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PERFORMANCE ANALYSIS OF PROACTIVE AND REACTIVE ROUTING PROTOCOLS IN MANET

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ABSTRACT

Mobile Ad-hoc Network (MANET) routing is considered a challenging task because of the unpredictable changes in the network topology due to the absence of any centralized control. This routing has led to the development of several different routing protocols for MANET. Thus, it is hard to decide which of these protocols act better than the others. The objectives of this study are of two folds. First, this study provides a performance comparison of MANET routing protocols in terms of delay, packet lost, throughput, jitter, packet delivery ratio (PDR), and normalized routing load (NRL). Second, this study identifies whether MANET routing protocol has an impact on the artificial disaster and suggests which protocols may perform better. The simulation results show that Destination Sequence Distance Vector (DSDV) protocol provides better throughput and PDR with less jitter, delay and NRL for low or high-traffic load and mobility. However, DSDV still has performance limitations with packet loss parameter. Additionally, the results obtained show that DSDV gives a great improvement for using network resources, especially when the number of connections is high with low mobility.

KEYWORDS: MANET, routing protocol, artificial disaster, network simulation 2.

1 INTRODUCTION

Mobile Ad-hoc Network (MANET) is a group of devices or nodes which communicate with each other with no need to the availability of fixed pre-installed physical infrastructure or a service providing organization. The nodes in MANET are responsible for keeping the end-to end communication link alive by dynamically discovering the nearby nodes.

MANET's main benefit and advantage allow devices and people to seamlessly internet work in places without pre-existing communication infrastructure. Therefore, this idea is deployed in various applications, such as disaster recovery, games, and groupware. Also, many applications interested in providing video materials like video on demand and real-time video streaming, which also depend on MANET.

Generally, routing can be considered as a main networking issue for sending data from one node to another. In MANET and other networks, which are built to provide the needed communications, are limited or no networking infrastructures are available by depending on mobile devices to create a dynamic and temporary network.

Each category has its own list of protocols developed to meet specific applications, mainly reactive, proactive and hybrid protocols which derive their significance from depending on algorithms and their application support. The main target of this paper is studying and analyzing four traditional routing protocols of MANET with low or high traffic and mobility, respectively in order to confirm, which is the most suitable protocol that saves the network resource consumption.

2 Routing protocols in Manet

Scalability can be defined as the network's ability to give an acceptable service quality in the presence of the large number of nodes. It can be considered an important issue accompanying ad-hoc networks due to the dynamic nature of these networks when nodes are free to join or leave. Regarding the ad-hoc routing protocols, they can also be considered as one of the factors that limits the scalability of the ad-hoc networks. Quality of Service (QoS) can be defined as a term in which a network confirms its capability to provide a specific performance in terms of the quantities of delay, bandwidth, packet loss, and jitter. QoS of a wireless network is not guaranteed and still considered as an open issue due to the difference in the link's quality and stability used by the routers which are usually asymmetrical links.

Energy consumption is another factor that needs to be considered in ad-hoc networks. Mobile nodes have limited power resource and each node act as end host, as well as intermediate node. Because each node in the network needs to route on any traffic to the other nodes. The energy-efficiency issue become an important factor that has a negative impact on the network performance.

Security is also a critical issue of the ad-hoc networks because networks are wireless and operate in open shared radio medium. Therefore, in unsecured conditions, they will be good targets for malicious attacks which could results in actions, such as the Denial of Service (DoS). However, many peculiar features of the adhoc network increase the security risks, and the most serious security problem is the possibility that one of the nodes could be captured and the node is considered as a part of the entire network.

2.1 Classification of routing protocols in Manet

MANET routing protocols have to adapt fast to the frequent changes in topology that is also unpredictable. It has to be effective in properly utilizing the network resources. The protocols are classified into three: proactive (table-driven), reactive (on-demand) and hybrid. Figure-2 shows the classification of MANET routing protocols. Every group has various routing strategies that employ a hierarchical or flat structure of the routing.

