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A COMPARATIVE ANALYSIS OF PROACTIVE ROUTING PROTOCOLS (DSDV, OLSR) & REACTIVE ROUTING PROTOCOLS (AODV, DSR) IN MANET USING NS-3

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ABSTRACT

The abstract outlines a comprehensive analysis focusing on routing protocols in Mobile Ad Hoc Networks (MANETs). Ad-hoc networks are dynamic wireless networks without a central infrastructure. This analysis compares two types of routing protocols—proactive (table-driven) and reactive (on-demand)—using simulation analysis. The protocols DSDV, OLSR, AODV, and DSR are evaluated using NS-3, considering various performance metrics under different scenarios. The research aims to provide insights into protocol strengths and weaknesses, aiding network protocol selection and potential enhancements. This investigation contributes to understanding routing behaviours in ever-changing MANETs, benefiting network design and optimization efforts.

Keywords:

MANET (Mobile Ad Hoc Network), DSDV (Destination-Sequenced Distance Vector), OLSR (Optimized Link State Routing), AODV (Ad Hoc On-Demand Distance Vector), DSR (Dynamic Source Routing), Routing Information Protocol (RIP)

➢ INTRODUCTION

Mobile Ad Hoc Networks (MANETs) are characterized by their dynamic topology and lack of a fixed infrastructure. This makes routing a challenging task, requiring efficient protocols to enable seamless communication. Proactive and reactive routing protocols are two major categories that address this challenge differently. Proactive protocols maintain routing tables to have up-to-date routes at all times, while reactive protocols establish routes on-demand. This paper conducts an in-depth comparative analysis of the Dynamic Source Routing (DSR), Destination-Sequenced Distance Vector (DSDV), Ad Hoc On-Demand Distance Vector (AODV), and Optimized Link State Routing (OLSR) protocols using the NS-3 simulation framework.

➢ ROUTING PROTOCOLS

Figure 1 : Manet Routing Architecture

Differences in the topology of the network, MANET routing protocols can be divided into Proactive Routing protocol and Reactive routing protocol powered by the Figure below.

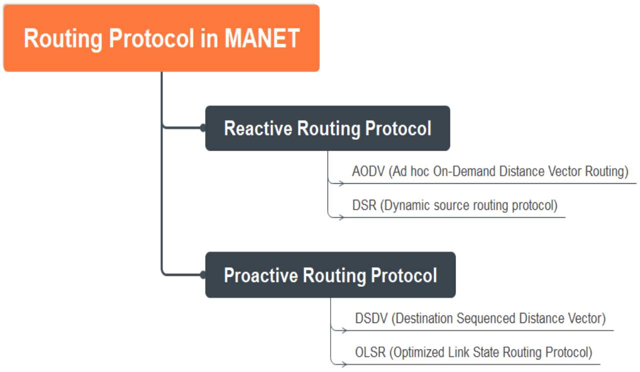

Figure 2 : Type of Routing Protocol

- **PROACTIVE (TABLE-DRIVEN) PROTOCOLS**

Proactive (or Table-Driven) protocols are a type of network protocol that uses pre-configured tables to determine how to route packets across a network. These protocols are frequently used in routing, where a router keeps a table of known destinations and pathways to them.

The network is continuously updated in proactive protocols, and the routing tables are regularly modified based on network changes. As a result, proactive protocols necessitate greater memory and processing capacity than reactive protocols, which only update their routing tables in reaction to network changes.

Routing Information Protocol (RIP), Open Shortest Path First (OSPF), and Intermediate System to Intermediate System (IS-IS) are examples of proactive protocols. These protocols are widely used in business networks, data centres, and service provider networks.

The benefit is that there is always a path between source and destination without the need for route-finding techniques. However, proactive routing methods have some drawbacks when the network experiences frequent and quick topological changes or when it is comparatively big. The destination-sequenced distance-vector (DSDV) protocol is an illustration of this kind of protocol.

In Short, this kind of routing protocol employs link-state routing algorithms, which frequently flood link information about its neighbours. The proactive routing protocol exchanges control packets with its neighbours to store routing information and keep it updated. DSDV and OLSR, among other protocols, are examples of proactive routing protocols.

- **REACTIVE (ON DEMAND) PROTOCOLS**

Reactive protocols, also known as on-demand protocols, are a type of communication protocol used in computer networks to establish routes between nodes only when they are needed. Unlike proactive protocols, which maintain a consistent routing table, reactive protocols construct a route only when data needs to be sent between two nodes.

In reactive protocols, a node that needs to send data broadcasts a route request (RREQ) packet to its neighbouring nodes. The RREQ packet travels from node to node until it reaches the destination node or a node that has the route to the destination node in its routing table. Once the destination node receives the RREQ packet, it sends a route reply (RREP) packet back to the source node, and the path established by the RREQ packet is cached in the routing table of each node along the way.

Reactive protocols are particularly useful in networks with a highly dynamic architecture, where the topology changes frequently. They are also more efficient in terms of bandwidth utilization since they do not maintain a consistent routing table. However, because the route request packet must traverse the network to reach the destination node, they may introduce delay in establishing the route, especially in large networks with many nodes.

