Analysis of Routing Protocols over TCP in Mobile Ad-hoc Networks using Random Way Point Model

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ABSTRACT: *Mobile ad hoc network, MANET is an impartial disseminated wi-fi structure inclusive of unbound nodes due to the fact, each node may communicate with each other at random, and then, redirecting data like a router for exclusive nodes. Packet forwarding in MANET is challenging assignment, furthermore, the presence of malicious nodes makes the general platform very insecure and the unpredictable existence of the changing nodes adds complexity. Shifting of the nodes has massive influence at the network performance. This paper offers the overall performance comparison between dynamic source routing, DSR, ad hoc on demand distance vector routing, AODV and destination sequenced distance vector, DSDV [7]. And then, precisely determine which routing mechanism is greater powerful. The objective of this paper is to review routing mechanisms in MANET to get a perfect performance of the factors influencing the actual quality among these network applications. This analysis of routing mechanisms is useful in know-how of the requirements and challenging circumstances for routing mechanisms in MANET and procedures relating to premise of developing a new routing protocol which we expect to supply in the future. The overall performance measurement of three routing protocols using the random way point mobility over tcp was performed and assessed the measurement of those protocols in phrases of the window size of tcp, packet loss, jitter, average throughput, average delay and packet delivery ratio with regard to the alterable number of nodes. In this paper, we are able to simulate MANET using network simulator NS2 and then make a result-primarily based assessment by using NS2 visual trace analyzer.*

Keywords: MANET; AODV; DSDV; DSR

1. INTRODUCTION

MANET generally is a sequence of freedom to integrated progressive wireless nodes' framework because there are no a centralized rule or platform. These dynamic nodes are more effective either directly or with the aid of intervening nodes to establish a correspondence with each other due to there is no core management using radio connections or wireless multi-hop networks. Such systems are called dynamic topology. This network topology is not rigid and the entire nodes work as access points because there is no the need of any base stations. Home and industrial communication, military environments, moving vehicles, and IOT systems are some applications where the ad hoc service is used. The routing mechanisms for ad hoc networks are broadly categorized into three classes based upon the update mechanism of the routing information: proactive, reactive, and hybrid. Each node updates and retains the routing tables in proactive protocols to keep track of all potential targets for the instant availability of the routes for future use. DSDV is the sample of proactive protocol. Reactive protocols set up routes only when routes are essential by an initial node and every node sustains individual routing data to targets but would not own an exhaustive topological view of the system. In reactive protocols routes are found on-call and for locating a route to target, a route request is initiated. The samples of reactive protocols are DSR and AODV. The main purpose of this paper is to post a detailed analysis of MANET protocols. In this analysis, we elected three routing protocols AODV, DSR, and DSDV then, compared their results. First we illustrate the particular features of routing protocols for MANET and describe their strengths and limitations. We used network simulator NS2 for simulations and it is the most common wireless network testing simulator supporting many MANET routing protocols. Ns2 visual trace analyzer has used to assess the performances of these protocols. The parameters are window size of tcp, packet loss, jitter, average delay, average throughput, and packet delivery ratio. The analysis is reviewed by simulating networks with disparate variables of nodes, tcp traffic, and random way point mobility model. The remaining paper is standardized as follows: section 2 discusses the work related to MANET routing simulations, section 3 briefly describes the basic MANET architecture and the features of each of the three routing protocols, the performance assessment metrics are discussed in section 4 and the results of the study are analyzed, and lastly, section 5 terminates the paper.