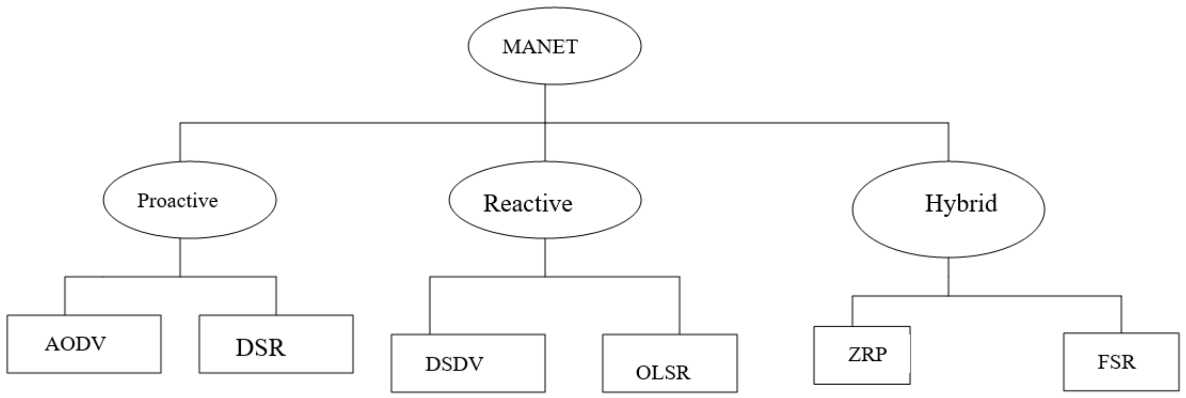

Figure 1 Routing Protocols of Manet

2.1.1 Proactive Routing Protocols

Pro active routing protocols provide a route for on demand flow of information. Hence, routes are decided and maintained for nodes that need to send data to a specific destination. However, the node could remain idle or active for participating in the process of forwarding for serving other source nodes. Reactive protocols consume less resources while the nodes remain idle for discovering a route.

Ad-hoc On-demand distance vector (AODV)

AODV is a reactive routing protocol that establishes a route when a node needs to send data packets. AODV is capable of multicast, as well as unicast routes. It does not maintain routes from all nodes to all other nodes in the network. It performs route discovery by control message Route Request (RREQ) and Route Reply (RREP). Routes in AODV are set up by flooding the network with packets of RREQ, which however does not collect the traversed hops' list. Instead, as a RREQ traverses through the network, the traverses mobile nodes keep the information regarding the source, destination and the mobile node from which they accepted the RREQ. Later information is used for setting up the reverse path back to the source. When a mobile node is reached by RREQ, it knows a destination route or the destination itself; the mobile node gives a response to the source with a data packet (RREP), which is routed via the reverse path and set up by RREQ. This sets the route forward from source to destination.

Dynamic source routing (DSR)

DSR is quite simple, as well as efficient proactive routing protocol that is designed to be used in MANET. It is used for delivering to the target node by using route cache that can be updated periodically for enabling new route detect node to get updated. When a packet reaches the target node, a sender got to input information inside the packet header for following the direction with the purpose of reaching the target node and for identifying hops addresses by the next node, and even to forward to the needed destination.

DSR protocol uses two algorithms that work combined for the discovery and maintenance of source route. First, Route Discovery (RD) is the mechanism through which a source node that tries to send a packet to a destination node gathers a source route to the destination. This is utilized just as the source node tries to send a packet to a different node and does not have the knowledge of the route. Second, Route Maintenance (RM) is the mechanism through which the source node is capable of detecting the failure of the source route to the destination because the network topology changes.

2.2.2 Reactive Routing protocols

In Reactive routing protocol every node maintains information regarding routing to other nodes in the network. Routing information is kept on various tables. These tables get updated periodically or when the topology changes. Difference among them exists in the way in which the routing information gets updated, and detects the kind of information maintained in the routing tables.

Destination sequence distance vector (DSDV)

DSDV is a proactive unicast MANET routing protocol DSDV is based on conventional algorithm of 'Bellman-Ford' (BF). Table driven DSDV protocol is an advanced version of 'Distributed Bellman-Ford' (DBF) algorithm that has been successfully utilized in various dynamic packets switched networks. The BF method offers a way for calculating the minimal paths from source node to a destination node if the metrics to every link is known. DSDV makes use of this idea and overcomes the tendency of DBF for creating routing loops by including a parameter known as the destination-sequence number. In DSDV, each node is needed to transmit a sequence number that is periodically increased by two and transmitted along with other messages of routing updates to every nearby node.