Reactive protocols are one of the latest routing solutions in wireless networks, and their primary feature is that they conduct a route search when a source needs to communicate with a destination but does not know how to get there. Path discovery is accomplished using flooding messages, where the source node broadcasts a request for information across the network to find a path to the destination. When a transit node receives the request, it attempts to teach the route to the source node and saves the route in the routing table. Once the route reaches the destination node, it can react using the path traced by the request, forming a full duplex route between the source and destination nodes.

Reactive protocols like AODV and DSR are available in mobile ad hoc networks (MANET's), providing various options for dynamic routing. Source routing is also used in some reactive protocols, such as the dynamic source-routing protocol, which enables nodes to specify the desired path. Once calculated, the route must be saved and updated at the source level for as long as it is in use.

In summary, reactive protocols reduce overheads compared to proactive systems, as the route to a specific destination is only established using the distance-vector routing method when a node requests it by initiating the route discovery process.

RELATED WORK:

Prior research has analyzed the performance of individual routing protocols in MANETs. However, a comprehensive comparative analysis considering both proactive and reactive protocols using NS-3 is limited. This paper aims to fill this gap by providing a side-by-side evaluation of DSDV, OLSR, AODV, and DSR in various scenarios.

PROBLEM STATEMENT

The performance of wireless network depends on the different factors such as bandwidth, power, QoS, routing efficiency etc. Due to the random mobility of nodes and decentralized nature it is a very challenging issue to obtain better performance in MANETs. Among all parameters, routing is one of the core factors that have great influence on network performance. The traditional routing approaches do not always show methods of finding optimum solution to detecting new routes in such dynamic and adaptive scenarios as being experienced in MANET. Many MANET routing protocols are already designed and tested in different simulators; but up till now, no research effort has been able to provide the optimum routing efficiency to ensure the high network performance. Many factors including nodes speed and packet size etc directly have influence on decision taking in routing. So, analysing the effects of nodes speed and packet size on the performance of routing protocols will help in designing an efficient routing protocol which is vital issue to improving the performance of MANET.

AIM & OBJECTIVE

In this paper, proactive routing protocols, specifically Destination-Sequenced Distance Vector (DSDV) and Optimized Link State Routing (OLSR), has been analysed and contrasted with reactive routing protocols, namely Ad hoc On-Demand Distance Vector (AODV) and Dynamic Source Routing (DSR).

The primary focus of the analysis is to evaluate and compare the performance of these routing protocols based on various metrics, such average throughput, packet delivery ratio, packet loss ratio, total sent packets, total received packets, end-to-end delay, and end-to-end jitter delay. By using the NS-3 network simulator, which allows for the creation of realistic MANET scenarios, the paper aims to replicate and analyze the behaviour of these protocols mentioned above in a controlled environment.

RESEARCH METHODOLOGY

The research methodology involves conducting a thorough literature review of existing research and literature on proactive and reactive routing protocols in MANETs. Subsequently, simulations will be designed and implemented in NS-3, considering parameters like packet size, node speed, mobility models, and traffic patterns. Performance metrics will be defined to evaluate the protocols, and simulations will be run to collect performance data.

The collected data will then be subjected to comparative analysis, statistical techniques, and discussion to identify significant differences and trends between proactive and reactive routing protocols. The research aims to provide meaningful insights into the relative strengths and weaknesses of these protocols under various network conditions.

Ultimately, the research findings and conclusions will contribute to a better understanding of proactive and reactive routing protocols in MANETs, enabling network designers and researchers to make informed decisions regarding protocol selection and configuration in practical MANET deployments.

PROTOCOL IMPLEMENTATION:

The selected routing protocols, DSDV, OLSR, AODV, and DSR, are implemented in NS-3, ensuring adherence to their respective specifications and functionality.

To implement the DSDV, OLSR, AODV, and DSR routing protocols in NS-3 for a comparative analysis, following steps can be taken:

- **Install NS-3:** Make sure you have NS-3 installed on your machine. Follow the official NS-3 installation guide for the necessary setup.
- **Create a Simulation Script:** Begin by creating a new simulation script or modifying an existing one to set up the MANET simulation environment. This includes defining the network topology, node placement, mobility models, and other relevant parameters. Ensure that the nodes are mobile and can move within the network.
- **Configure Simulation Parameters:** In your simulation script, configure the parameters such as network size, node mobility speed, pause time, traffic load, and simulation time. Adjust these parameters to represent different network scenarios and evaluate the protocols under varying conditions.
- **Run Experiments:** Design a set of experiments to evaluate the performance of the routing protocols. Define metrics such as packet delivery ratio, end-to-end delay, throughput. Run

simulations for different scenarios, such as varying node density or mobility patterns, to capture diverse network conditions.