2. RELATED WORK

This section discusses the reviews related to MANET routing protocols by researchers. H. Ehsan and Z.A. Uzmi [3] contrasted AODV, DSR, DSDV and TORA to ad hoc routing protocols. Their research indicates that DSR is outperforming other routing protocols due to its capacity to efficiently use caching and support various paths to target. S. S. Tyagi and R. K. Chauhan conducted a related survey [8]. They analyze protocols using PDR, average delay, packet loss, and overhead routing. The number of nodes, speed, time of pause and time of simulation varies. In large environments, they reason that AODV performs better than DSR, and that both AODV and DSR perform better than DSDV. The authors undertake a related survey in [6]. They assess similar protocols by shifting the quantity of sources, the pause time, the quantity of nodes and speed. They presume that in high mobility scenarios AODV and DSR perform better than DSDV, and that AODV beats DSR in higher load scenarios. N.Vetrivelan and A V Reddy[4] assess average delay, fraction of packet delivery and load of routing for AODV , DSDV and TORA. They shifted the quantity of nodes and held up to 100sec simulation time. Their findings show that AODV outperforms the other two routing protocols as far as average delay is concerned but TORA provides better performance in terms of packet transmission fraction and DSDV performs best in less stressful situations. DSDV performs best in less distressing circumstances. DSDV is best in upsetting conditions followed by TORA for the standardized routing load.

3. MANET AND ROUTING PROTOCOLS

3.1. MANET

MANETs are very useful when networks dependent on the infrastructure are not accessible, inefficient or costly. That is not always feasible to set up fixed access points and backbone networks. MANET is a network where no wireless or cellular networking infrastructure exists. MANETs require no backbone infrastructure support. Instead MANET is a network in which frequent host, frequent movement, topology changes and wireless multi-hop links occur. Any applications of MANET are smart phone, laptop, wrist watch, military environments, vehicles, aircraft, civil environments, taxi-cab network, conference rooms, sports facilities, emergency operations. Mobile nodes can play the features of hosts and routers in this environment and are free to transfer and manage arbitrarily. The mobile nodes within the radio range can interact directly with one another. In this environment, data must be routed across intermediate nodes. These networks are fully dispersed, can be established anywhere and at any time and then contribute access to message and resources without any infrastructure support. Some of MANET's challenges are packet loss because of transmission faults, variable capacity link,

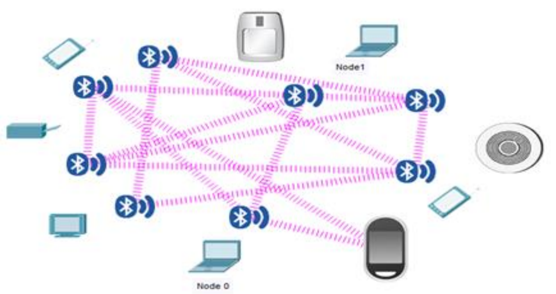

Figure 1. Our model for MANET

frequent disconnections or partitions, restricted communication bandwidth, communications broadcast nature, mobility-imposed constraints, dynamically changing topologies, paths lack of system and application mobility awareness. Figure 1 demonstrates our model for MANET in this paper.

3.2. AODV

AODV is one of a classification of demand-driven routing protocols intended for use in MANETs [1]. The mechanism for route discovery is only requested when a node wants to transmit information to a different node. And this protocol is reactive. For every route entry, AODV utilizes a destination sequence number. Considering the option between two routes to a target, a requesting node always chooses the one with the highest number of sequences. To discover and preserve connections, the protocol uses various messages. If a source node needs to discover a route to target, it will transmit a route request, RREQ message to the whole network [9]. When an RREQ message reaches a target, the target will send a route replies, RREP message by unicasting back to the source route and then the target route is made available. An interceding node can also respond with an RREP message if the route to the target is fresh sufficiently. As the RREP propagates again to the source node and their routing tables are modified by interceding nodes. Nodes of an active route can deliver connectivity information to their instant neighbors by periodically transmitting local Hello messages. If Hello messages prevent originating from a neighbor within a given time interval, it is presumed the communication is fail. When a node observes that a path to a neighbor is presently false, it eliminates the routing entry and transmits a route error, RERR message to active neighboring nodes the utilization of the path.

3.3. DSR

The DSR protocol is a reactive or on-demand routing mechanism designed for wireless communication systems [1]. In DSR, routing entries at the interceding nodes are not organized and use the source routing mechanism. The source of a packet specifies the full sequence of a route that packets of data are forwarded. A route discovery packet, RREQ is transmitted to all neighbors by the source. This packet involves the target host address, the source address, a route record field and a unique identifier. Every node that receives this packet retransmits it, except it is the target or there is a path in its cache to the target. Only when the RREQ message hits the final destination, it will send back an RREP message to source by going backward. The route that RREP packet conveys back is stored for later use at the source. If any connection on a source route is broken, a Route Error (RERR) packet is used to alert the source node. The source eliminates any route utilizing this connection from its store. The routes to some random node are stored at the source in a route cache and hence routing loops can't be made as they will be detected immediately. This protocol diminishes transmission capacity squandered in remote systems which the control packets and erases the periodic routing table update messages.

