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Comparing Packet End to End Delay of Reactive Protocols with respect to Simulation Time, Packet size and Mobility

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Abstract

The essential component of mobile node communication is routing protocols. It outlines the protocols that routers use to exchange data with one another so they can choose the best routes between network nodes. On the Internet, routers are responsible for directing traffic. Data packets are routed from one router to another over the network until they arrive at their intended computer.MANET routing methods are designed to adapt to dynamic changes in topology, reducing latency, average jitter, and packet loss, and optimizing throughput and packet delivery ratio. Traditionally, there are two classifications for protocols. Routes are acquired and maintained on-demand by nodes, which classifies reactive protocols. All nodes having routes to every destination in the network at all times characterize proactive protocols.

Routes are only created by reactive protocols when they are required. The process of finding a route inside the network is started by the source. After routes with potential route variants have been analyzed, this step is finished. Packet delivery ratio is the ratio of total packets sent from source node to destination node in the network divided by total packets delivered.The time interval between when a packet leaves the source application and when it reaches its destination is used to compute the end-to-end latency.Finding the packet end-to-end delay performance of MANET routing protocols in terms of simulation duration, packet size, and mobility is the goal of this paper's simulative investigation.

1. INTRODUCTION

Network performance is directly impacted by the coordination of routing protocols. For MANETs, the Reactive Routing mechanism (RRP) is an on-demand routing mechanism that uses less bandwidth. The goal of RRP is to be implemented at the ISO OSI reference model's layer 3, or the network layer of mobile nodes. The protocol's route maintenance and discovery features are explained next.

1.1 Functioning of RRP

RRP differs from prior proposed on-demand routing protocols in that it employs the Incremental Search Method (ISM), making it more bandwidth-efficient. Each node in this RRP technique has a list of its near neighbors—that is, the nodes with whom it has a direct communication link—inside it. Every node occasionally sends out "Echo" packets, which are instantly returned by the node that receives them, in order to maintain the neighbor list. In addition to being used for route maintenance and discovery, the neighbor list may also be employed for further protocol improvements. When a node gets a route discovery packet, it searches its neighbor list and routing databases for a route to the target node. If a node discovers a path to the target node, it will send the target node a route verification packet so that it may respond by sending a route confirmation packet back to the source node. This is to make sure that there are no errors and that the route is legitimate. The source node may assume that a route is no longer legitimate if it does not receive a route confirmation packet within the timeout window that is associated with each sending of a route verification packet.

When more than one route from the originator to the destination is returned by a route discovery process, the originator would store the best route in its Active Routing Table and the other routes in its Passive Routing Table. The main benefit of this approach is that, thanks to their temporary routing tables, source and other intermediate nodes can determine the routes to multiple other nodes in the network besides the target node. This lowers the routing overhead for subsequent route discoveries and increases the bandwidth efficiency of RRP.The Surroundings Repair Method (SRM) in RRP is used to identify broken links and restore a route that already exists. The source node starts the Surroundings Repair Method for any routes listed in its Active Routing Table that utilize the target node as their next hop when it can no longer forward data packets to that node because of a break in its connection.

The benefit of the Surroundings Repair Method is that, should a route be successfully repaired, the overhead associated with commencing the designer node's search for a new route and returning an invalid route packet to the originator node is avoided. Thus, the Surroundings Repair Method improves the overall bandwidth efficiency of the MANET.Ad hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR), Temporally Ordered Routing Algorithm (TORA), and Associativity-Based Routing (ABR) are a few instances of reactive protocols.

2. An overview of the DSR, TORA, and AODV reactive protocols

2.1 Distance Vector Routing on-demand Ad Hoc (AODV)

AODV is a member of the Distance Vector Routing Protocol (DV) family. Every node in a DV is aware of its neighbors' nodes and the distances needed to get there. Reactive routing protocol Ad hoc On Demand Distance Vector (AODV) initiates a route discovery process only when it needs to send data packets. In AODV, route finding is referred to as on-demand. Each intermediate node on an active route recognizes the possibility of a link break to an upstream node and re-establishes a new route before a route break, resulting in a novel route maintenance method to prevent route breaks.