- **Collect and Analyze Results:** Capture the simulation output data and use NS-3 tools to collect and analyze the results. Extract the performance metrics for each protocol and compare them to identify any significant differences. Visualize the results using graphs or tables to facilitate analysis and interpretation.
- **Statistical Analysis:** Perform statistical analysis on the collected data to determine the statistical significance of the observed performance differences between the routing protocols. This step will help validate the reliability of your experimental findings.
- **Documentation and Reporting:** Document your implementation details, experimental setup, and results thoroughly. Prepare a comprehensive report summarizing your findings, including any insights, trends, and conclusions drawn from the analysis.
- Make sure to refer to the NS-3 documentation, examples, and tutorials to understand the capabilities of the simulator and available routing protocol modules. This implementation guide should help you get started with implementing and comparing the DSDV, OLSR, AODV, and DSR routing protocols in NS-3 for a comparative analysis in MANETs.

➢ PERFORMANCE METRICS:

A set of performance metrics is defined to assess the effectiveness of each routing protocol. These metrics may include average throughput, packet delivery ratio, packet loss ratio, total sent packets, total received packets, end-to-end delay, and end-to-end jitter delay. They provide quantitative measures to evaluate the protocols' performance under different conditions.

A comparative analysis of proactive routing protocols (DSDV and OLSR) and reactive routing protocols (AODV and DSR) in Mobile Ad hoc Networks (MANETs) can be conducted using NS-3, a widely used network simulation tool. To assess the effectiveness of each routing protocol, several performance metrics can be considered. Here are the metrics commonly used to evaluate the performance of routing protocols in MANETs:

1. Average Throughput:

It measures the amount of data successfully transmitted from source to destination per unit of time. Higher throughput indicates better network performance.

$$\text{Throughput} = \frac{(\text{Received Bytes Total} \times 8)}{(1024 \times \text{Simulation Time})}$$

```
Throughput =" <<iter->second.rxBytes * 8.0/(iter-
>second.timeLastRxPacket.GetSeconds()-iter-
>second.timeFirstTxPacket.GetSeconds())/1024<<"Kbps
```

2. Packet Delivery Ratio (PDR): PDR is the ratio of the number of packets successfully delivered to the destination compared to the total number of packets sent. A higher PDR indicates better

$$\text{PDR} = \frac{(\text{Received Packets Total})}{(\text{Sent Packets Total})} \times 100\ \%$$

reliability and successful packet delivery.

```
"Packet delivery ratio =" <<iter-
>second.rxPackets*100/iter->second.txPackets << "%"
```

3. Packet Loss Ratio (PLR):

PLR represents the ratio of the number of lost packets to the total number of packets sent. Lower PLR indicates better packet delivery performance.

```
"Packet loss ratio =" << (iter->second.txPackets-iter-
>second.rxPackets)*100/iter->second.txPackets << "%"
```

4. Total Sent Packets:

This metric measures the total number of packets generated by the source nodes in the network.

```
"Sent Packets=" <<iter->second.txPackets
SentPackets = SentPackets +(iter->second.txPackets);
```

5. Total Received Packets:

It measures the total number of packets received at the destination nodes in the network.

```
"Received Packets =" <<iter->second.rxPackets
ReceivedPackets = ReceivedPackets + (iter-
>second.rxPackets);
```

6. Packet Loss (PL):

The difference between the total packets sent and the total packets received.

PL= (Total Packets Sent) − (Total Packets Received)

```
"Lost Packets =" <<iter->second.txPackets-iter->second.rxPackets
LostPackets = LostPackets + (iter->second.txPackets-iter->second.rxPackets);
```

Lesser values of packet loss provide better and enhanced performance. PL is derived as number of packets.

7. End-to-End Delay:

This metric calculates the average time taken for a packet to travel from the source node to the destination node. Lower end-to-end delay signifies better real-time communication and reduced latency.

$$\text{EED} = \frac{\text{Delay Sum}}{\text{Total Packets Received}}$$

```
"Delay =" <<iter->second.delaySum
Delay = Delay + (iter->second.delaySum);
```

8. End-to-End Jitter Delay:

Jitter is the variation in packet delay experienced by different packets belonging to the same flow. It measures the deviation or fluctuation in end-to-end packet delays. Lower jitter implies better stability in the network.

```
"Jitter =" <<iter->second.jitterSum
Jitter = Jitter + (iter->second.jitterSum);
```

To perform a comparative analysis, you can simulate scenarios using NS-3 with different network topologies, traffic patterns, mobility models, and network sizes. By collecting data for the above metrics, you can compare the performance of proactive routing protocols (such as DSDV and OLSR) and reactive routing protocols (such as AODV and DSR) under various conditions.

NS-3 provides modules and functionalities to simulate these protocols and evaluate their performance. You can configure the network settings, protocol parameters, and simulation scenarios to collect the desired performance metrics. Analyzing the results obtained from these simulations will allow you to make informed comparisons and draw conclusions about the performance of different routing protocols in MANETs.

➢ EXPERIMENTAL RESULTS

The simulations are performed on various performance metrices for each routing protocol. A Comparative analysis is conducted to identify the strengths and weaknesses of proactive and reactive protocols in terms of their performance, scalability, adaptability, and efficiency.