3.4. DSDV

The DSDV routing protocol is a table-driven routing scheme intended for MANETs. Every node has a routing table showing the next hop and quantity of hops to the target and regularly forwarding the routing table to neighbors [1]. A sequence number is utilized to label each route when every node advertises its own routing information to each neighbor, and routes with greater number of sequences are more desirable. Moreover, the one with better metric is more desirable among two routes with an equal number of sequences. In the event that a node identifies that a path to a target has fallen, then it will set its hop number to infinity and change its sequence number. Information about new paths, broken connections, metric change is propagated to neighbors immediately. By exchanging that refurbished routing information, every node updates its own routing tables. Because of there is some alteration, and all nodes share the routing information changes, the overhead is more encouraged in DSDV protocol.

4. RESULT AND DISCUSSION

Table 1. Simulation Parameters

Parameter	Value
Routing Protocols	AODV, DSR, DSDV
Simulation Duration	150 seconds
Number of Nodes	10,30,100,150
Simulation Area	950 X 700 meters
Antenna	Omni-directional
MAC	IEEE802.11
Traffic Agent	TCP
Traffic Type	FTP
Packet Size	512 bytes
Channel Type	Wireless
Propagation Model	Two ray ground reflect
Mobility Model	Random Way Point
Node 0 position	(5,5)
Node 1 position	(490,285)
Mobility Speed	3m/s

We tend to compare the performance of AODV, DSR and DSDV over TCP in ad hoc wireless networks using Random way point mobility regarding window size of tcp, throughput, average delay and packet delivery ratio, whereas, variable the network size. The source is node 0 and also the destination is node 1. As shown in table 1, the first location of node 0 and 1 are severally (6,6), (489,284) and also the z coordinate is 0. At time 1s, node 0 begins to move towards point (249,249) at a speed of 3 m / sec and node 1 also starts to move towards point (44, 258) at a speed of 3 m / sec.

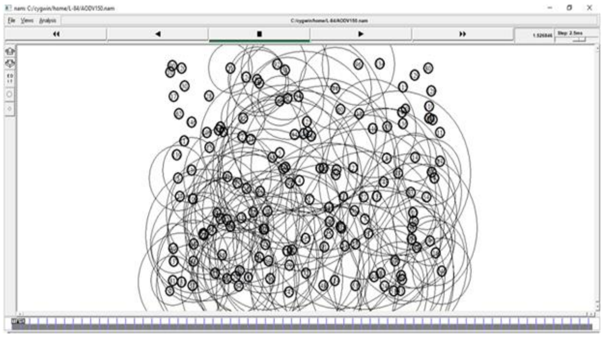

Figure 2. Simulation of Our Model

The other nodes are randomly moved by Random way point mobility at time 1s and a speed of 3 m/sec. A tcp link is initiated between node 0 and node 1 at time 1s, using a routing protocol and also the IEEE802.11 mac protocol. During this tcp protocol, our application is file transfer protocol from source to destination. The form of channel will be set to wireless internet. The Two Ray Ground model is designed to be radio-propagation. The function of the network interface is set as Wireless. The mac type is set to suit in IEEE protocol 802 11 mac. The interface queue type for AODV and DSDV is ready to be Queue/DropTail/PriQueue. DSR type of interface queue is configured to be CMUPriQueue. The layout antenna is designed to be OmniAntenna. The maximum packet is set to 50 in interface queue. We will compare multiple protocols using different sets of mobile nodes. The small variety of node is configured as 10, the medium range of node is configured as 30 and the large wide variety of node is configured as 100 and 150. AODV, DSDV, and DSR are set to the routing protocol. The topography dimension X is set at 950. The topography Y-dimension is set at 700. Simulation end time is set to be 150s. Figure 2 illustrates our simulation environment in this analysis.