The three mechanisms that make up AODV are the route maintenance, route message production, and route discovery process. The key benefit of AODV is that it does not increase packet overhead anytime a route is available from source to destination. The route discovery procedure, however, is only implemented when routes are either abandoned or ended and subsequently rejected. The impacts of stale routes are mitigated by this tactic. Additionally, it is brought out that underutilized routes need upkeep. The capability of AODV to provide broadcast, multicast, and unicast communication is another distinctive characteristic.

2.2 DSR, or dynamic source routing

One healthy example of an on-demand routing technology is Dynamic Source Routing (DSR). It is predicated on the source routing model. It is a routing system used in networks using wireless mesh. In that it creates a route on-demand in response to a transmitting node's request, it is comparable to AODV. But rather than depending on the routing table at every intermediary node, it employs source routing. During route discovery, obtaining the address of every device between the source and destination is necessary for determining source routes. Nodes sending route discovery packets store the information about the obtained path. Packets are routed using the learnt pathways. Each device's address will be included in the routed packets that traverse in order to complete source routing. In the case of IPv6, this might lead to significant running costs for lengthy pathways or big addresses. DSR optionally includes a flow id option that allows packets to be routed hop-by-hop in order to circumvent the need for source routing.As a result, it is specifically developed for use in mobile node multihop ad hoc networks. DSR enables total self-organization and configuration of the network. It doesn't need any administrative or network infrastructure that already exists. Route Discovery and Route Maintenance, the two techniques that make up DSR, cooperate to enable nodes to find and maintain source routes to any destination in the network. DSR's source routing gives it a distinct edge. Routing loops, whether short- or long-lived, cannot arise because they can be quickly identified and removed. The route is an integral component of the packet. This characteristic allows for a number of practical protocol optimizations.

2.3 The Routing Algorithm with Temporal Order (TORA)

Based on the idea of link reversal, the Temporally Ordered Routing system (TORA) is an extremely flexible and effective distributed routing system. The TORA is a non-hierarchical, "flat" routing method that aims to provide great scalability. When the algorithm runs, it makes every effort to prevent the creation of long-range control messages from spreading as much as feasible. A Directed Acyclic Graph (DAG) with a destination routed is created and maintained by TORA. The height of any two nodes cannot be the same. Higher level nodes may exchange information with lower level nodes. Thus, information may be compared to a liquid that may only travel in one direction. Loop-free multipath routing is achieved by TORA by preserving a collection of fully ordered heights at all times. Information cannot travel back on itself or "flow uphill."TORA is suggested for highly dynamic multi-hop mobile wireless networks. If a network splits, the protocol finds the split and removes any erroneous routes. The three fundamental operations of the protocol are route generation, route maintenance, and route erasure.

3 End-to-End Packet Delay

3.1 Measures of PerformanceMobile ad hoc networks may gain a great deal from effective routing protocols in terms of dependability and performance. Routing protocols are assessed using certain performance measures. They depict many aspects of the overall network performance that are necessary to meet the quality of service (Qos) requirements. The packet end-to-end latency measure has been used in this report's evaluation and comparisons to examine its impact on the overall performance of the network.

The ns2 simulator was used to run the simulation, which contrasted the TORA, DSR, and AODV protocols. The broad concepts from earlier simulation research were adhered to. First, we create scenario files in the simulation, taking into account the 1050 m*600 m space. and separated them into the following three groups.

1. Scenario files (25 files) for changing the simulation duration while maintaining a consistent number of nodes (42), speed (10 m/s), and pause period (100 sec).

2. Scenario files (25 files) with different packet sizes, while maintaining a constant number of nodes (42) and speed (10 m/s) and pause time (2 sec).
3. Scenario files with varying mobility speeds while maintaining a constant 42 node count and pause time. (Twenty-five files).Using the cbrgen function of ns2, traffic files are created after the generation of scenario files. The number of nodes for a certain file was stated as the

maximum number of connections, and packets per second was used to specify the data transfer rate. The creation of 120 trace files, each with a volume ranging from 1 gigabyte to 50 gigabytes, demonstrated the computer system's high processing speed and enormous storage capacity prior to the simulation. To create the trace files for the different protocols, a Tcl script was run. Additionally, it took a long time—some simulations required between 15 and 20 hours to produce a single trace file, particularly when there were many nodes involved. next an awk script analysis of these 120 trace files, we arrived at conclusions on the different parameters to be computed and presented the graph as shown in the next section. Ten minutes, or 600 seconds, were spent on each simulation.