The Discrete event Simulator NS-3.38 has been used for the Simulation. It is capable of simulating wireless multi-hop networks. It includes all data packets that are awaiting a route, such as packets that have begun but have not yet been addressed. If packets sit in the transmitting buffer for indefinite time in packet buffering, they will be discarded. All packets (data and routing) transmitted by the routing layer are queued until they are moved to the MAC layer. Packets have a higher priority than data packets. We constructed three scenarios with various sources (DSDV, OLSR, AODV and DSR routing protocols) for each type of TCP traffic. These conditions are used to create a model.

We have a diverse selection of mobility and performance measurement sources. Different packet sizes of 64, 512, 1000 bytes, are used for simulation for 200 secs. The simulation results show some significant changes in the routing protocol features. As shown in below table , the varied underlying internal mechanisms cause variances in protocol performance.

Table 1: Simulation Parameter

PARAMETER	VALUE
Protocols	DSDV, OLSR, AODV and DSR
Nodes	50
Mac Standard	802.11B
Antenna Used	Antenna/Omni Antenna
Queue Length	50
Size Of Data Packet	64, 512, 1000 bytes
Ns 3 Version	NS3.38
Time Of Simulation End	200 seconds
Node Speed (Model: Random Waypoint Mobility Model)	5m/s, 10m/s, 20m/s

Transmit Power Set To	7.5dBm
Wi-Fi Operation Mode	Ad-Hoc
Wi-Fi Rate	2 Mbps
Pause Or Halt Time	0
Network Region	300*1500m
Source/Sink Connections	10 Numbers
Data Rate (Sent)	2.048 Kilobits per second
Model	Random Waypoint Mobility Model and Friis loss model

Observation based on Scenarios with different Node Speed and Packet Size

Scenario 1: Node Speed 5m/s / Packet Size 64 Byte

Protocols	DSDV	OLSR	AODV	DSR
Total sent packets	3974	2951	12149	0
Total Received Packets	1580	1535	10376	0
Total Lost Packets	2394	1416	1773	0
Packet Loss ratio	60%	47%	14%	0
Packet delivery ratio	39%	52%	85%	0
Average Throughput	1.18241Kbps	1.19593Kbps	3.88379Kbps	0
End to End Delay	+1.39781e+10ns	+1.09409e+10ns	+4.77225e+11ns	0
End to End Jitter delay	+8.50534e+09ns	+9.77915e+09ns	+2.86854e+11ns	0
Total Flow id	10	10	702	0

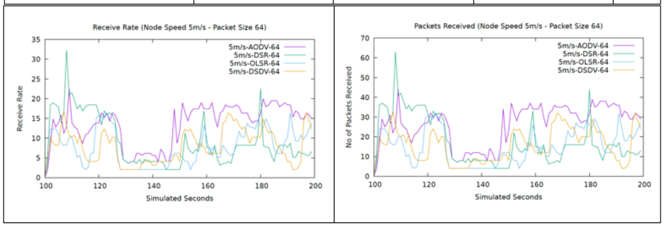

Figure 3 : Node Speed 5m/s / Packet Size 64 Byte

Scenario 2: Node Speed 5m/s / Packet Size 512 Byte

Protocols	DSDV	OLSR	AODV	DSR
Total sent packets	490	350	7161	0
Total Received Packets	192	178	6481	0
Total Lost Packets	298	172	680	0
Packet Loss ratio	60%	49%	9%	0
Packet delivery ratio	39%	50%	90%	0
Average Throughput	0.905126Kbps	0.883551Kbps	8.69203Kbps	0
End to End Delay	+5.21116e+09ns	+2.34153e+09ns	+3.07143e+11ns	0
End to End Jitter delay	+6.92774e+09ns	+1.88418e+09ns	+2.48994e+11ns	0
Total Flow id	10	10	681	0

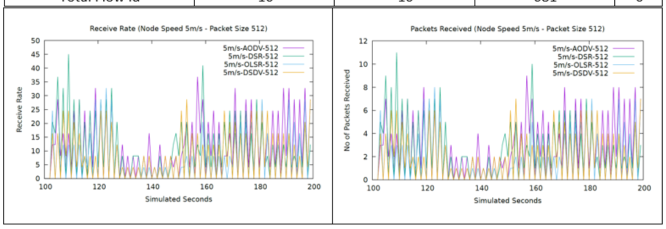

Figure 4 : Node Speed 5m/s / Packet Size 512 Byte

Scenario 3: Node Speed 5m/s / Packet Size 1000 Byte

Protocols	DSDV	OLSR	AODV	DSR
Total sent packets	250	186	7027	0
Total Received Packets	101	99	6573	0
Total Lost Packets	149	87	454	0
Packet Loss ratio	59%	46%	6%	0
Packet delivery ratio	40%	53%	93%	0
Average Throughput	0.911719Kbps	0.927965Kbps	9.07849Kbps	0
End to End Delay	+3.72966e+09ns	+2.16366e+09ns	+2.81384e+11ns	0
End to End Jitter delay	+1.64371e+09ns	+2.5952e+09ns	+2.34921e+11ns	0
Total Flow id	10	10	687	0