Window size of tcp is the size of the receiver's buffer which will influence the flow of transmission. To evaluate the window size of tcp for each protocol is based on the total number of TCP transferred packets.

Table 2. AODV Result of Simulation

	AODV			
	10 nodes	30 nodes	100 nodes	150 nodes
Generated packets	3801	5298	7717	5944
Lost packets	38	15	48	33
Transferred packets	3763	5283	7669	5911
Jitter	0.013072 s	0.024729 s	0.009754 s	0.013046 s
Average Delay	0.231268 s	0.193891 s	0.184348 s	0.251609 s
Average Throughput	17 KB/s	26 KB/s	28 KB/s	21 KB/s
Packet Delivery Ratio	1.00%	0.28%	0.62%	0.56%

Table 3. DSR Result of Simulation

	DSR			
	10 nodes	30 nodes	100 nodes	150 nodes
Generated packets	8102	9276	9181	9036
Lost packets	18	8	8	3
Transferred packets	8084	9268	9173	9033
Jitter	0.010714 s	0.011089 s	0.009848 s	0.009973 s
Average Delay	0.164771 s	0.204117 s	0.197196 s	0.190531 s
Average Throughput	40 KB/s	34 KB/s	33KB/s	33 KB/s
Packet Delivery Ratio	0.22%	0.09%	0.09%	0.03%

Table 4. DSDV Result of Simulation

	DSDV			
	10 nodes	30 nodes	100 nodes	150 nodes
Generated packets	6800	7772	7316	6625
Lost packets	20	12	9	32
Transferred Packets	6780	7760	7307	6593
Jitter	0.008149 s	0.007486 s	0.008523 s	0.010002 s
Average Delay	0.123940 s	0.134735 s	0.132913 s	0.146609 s
Average Throughput	41 KB/s	40 KB/s	38 KB/s	34 KB/s
Packet Delivery Ratio	0.29%	0.15%	0.12%	0.48%

The protocol that can transmit most packets has the best window size. Table 2,3,4 demonstrate the effect of network size on the total number of TCP transferred packets between AODV, DSR and DSDV routing mechanisms, separately. Comparing these total transferred packets, it is easy to know that in the DSR, it has transferred most packets. DSR protocol most suits highly mobile systems among the DSDV, DSR, and AODV. Because according to the simulation results shown in Figure 3, the DSR can transmit most packets in scenario, which is best to highly mobility systems. So the windows size evolution of DSR is better than other protocols when the size of network is enormous. There is negligible impact on window size in DSDV protocol as the size of network extends. But the number of transferred packets is slightly decrease when the size of network increments. The total amount of TCP transferred packets on AODV is less than the others, but increases when number of nodes is enlarged up to 100. We presume that window size in DSR outflanks the other two protocols when organization size is huge.

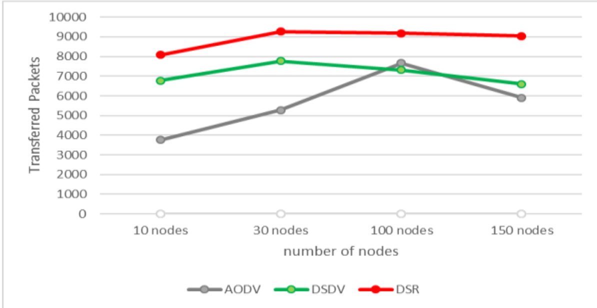

Figure 3. Transferred Packets

Packet loss occurs when one, or extra packets of data traveling throughout a network fail to attain their destination node. Packet loss is measured with respect to packets sent as a percentage of packets lost. If a path to the destination is not available or the buffer that stores pending packets is complete, a packet may be dropped at the source. If the connection to the subsequent hop is broken, it can also be dropped on an intermediate host. Wireless link transmission errors, host mobility, traffic load and buffer overload (congestion) are key causes for packet loss in mobile ad hoc networks. Protocol efficiency will improve if the loss of the packet is low. From Table 2,3,4, AODV has higher packet loss for a few nodes, and the packet loss is significantly decrease up to 30 nodes then the packet loss is highest when the size of network set to 100. But, the packet loss is moderately decrease when the size of network is huge. DSR has higher packet loss for a few nodes. But the packet loss is significantly decrease when the size of network enlarges. The packet loss in DSDV is slightly decrease when the size of network grows. But the packet loss is significantly increase when the size of network enlarges. DSDV outperforms AODV due to the fact the packet loss for DSDV is much less than AODV. In AODV, the packet loss is higher than the other two protocols. In DSR, the packet loss is less than that of AODV and DSDV for all different sets of mobile nodes. So, DSR is the most efficient option at packet loss metric. DSR is the most suitable protocol for real-time applications where packet loss is an important consideration.