Optimized link state routing (OLSR)

OLSR is considered as one of the proactive routing protocols. Each node has a route table containing information regarding routing of all nodes in the network. As such, the routes are ready to use right away all the time as required. OLSR is one of the optimized versions of link-state protocol. Therefore, the topological alteration results in the inundation of information regarding the topology to every attainable node in the network. OLSR protocol uses Multi-Point Relays (MPR) for reducing potential network overheads. The whole idea of MPR is to decrease inundation of broadcasts via the reduction of the same broadcast in certain parts of the network and for providing the minimal path. OLSR utilizes such control messages as Topology Control (TC) and Hello.

OLSR also has Multiple Interface Design (MID) for allowing the nodes to have multiple OLSR interface addresses and for providing external routing information, enabling the routing possibility for external addresses. Based on this information, the ad-hoc network nodes act as gateways for other possible networks.

3 Simulation Setup and Performance Metrics

Network Simulator 2 was used for this simulation. This is quite common in the ad-hoc network community. Continuous Bit Rate (CBR) is the traffic source used, and the size of the packet data was 512B. The rate at which data were sent is 4 packet data per second. The source destination pairs were spread randomly in the network in a 1000m x 1000m rectangular file. The simulation time was 200 seconds and the maximum speed of a node was 10 m/s. Various network scenarios with different pause times of 10 to 50sec were applied. From 20 to 100 maximum connections with 200 nodes (high density) were generated.

3.1 End-to-end delay (E2E)

It is defined as the average delay in time for the packets of data from source node to reach the destination node. The performance is good when the packet E2E delay is low.

3.2 Packet Lost (PL)

It is defined as the ratio of the number of packet data lost while getting transmitted from the source. The performance is good when the PL is low.

3.3 Throughput

It is defined as the total data amount which gets to the receiver from the sender, and the time it takes for the receiver to receive the final data packet. The performance is good when the throughput is high.

3.4 Delay-variation (Jitter)

It is defined as the variation in the delay of the data packets received. The performance is good when the jitter is low.

3.5 Packet delivery ratio (PDR)

It is defined as the ratio between the number of packets created through the application layer sources, and the number of packets received by the sinks at the end destination.

3.6 Normalized routing load (NRL)

It is defined as the number of routing packets transmitted per data packet delivered at the destination.

4 RESULTS AND DISCUSSIONS

4.1 Effect of traffic load

To analyze the traffic load effect, the maximum number of connections was varied as 20, 40, 60, 80, and 100 connections. The network was simulated for a pause time 20 sec. Figures-3-8 show the traffic load effect for AODV, DSR, DSDV, and OLSR protocols regarding the various performance metrics.

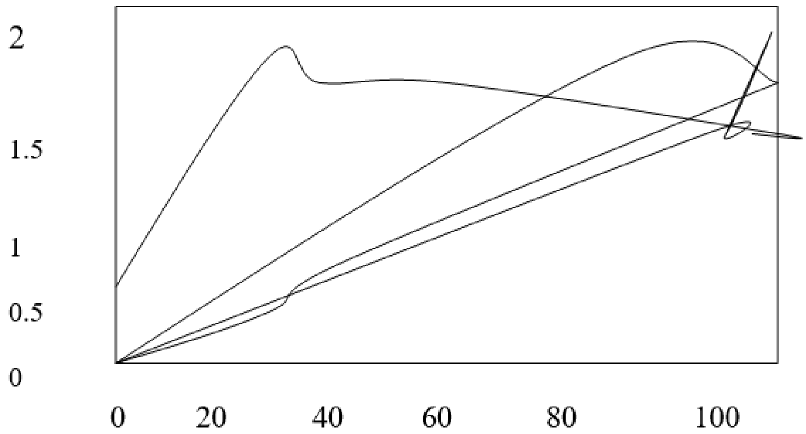

Figure 2: E2E delay vs traffic load Maximum no of connections

End-to-end delay result

End-to-End delay is small for DSDV as compared with OLSR, DSR and AODV. This is because DSDV is a proactive protocol, where all routing information is already stored in the table. DSDV takes less time when compared with others. When traffic load differences occur, no effect exists on the DSDV protocol performance. OLSR has a better performance when compared to DSR and AODV, but it is not better than DSDV. Because OLSR maintains a routing table for every possible route and two hop neighbor knowledge needed, then the end-to-end delay increases as the number of connections increases. This, this study indicates that DSDV reliability is better than OLSR, AODV, and DSR.