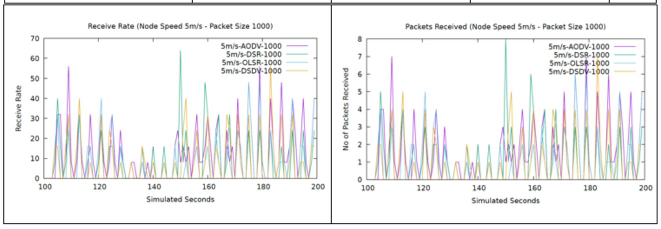

Figure 5 : Node Speed 5m/s / Packet Size 1000 Byte

Scenario 4: Node Speed 10m/s / Packet Size 64 Byte

Protocols	DSDV	OLSR	AODV	DSR
Total sent packets	3974	2501	12617	0
Total Received Packets	1100	1419	10577	0
Total Lost Packets	2874	1082	2040	0
Packet Loss ratio	72%	43%	16%	0
Packet delivery ratio	27%	56%	83%	0
Average Throughput	0.872306Kbps	1.07433Kbps	12.5185Kbps	0
End to End Delay	+1.23821e+10ns	+1.43063e+10ns	+4.35715e+11ns	0
End to End Jitter delay	+8.78275e+09ns	+1.1159e+10ns	+2.43771e+11ns	0
Total Flow id	10	10	811	0

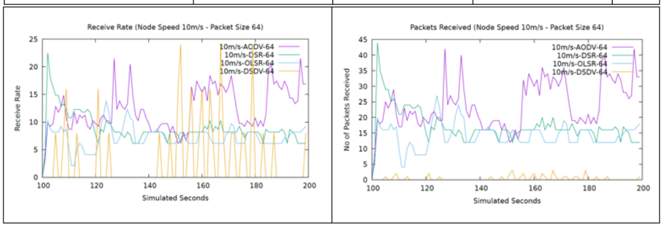

Figure 6 : Node Speed 10m/s / Packet Size 64 Byte

Scenario 5: Node Speed 10m/s / Packet Size 512 Byte

Protocols	DSDV	OLSR	AODV	DSR
Total sent packets	490	296	5951	0
Total Received Packets	159	177	5434	0
Total Lost Packets	331	119	517	0
Packet Loss ratio	67%	40%	8%	0
Packet delivery ratio	32%	59%	91%	0
Average Throughput	0.759918Kbps	1.08204Kbps	16.8045Kbps	0
End to End Delay	+1.75158e+09ns	+7.74467e+09ns	+2.00577e+11ns	0
End to End Jitter delay	+1.48436e+09ns	+1.24585e+10ns	+1.64627e+11ns	0
Total Flow id	10	10	718	0

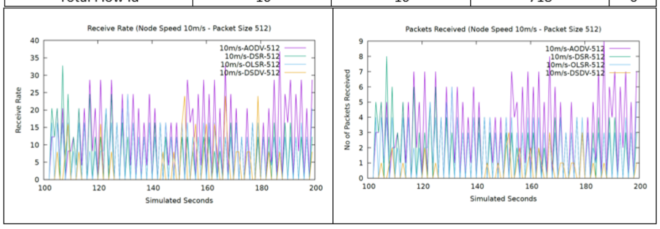

Figure 7 : Node Speed 10m/s / Packet Size 512 Byte

Scenario 6: Node Speed 10m/s / Packet Size 1000 Byte

Protocols	DSDV	OLSR	AODV	DSR
Total sent packets	250	148	4961	0
Total Received Packets	81	93	4504	0
Total Lost Packets	169	55	457	0
Packet Loss ratio	67%	37%	9%	0
Packet delivery ratio	32%	62%	90%	0
Average Throughput	0.865718Kbps	0.851877Kbps	12.47Kbps	0
End to End Delay	+4.60842e+09ns	+4.66078e+09ns	+2.06124e+11ns	0
End to End Jitter delay	+4.25205e+09ns	+5.35061e+09ns	+1.66182e+11ns	0
Total Flow id	10	10	740	0

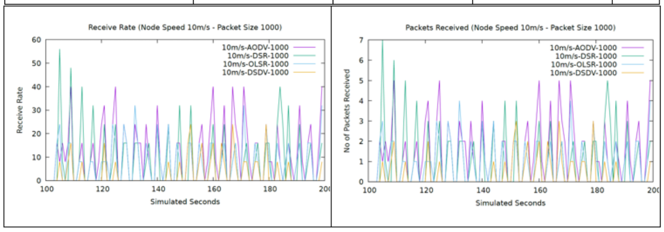

Figure 8 : Node Speed 10m/s / Packet Size 1000 Byte

Scenario 7: Node Speed 20m/s / Packet Size 64 Byte

Protocols	DSDV	OLSR	AODV	DSR
Total sent packets	3974	1454	10694	0
Total Received Packets	712	691	7777	0
Total Lost Packets	3262	763	2917	0
Packet Loss ratio	82%	52%	27%	0
Packet delivery ratio	17%	47%	72%	0
Average Throughput	0.833415Kbps	1.36191Kbps	15.069Kbps	0
End to End Delay	+2.28357e+10ns	+7.20132e+08ns	+3.82874e+11ns	0
End to End Jitter delay	+1.14182e+10ns	+5.64301e+08ns	+2.2766e+11ns	0
Total Flow id	10	10	919	0