Jitter is a latency that varies over time, or when packets are not sent in the same order. Jitter is the variation in the time of arrival of the packet in another phrase. There are no variations or jitters in a network with constant latency. The packet jitter is expressed as an average of the network's mean latency variation. The performance of protocol is better efficiency if the latency between various packets is short. From the results in table 2,3,4, AODV has the highest jitter when the network size is 30 and the lowest jitter when the network size is set to 100. In DSR, jitters are higher for small network sizes. But as the network grows, jitter of DSR decreases. The jitter in DSDV is lower on 10 to

100 nodes. But, there is minimal increase in jitter when the size of network set to 150. However, DSDV gives better jitter performance than AODV and DSR. With the different range of nodes, DSR is more fitting than AODV. AODV shows higher degree of jitter than that of the other protocols.

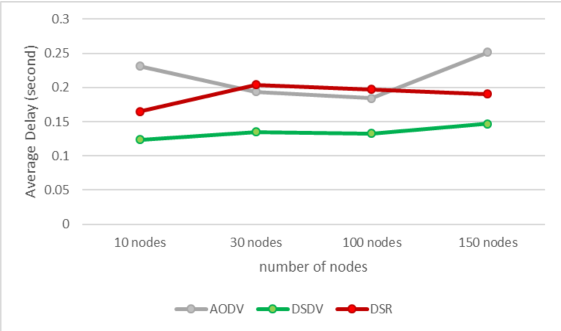

Figure 4. Average Delay

The average delay can be characterized as the average time it takes for data packets to reach the destination through the network from the source [5]. It consists of the queue in the transfer of data packets, the delay caused by route discovery process, MAC retransmission delays, packet propagation and transfer times. In a routing protocol, a lower average delay value represents powerful protocol, fast route convergence, and packets transiting the optimal path. Table 2,3,4 display the effect of network size on average delays for AODV, DSR and DSDV, respectively.

Figure 4 displays average delay outcomes of our simulation for the routing protocols. It indicates that AODV has higher delay for a small number of nodes and the delay is moderately decrease up to 100 nodes then the delay starts significantly increase when the size of network increases. DSR has higher delay for a small number of nodes due to the delay of DSR significantly increases when the network size is extended to 30 nodes. But the delay is slightly decrease when the size of network enlarges. DSR become more suitable in a large number of nodes compared to AODV. DSDV protocol outperforms the other two routing protocols because it has lower delay. But the delay is slightly decrease when the size of network grows. In average delay metric, AODV gives worst form comparing with other protocols and is suitable for medium sized network. DSDV is suitable for applications where delay is an important consideration.

Throughput is the proportion of how quick we can really send packets through the network [2]. The quantity of packets that are sent to the destination gives network throughput. The proportion of the aggregate sum of data that a source gets to a destination to the time it takes for the destination to get the final packet is known as throughput. The efficiency is better when it's higher throughput. It represents to a powerful throughput network. For AODV, DSR and DSDV routing protocols, respectively, Table 2,3,4 display the effect of network size on the throughput.