3.2 End-to-End Packet Delay

The average time a packet takes to travel throughout the network is known as the packet end-to-end delay. This is the amount of time, measured in seconds, that elapses between the source's packet creation until the packets are received at the destination's application layer. Finding the mean of the end-to-end delays of all messages that are delivered productively will provide the average end-to-end delay. As a result, the packet delivery ratio influences end-to-end latency in part. The likelihood of a packet dropping increases with increasing distance between the source and the destination, taking into account all delays brought on by queuing, buffering, retransmission, propagation, and transfer durations.

The amount of packet delay required varies depending on the application. While certain applications, like File Transfer Protocols (FTP), may be tolerant of delays up to a certain point, delay-sensitive applications, like speech, need a low average delay in the network. Node mobility, packet retransmissions because of weak signal strengths between nodes, connection breakdown and creation are the characteristics of MANETs. This is the cause of the network's increase latency. Therefore, the end-to-end latency serves as a gauge for a routing protocol's adaptability to different network restrictions and as an indicator of its dependability.

4. Performance Metrics Comparison

The effectiveness of the reactive procedures TORA, DSR, and AODV as each was discussed in the preceding sections. The packet size (625 bytes), mobility (15 m/s), and sample simulation time (20 sec) are used to compare the aforementioned protocols in terms of metrics. The table and bar graphs that follow illustrate and explain their findings.

4.1 Packet End-to-End Delay Comparison in Relation to Simulation

The comparison of reactive protocols and their performance metrics values for the 20-second simulation period is shown in Table 1 below.

Table 1: Relation to Simulation (20 Sec)

Performance metrics	AODV	DSR	TORA
Packet Delivery Ratios	0.95	0.95	0.29
End - End Delay	55.43	353.3	878.46
Throughput	324.72	382.8	516.2
Route overhead	0.231	0.44	2.7
Energy Used	59.4	54.8	109

The X-Graphs Shown in figure1 represents End to End Delay and AODV, DSR & TORA with respect to Simulation Time. The graphs illustrate the results of End to End Delay with Simulation Time, taking Simulation Time along the X-axis and End to End Delay along the Y-axis. In the graph lines and bars in green colour represents AODV, red colour represents DSR and blue color represents TROA.

AODV performs best as it is constant. DSR delay increases at 20 s and decreases at 25s. In TORA the delay has very drastic variations, it increases gradually at 15s and decreases gradually at 20 & 25s. DSR shows better performance than AODV. As AODV requests more time in route discovery, it creates more End-to-End delay.