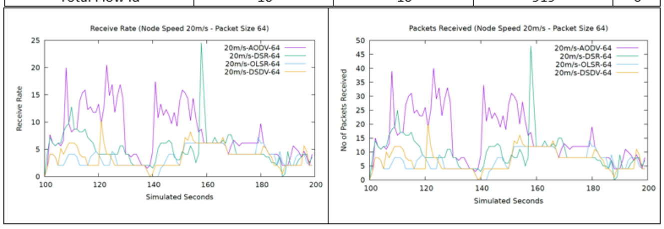

Figure 9 : Node Speed 20m/s / Packet Size 64 Byte

Scenario 8: Node Speed 20m/s / Packet Size 512 Byte

Protocols	DSDV	OLSR	AODV	DSR
Total sent packets	490	173	5840	0
Total Received Packets	94	83	5140	0
Total Lost Packets	396	90	700	0
Packet Loss ratio	80%	52%	11%	0
Packet delivery ratio	19%	47%	88%	0
Average Throughput	0.850623Kbps	0.794937Kbps	20.6571Kbps	0
End to End Delay	+2.70165e+08ns	+2.66073e+08ns	+2.9006e+11ns	0
End to End Jitter delay	+1.5922e+08ns	+2.043e+08ns	+2.17141e+11ns	0
Total Flow id	10	10	867	0

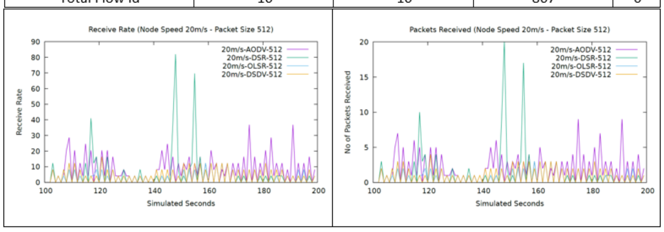

Figure 10 : Node Speed 20m/s / Packet Size 512 Byte

Scenario 9: Node Speed 20m/s / Packet Size 1000 Byte

Protocols	DSDV	OLSR	AODV	DSR
Total sent packets	250	98	4644	0
Total Received Packets	38	37	4062	0
Total Lost Packets	212	61	582	0
Packet Loss ratio	84%	62%	12%	0
Packet delivery ratio	15%	37%	87%	0
Average Throughput	0.709564Kbps	25.2211Kbps	27.1546Kbps	0
End to End Delay	+2.79915e+08ns	+2.54068e+08ns	+2.27142e+11ns	0
End to End Jitter delay	+1.25542e+08ns	+9.53433e+07ns	+1.80414e+11ns	0
Total Flow id	10	10	859	0

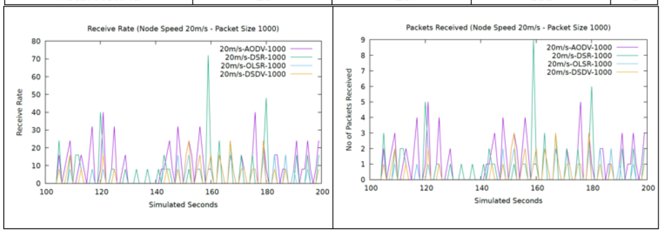

Figure 11 : Node Speed 20m/s / Packet Size 1000 Byte

➢ EVALUATION AND DISCUSSION

We performed simulation on different scenarios with change in Size of Network and node speed. In this we will discuss results and its comparative analysis of proactive routing protocols (DSDV and OLSR) and reactive routing protocols (AODV and DSR) in MANET using NS-3.38 with the random waypoint mobility model.

1. Average Throughput:

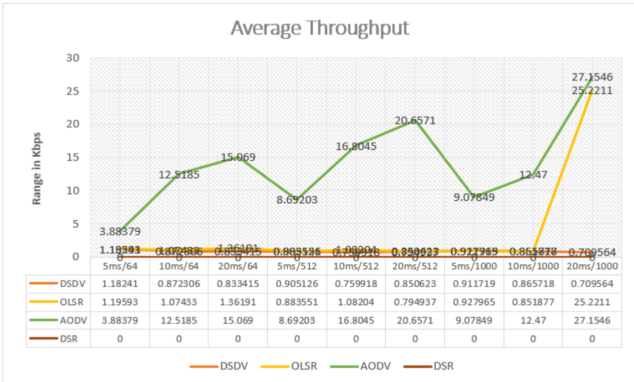

Figure 12 : Average Throughput

Average throughput measures the average rate of successful data delivery in the network, indicating the overall efficiency of the routing protocols in transmitting data. As shown in figure above we have analysed difference average throughput in proactive and reactive protocols.