From Figure 5 we noticed the DSDV has higher throughput, AODV has lower throughput, and

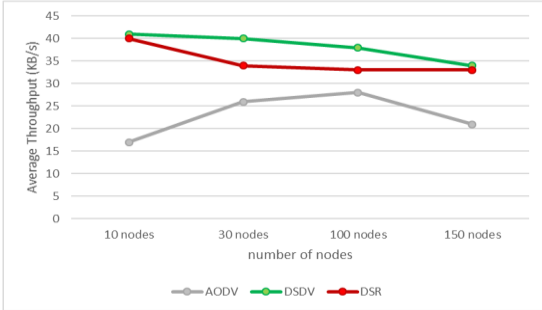

Figure 5. Throughput

both of DSDV and DSR act the same performance. Throughput in DSDV and DSR declines moderately as a number of nodes increase, but the better impact is observed in AODV where throughput increases appreciably as network size increases. But the throughput in AODV is slightly decrease when the size of network is over 100 nodes. We presume that DSDV outflanks the other two routing protocols and it is generally appropriate for small networks. For large networks, DSR is generally suitable because throughput in DSR does not decline at over 100 nodes.

The packet delivery ratio is the ratio of packets delivered successfully to the destination to the packets generated by the source. It reflects the success rate of packet transmission that is in an exceedingly given period, what percentage packets out of the overall packets that were transmitted can reach the destination. It is a process of packet loss because of route congestion, network queuing delays, and efficiency of routing algorithms. An effective routing protocol guaranteeing a large proportion of the packet transmission. Performance is higher when the delivery ratio for the packets is closer to one. Table 2,3,4 demonstrate the effect of the packet delivery ratio for the routing protocols AODV, DSR and DSDV, severally.

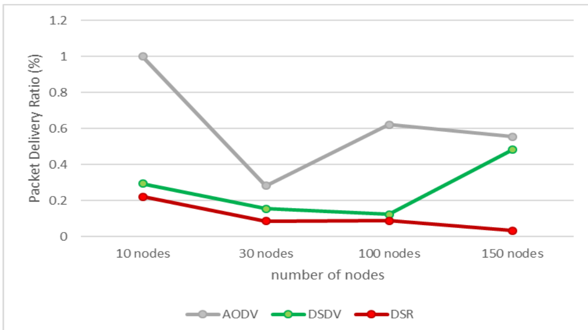

Figure 6. Packet Delivery Ratio

From Figure 6, we know that AODV has higher PDR for small number of node, and it considerably declines at 30 nodes and considerably increases at 100 nodes. However, AODV has had better packet delivery ratio than DSDV and DSR. Packet delivery ratio of DSR is extremely less than compared to AODV and it slightly declines as network size increases. Each of DSDV and DSR act a similar performance on packet delivery ratio and DSDV declines slightly as a number of nodes increase. But the better impact is observed in DSDV where packet delivery ratio increases appreciably as network size increases over 100 nodes. We have a tendency to conclude that AODV achieves the best packet delivery ratio performance but, if we consider the impact of large network size, DSDV also achieves optimum performance.

5. CONCLUSIONS

In future networking, wireless networks are anticipated to work an essential role. Because of common properties with respect to connection characteristics, node mobility and alterable network size, routing protocols in wireless networks are complicated whenever contrasted with wired networks. There are a variety of routing protocols being approved in ad hoc wireless networks that are absolutely different within the results from one another. The performance comparison between DSR, AODV and DSDV has been proposed in this paper to verify exactly which protocol is more powerful. We have used ns2.35 for simulations. NS2 visual trace analyzer has used to assess the performance of these protocols with regard to the variable number of nodes in relation to the performance metrics. The simulation results for window size in tcp, packet loss, jitter, throughput, average delay and packet delivery ratio show that with increase in networks size, Random way point mobility model and transmission control protocol as type of traffic. From the analysis of the graphs obtained from the simulation of the protocols shows that, window size in DSR outperforms than the other two routing protocols when the network size is huge. The most successful option for packet loss metrics is DSR, since the packet loss for all separate sets of mobile nodes is lower than that of AODV and DSDV. In jitter performance, DSDV achieves greater effectiveness than AODV and DSR. At average delay metric, DSDV is ideal for applications wherever delay is a critical factor. In throughput metric, DSDV outflanks the other two routing protocols and it is especially perfect for smaller networks. DSR is typically ideal for large networks because throughput in DSR does not decline to more than a hundred nodes. AODV achieves the most efficient results on the packet delivery ratio. If we prefer to observe the combined effect of network size, window size in tcp, throughput, average delay and packet delivery ratio, DSR is the most efficient option for large networks.

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