the node B. This procedure is repeated until reach its source node. Once the source node receives its route path the data transmission starts.

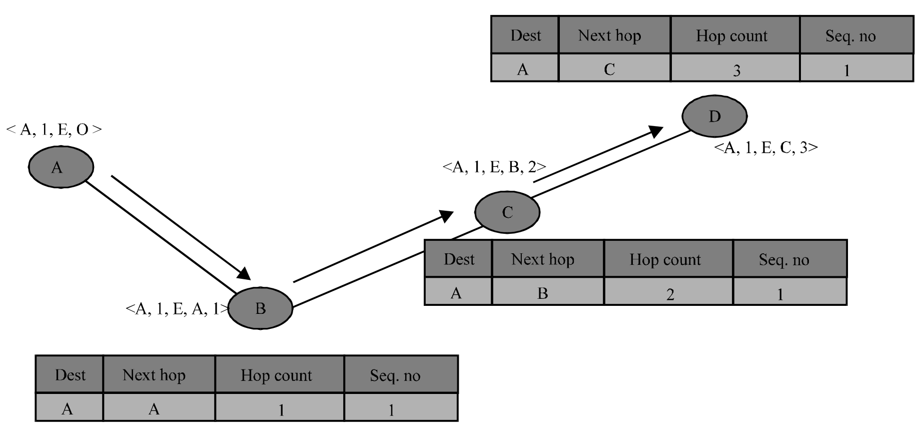

Fig. 4: AODV route discovery

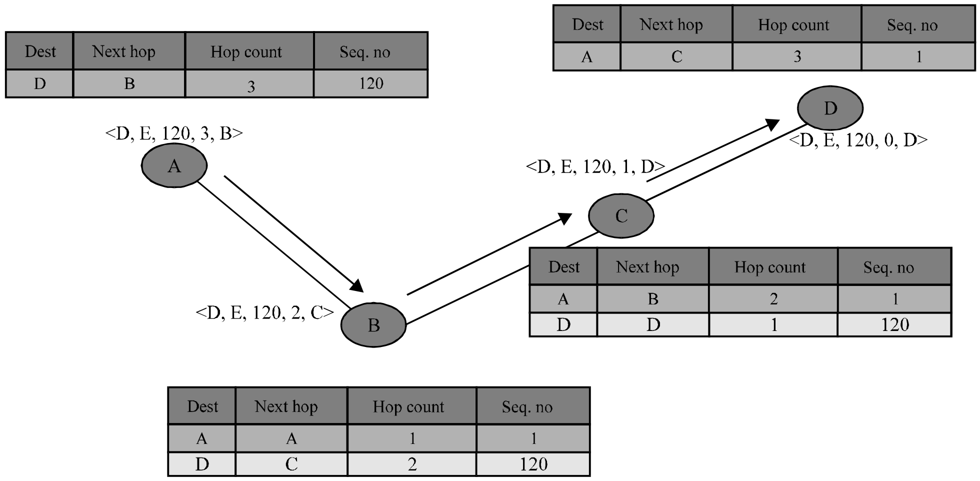

Fig. 5: AODV route reply

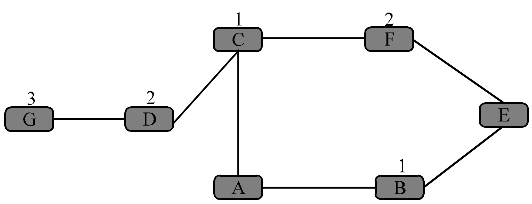

Fig. 6: ZRP network formation

Hybrid routing protocols: To avoid the drawbacks of reactive and proactive routing protocols, protocols are conjured. Reactive routing protocol uses global flood search for querying route. Any update in network is broadcasted to entire network. The Zone Routing Protocol (ZRP) is considered as an example (Fig. 6). In zone routing protocol, each node maintain its zone for data transmission. Proactive routing protocol is used for intra zone. For inter zone, reactive routing protocols are used. The node having distance equal to zone radius are peripheral nodes.

By using proactive protocol the node A can send anything to node D. The node A checks its zone whether the destination belongs to it or not. If the destination is within zone then node A must be having route to destination (proactive routing is used). Node A send a route request query to all its peripheral nodes, if the destination is not in the zone. When, the peripheral node receive route request query then it also run same logic. It will check whether the destination is in.

RESULTS AND DISCUSSION

Performance analysis: The performance of routing protocols like AODV, DSDV and DSR are compared in this study. Execution of these can be measured by packet delivery ratio, throughput, jitter, packet loss, etc. Based on the simulation results AODV and DSR produced good results.

The DSDV routing protocol produced very poor results in all cases. Because every nodes are moving quickly and topology gets changed dynamically. In DSDV, every node maintains lots of routing table 1 information's such as next hop, sequence number, destination node. Table 1 information is periodically updated based on the node mobility. The routing table 1, updated either by fixed time interval or by immediate. Also, the node needs to store lots of information at a moment. So, in most of the cases link failures can happen with this periodic route table change. The DSDV will give good results when the nodes have no/less mobility.

In DSR, the data is coupled with full route for forwarding any packets from source to destination. Suppose, if the route path size is larger than actual packet size it will give poor performance. In MANET, we never expect that the destination is always very close. So, the node follows multi-hop packet transmission. But, DSR will give better results than DSDV routing.