- **Proactive Routing Protocols (DSDV and OLSR):** Proactive protocols generally exhibit lower average throughput, especially in scenarios with different node speed and stable network conditions.
  As proactive protocols establish and maintain routes in advance, they provide reliable paths for data transmission, resulting in low throughput.
- **Reactive Routing Protocols (AODV and DSR):** Reactive protocols achieves good average throughput, particularly in scenarios with a 50 number of nodes and dynamic network conditions. The reactive nature of these protocols allows them to adapt to changing topologies and establish routes as needed, ensuring efficient data transmission.

2. Packet Delivery Ratio

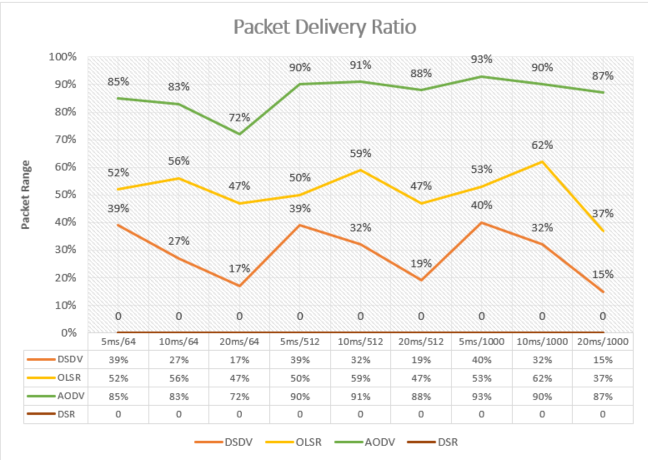

Figure 13 : Packet Delivery Ratio

Packet delivery ratio (PDR) measures the ratio of successfully delivered packets to the total number of packets generated. It reflects the effectiveness of routing protocols in establishing and maintaining communication paths. As shown in figure above we have analysed difference Packet Delivery ratio in proactive and reactive protocols.

- **Proactive Routing Protocols (DSDV and OLSR):**
  Proactive protocols generally demonstrate low to moderate packet delivery ratios, especially in scenarios with a different node mobility. The proactive nature of these protocols enables them to establish and maintain routes in advance, ensuring reliable packet delivery.
- **Reactive Routing Protocols (AODV and DSR):**
  Reactive protocols achieves good packet delivery ratios, particularly in scenarios with dynamic network conditions. The reactive nature of these protocols allows them to discover and establish routes on-demand, adapting to changes in network topology and maintaining successful packet delivery.

3. Packet Loss Ratio

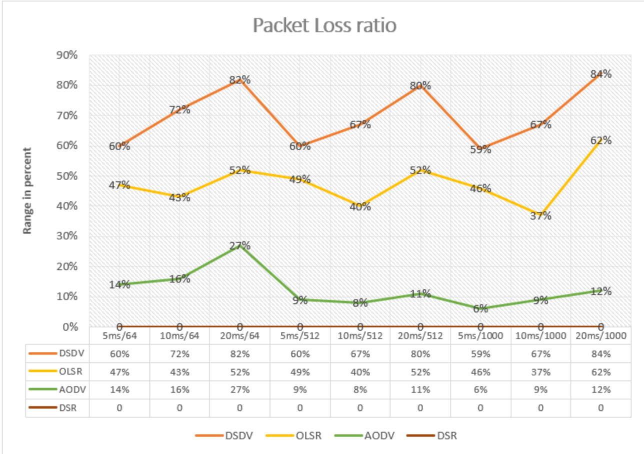

Figure 14 : Packet Loss Ratio

Packet loss ratio measures the ratio of lost packets to the total number of packets generated. It indicates the efficiency of routing protocols in minimizing packet loss during data transmission. As shown in figure above we have analysed difference Packet Loss ratio in proactive and reactive protocols.

- **Proactive Routing Protocols (DSDV and OLSR):**
  Proactive protocols generally exhibit high packet loss ratios, especially in scenarios with a different node mobility.
- **Reactive Routing Protocols (AODV and DSR):**
  Reactive protocols achieve low packet loss ratios, particularly in dynamic network conditions. The reactive nature of these protocols allows them to adapt to changes in topology and establish routes as needed, minimizing packet loss during data transmission.

4. Total Sent and Received Packets:

Total sent and received packets represent the overall number of packets generated and successfully received in the network. As shown in figure we have analysed difference total sent & received packets in proactive and reactive protocols.

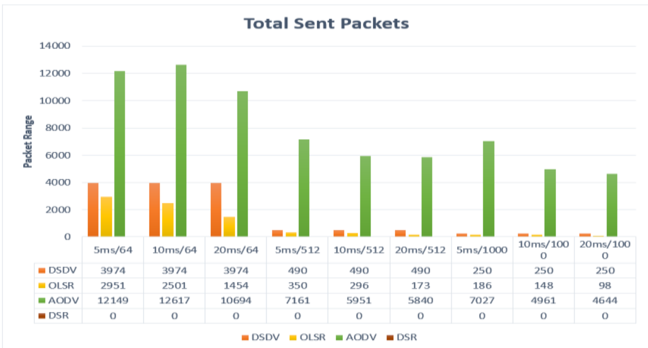

Figure 15 : Total Sent Packets

- **Proactive Routing Protocols (DSDV and OLSR):** Proactive protocols generally exhibit higher total sent and low received packets, especially in scenarios with a different node mobility.