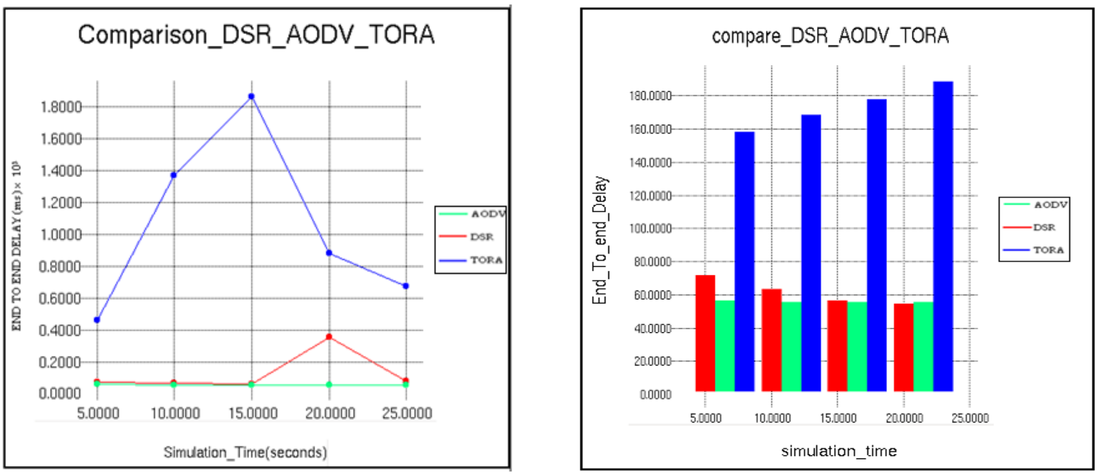

Figure 1: End to End Delay Vs Simulation Time for AODV, DSR and TORA

The authority of DSR comes from the nature of its routing operation. As a reactive protocol, DSR sends routing traffic into the network only when the source has data to send thus eliminating the overhead due to unnecessary routing traffic. DSR uses source routing in its operation thereby making the source aware of the entire path the packets will flow. All intermediate nodes use cached information to relay traffic and do not send replies during route discovery. Only the destination node sends the replies to route requests. The presence of multiple routes in DSR reduces the number of route discoveries in case of link failure. These factors coupled with the absence of periodic updates in DSR, has the net effect of reducing the amount of routing traffic.

4.2 Comparison of Packet End-to-End Delaywith respect to Packet size

Below Table2shows the comparison of Reactive protocols and their Performance metrics values with respect to the Packet Size (625 bytes).

Table 2: Packet size (625)

Performance Metrics	AODV	DSR	TORA
Packet Delivery Ratio	0.99	0.992	0.35
End to End Delay	55.75	589.42	382.6
Throughput	332.3	436.04	536.7
Route overhead	0.231	0.752	2.4

Energy Consumption	38.754	40.711	97.5

The X-Graphs Shown in figure 2 represents End to End Delay and AODV, DSR & TORA with respect to Packet Size. This graph illustrates the results of End-to-End Delay with Packet Size, taking Packet Size along the X-axis and End to End Delay along the Y-axis. In the graph lines and bars in green colour represents AODV, red colour represents DSR and blue color represents TROA.

AODV performs best as there is gradual increase in the delay. In DSR delay varies as the packet size varies. In TORA the delay has very drastic variations; it decreases for 512 bytes increases gradually for 712 and decreases at 850 and once again increases for 1024 bytes. DSR shows better performance than AODV. As AODV requests more time in route discovery, it creates more End-to-End delay.