4.2 Packet loss result

As traffic load increases, performance decreases because of the increases of the load compared to the limited bandwidth. Each packet in OLSR and DSDV are dropped if the MAC layer cannot find an alternative route to deliver. DSDV and DSR drop more packets than OLSR and AODV do. DSDV and OLSR incur the highest packet loss, as both are proactive, and they have all information related with each node. The performance of DSDV decreases as it drops more numbers of packets at higher mobility. This is attributed to the single route for every destination, as maintained by DSDV. Because there are no alternate routes, the packets undeliverable by MAC layer are dropped.

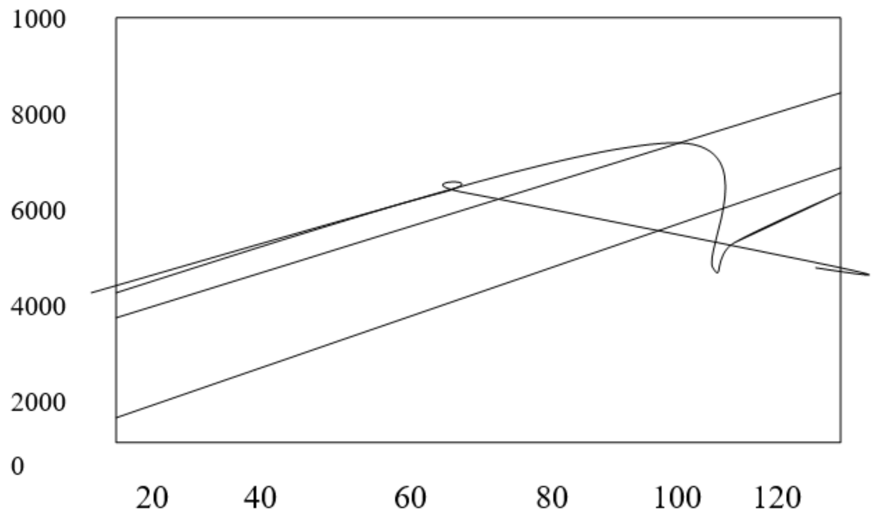

Figure 3 PL Vs Traffic load Maximum no of connections

4.3 Throughput result

It is understood that under low traffic AODV has a maximum throughput, whereas the throughput of DSDV is maximum under high traffic. As the density of the network increases, the performance of DSDV becomes better than AODV, OLSR and DSR, and this is mainly attributed to the avoidance of a loop free by DSDV and latency resulting from the discovery of a route. DSDV at lower and higher pause time performs well, but when the pause time increases, its performance increases; the performance is best at high pause times. AODV and DSR, the two On demand.

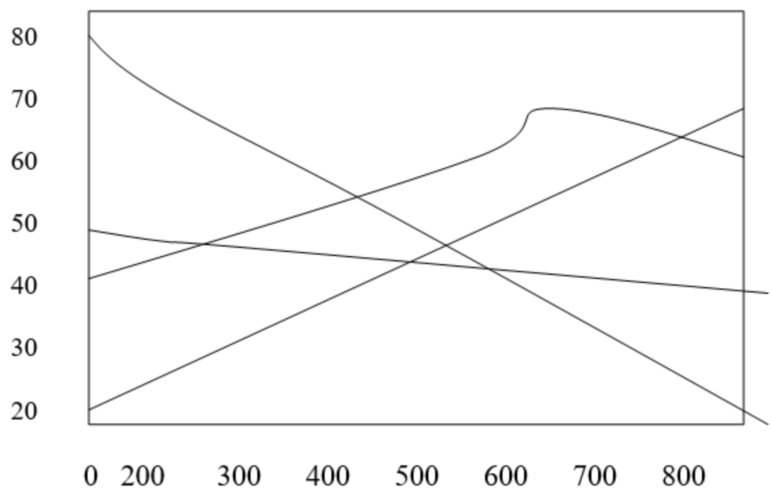

Figure 4: Throughput Vs traffic load Maximum no of connections

Protocols, drop a significant number of packets during route discovery because route acquisition time is proportional to the distance from the source to the destination. DSR has higher drop rate than AODV. Hence, when a route expires, AODV drops some packet, thereby making use of route expiry for new route discovery. OLSR protocol.

4.4 Jitter result

Jitter given by DSDV, as well as OLSR is the least when the traffic is low and high, which is illustrated in Figure-6. It is noted here that OLSR and DSDV with random way point mobility of nodes deliver data packets efficiently in both models of traffic because PDR relies on the neighborhood information periodic broadcast the source node needs to put the whole information of route in the data packet each time before sending to the destination. Hence, the delay in node processing is increased, which results in an increased jitter value. This establishes the fact that jitter is less in DSDV and OLSR as compare with the other two protocols, AODV and DSR.