The AODV routing node knows only next hop information. Every node maintains only two rows of information such as successor node and precede node. So, if there is any topology change then, the corresponding node will updates the routing table. The routing table change should not be replicated to all nodes.

The routing protocols are evaluated with the simulation parameters such as Packet Delivery Ratio (PDR), packet loss, throughput, jitter, etc. For measuring the performance, we use NS2 simulator Table 2. The simulation takes IEEE 802.11 as MAC standard and which

Table 2: Simulation parameters

Parameter name	Values
Network simulator	2.35 NS
Topology size	500×500 m
Routing protocol	AODV, DSDV, DSR
MAC layer	802.11
Number of nodes	10,20,30,40
Traffic type	UDP
Queue length	50
Maximum connection	3
Max speed	20.00 m sec
Pause time	10.00 sec
Sent rate	0.25 sec
Seed	1.0
Packet size (bytes)	512
Interval	0.25 sec
Traffic type	CBR

Table 3: Packet delivery ratio

No.of nodes/ protocol	Nodes 10	20	30	40
AODV	93.21	99.11	99.65	99.65
DSR	90.43	99.64	99.46	100.00
DSDV	44.64	58.25	66.10	87.17

Table 4: Packet loss

No.of nodes/ protocol	Nodes 10	20	30	40
AODV	39	5	2	2
DSR	55	2	3	0
DSDV	315	238	188	72

Table 5: Jitter

No.of nodes/ protocol	Nodes 10	20	30	40
AODV	0.18227	0.17475	0.17330	0.17304
DSR	0.18755	0.17366	0.17549	0.17634
DSDV	0.38451	0.26515	0.24060	0.18002

Table 6: Throughput

No.of nodes/ protocol	Nodes 10	20	30	40
AODV	23394.3	24365.9	24595.5	24591.4
DSR	21895.3	23602.7	23349.7	23234.8
DSDV	11111.1	14525.5	16006.9	21376.2

uses the traffic type as UDP. Totally, 512 bytes of data are transmitted over time. The packets are sent in every 0.25 sec interval which uses the traffic type as Constant Bit Rate (CBR). The simulation results are taken for 10, 20, 30, 40 nodes with maximum connection as three. The queue length of each node is 50.

Packet Delivery Ratio (PDR): The percentage of the packet successfully delivered to the destination (Table 3 and Fig. 7):

$$\text{PDR} = \sum \text{No. of packets received} / \sum \text{No. of packets send} \times 100$$

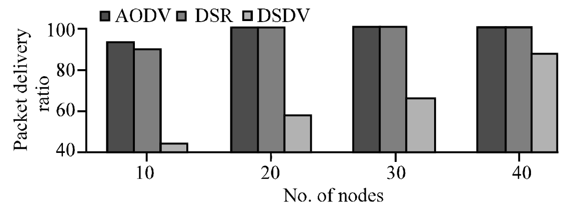

Fig. 7: Packet delivery ratio

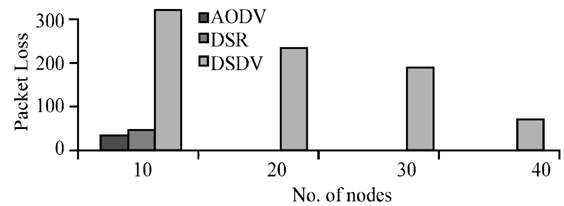

Fig. 8: Pocket loss

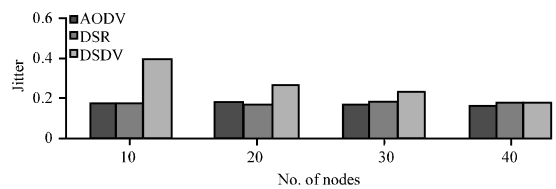

Fig. 9: Jitter of nodes

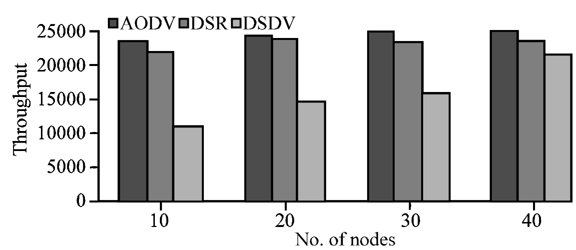

Fig. 10: Throughput of nodes

Packet loss: It is the measure of total number of packets dropped during the simulation (Table 4 and Fig. 8):

$$\text{Packet loss} = \sum \text{No. of packet send} - \sum \text{No. of packet received}$$

Jitter: The variation in the delay of received packets is said to be jitter. The packets are transmitted with continuous stream. Due to network congestion, queuing the delay between the packets can vary at the receiver side (Table 5 and Fig. 9).

Throughput: The throughput is defined as the total number of packets transmitted over the total execution time (Table 6 and Fig. 10).

CONCLUSION

In mobile adhoc networks routing is essential thing for data transmission. In this regard, we need to elect the optimum path for data transmission. For electing the efficient path, we use some traditional protocols like AODV, DSDV and DSR. The performance of the routing protocols is evaluated by the packet delivery ratio, jitter, throughput, packet loss, etc. With these comparisons, we found that AODV will give better packet delivery ratio, throughput and so on.

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