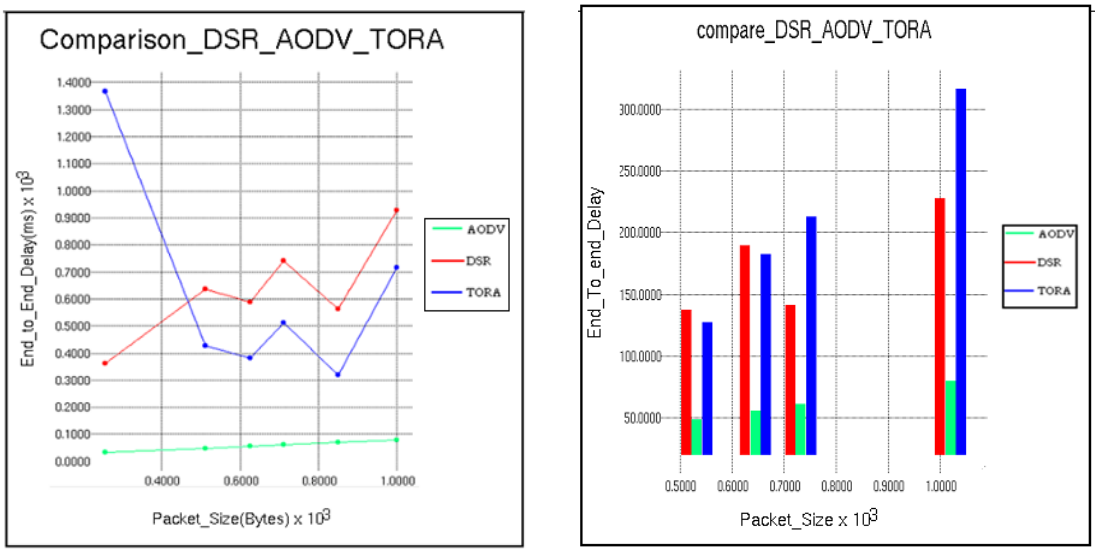

Figure 2: End to End Delay Vs Packet Size for AODV, DSR and TORA

4.3 Comparison of Packet End-to-End Delay with respect to Mobility

Below Table3shows the comparison of Reactive protocols and their Performance metrics values with respect to the Mobility 15m/s.

Table 3: Mobility (15)

Performance Metrics	AODV	DSR	TORA
Packet Delivery Ratio	0.99	0.99	0.27
End to End Delay	56.1	60.28	404.68
Throughput	332.39	320.9	427.90
Route overhead	0.23	0.32	3.44
Energy Consumption	39.81	37.95	97.49

Figure 3's X-Graphs depict end-to-end delays as well as AODV, DSR, and TORA in relation to mobility. With Mobility on the X-axis and End-to-End Delay on the Y-axis, this graph shows the outcomes of End-to-End Delay with Mobility. Lines and bars in the graph are colored green to show AODV, red to represent DSR, and blue to represent TROA.

This graph displays the end-to-end latency in relation to node mobility and speed in milliseconds. The performance of DSR and AODV is similar since the delay increases gradually at high mobility. The latency in TORA varies quite sharply; with low movement, it lowers, and at high mobility, it rises.

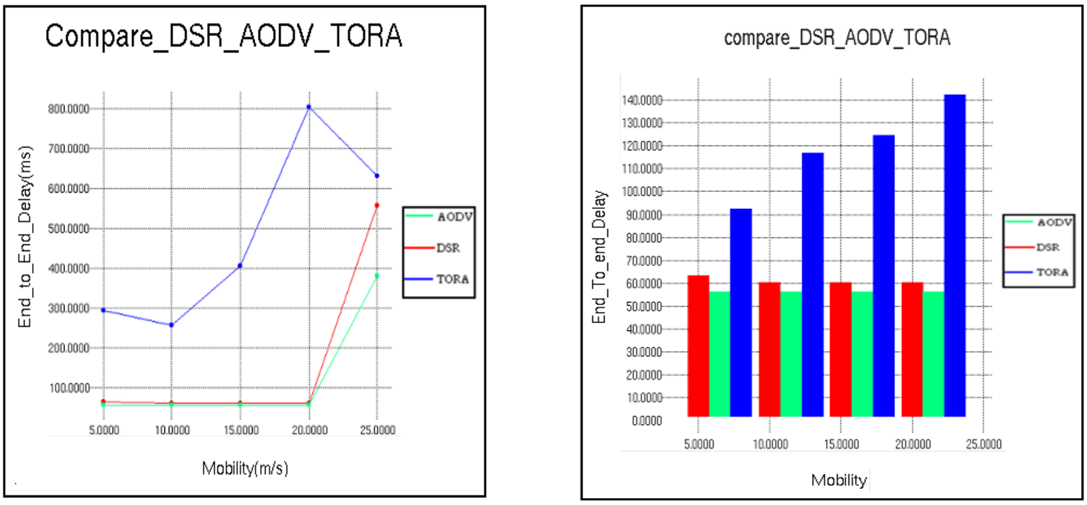

Figure 3: End to End Delay Vs Mobility for AODV, DSR and TORA

5. CONCLUSION

This study compares the reactive routing protocol's packet end-to-end latency metric, as represented by AODV, DSR, and TORA. According to the experimental findings, TORA provides less delays in terms of end-to-end latency as, in the event that one connection link fails, another is prepared to deliver data, ensuring that data is always sent consistently and without needless delay.

Every time AODV routes, it sends request and reply messages, adding needless latency to the process. For somewhat mobile traffic, DSR performs better. We want to investigate other performance indicators related to simulation time, packet size, and mobility in our next work.

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