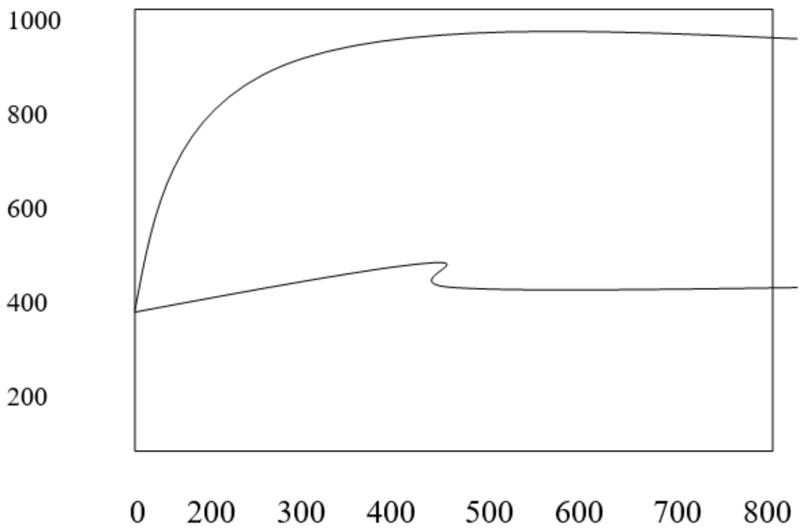

Figure 5: Jitter Vs traffic load Maximum no of connections

4.5 Packet delivery ratio result

As the number of nodes increases when the network traffic increases, then PDR performance diminishes. When comparing DSDV with DSR, AODV and OLSR, DSDV's performances are better when there are more numbers of connections in the network. DSR and AODV's performances are good, but they decrease as the number of connections in the network increases. DSDV always maintain the optimal path to destinations in their routing table, and the table is updated periodically. At moderate traffic, the packet delivery ratio in DSR is lower compared to AODV because of the number of hops increasing with an increase in traffic. When mobility increases, DSR has a lower performance because of its stale route cache issue and source path routing.

4.6 Normalized routing load result

AODV has a higher normalized routing load when compared with DSDV, OLSR and DSR due to its request broadcasting. As the connections increase, request propagation also increases. For confirming the connectivity of every node pair, AODV uses HELLO Message. This results in bigger overhead than that of DSDV. In moderate traffic, DSR's performance is better than AODV because DSR uses source routing, as well as the packet header length is not large at low to moderate traffic. At high-traffic, OLSR performs better than DSR as flooding is minimized by OLSR using MPR.

Routing overhead of AODV is more than that of DSDV, DSR and OLSR, as it generates more control packets for finding new routes to the destination. When nodes are at higher mobility, this increases NRL. Thus, it can be concluded that DSDV is the best protocol, which suits dynamic networks.

5 CONCLUSIONS

The eligibility of a routing protocol can be analyzed by metrics which measure its performance and suitability. This metric should be independent of any given routing protocol. DSDV protocol provides higher throughput and packet delivery ratio with less jitter, end-to-end delay and normalized routing load for low or high-traffic load and mobility because DSDV always gets the best path to destination, based on its routing table, and this table is being updated periodically. However, DSDV still has performance limitations with packet loss parameter in which AODV shows higher performance than DSDV, and the other two protocols like DSR and OLSR. DSDV protocol provides higher throughput and packet delivery ratio with less jitter, end-to-end delay and normalized routing load for low or high-traffic load and mobility because DSDV always gets the best path to destination, based on its routing table, and this table is being updated periodically. However, DSDV still has performance limitations with packet loss parameter in which AODV shows higher performance than DSDV, and the other two protocols like DSR and OLSR.

Thus, this leads to overload on the available network resources. Based on the obtained results, DSDV gives a great improvement for using network resources, especially when the maximum number of connections is high with low mobility, thus making it a better routing protocol that can be used in the disasters and emergency recovery applications.

A quantitative comparison of the ad-hoc routing protocols is difficult because the simulations are not dependent on one another and use various metrics and simulators for each of them. This study achieves a realistic comparison of the reactive and proactive protocols, which are DSDV, OLSR, DSR and AODV used in MANET high and low traffic and mobility under 200 nodes.

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