  As proactive protocols establish and maintain routes in advance, they facilitate successful packet transmission, resulting in higher total sent and low received packets.

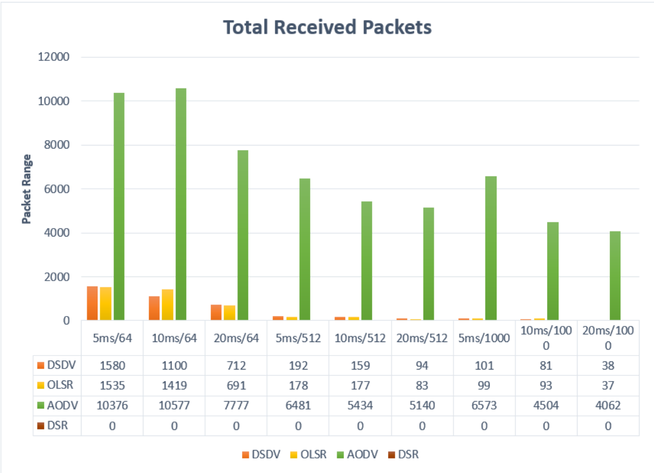

Figure 16 : Total Received Packets

- **Reactive Routing Protocols (AODV and DSR):** Reactive protocols achieves high total sent and received packets, particularly in dynamic network conditions.

  The reactive nature of these protocols allows them to adapt to changes in topology, establishing efficient routes and facilitating successful packet transmission.

5. <u>End-to-End Delay</u>

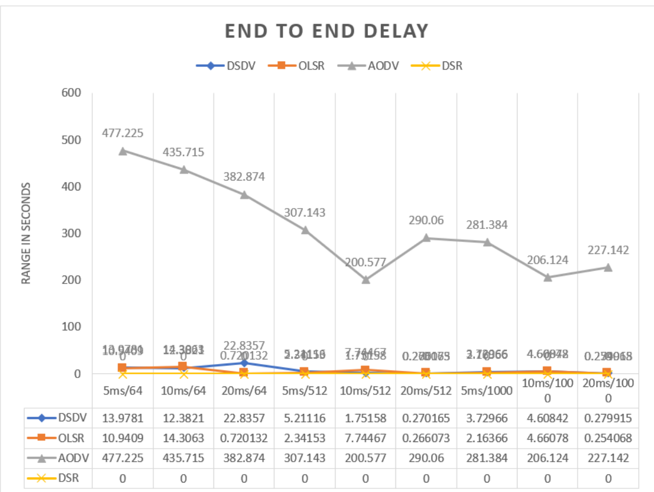

Figure 17 : End to End Delay

End-to-end delay measures the time taken for a packet to travel from the source node to the destination node. It is a critical metric that affects the overall performance of network applications. As shown in figure above we have analysed difference End to End Delay in proactive and reactive protocols.

- **Proactive Routing Protocols (DSDV and OLSR):** Proactive protocols generally exhibit lower end-to-end delays, especially in stable network conditions and scenarios with a different node mobility.
- **Reactive Routing Protocols (AODV and DSR):** Reactive protocols experience higher end-to-end delays compared to proactive protocols, particularly in dynamic network conditions. This is because reactive protocols need to initiate route discovery whenever a new data transmission is required. However, the efficient route discovery mechanisms employed by reactive protocols help mitigate the end-to-end delay to a considerable extent.

6. <u>End-to-End Jitter Delay</u>

End-to-end jitter delay measures the variation in end-to-end delay for different packets in the network. It indicates the stability and consistency of the routing protocols in delivering packets with minimal delay variation. As shown in figure we have analysed difference End to End Jitter Delay in proactive and reactive protocols.

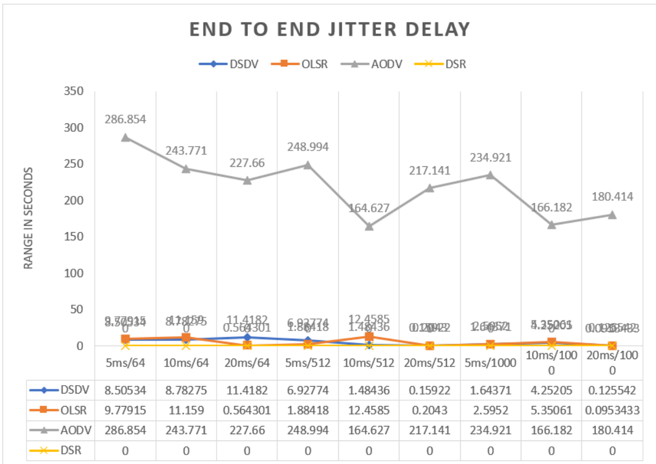

Figure 18 : End to End Jitter Delay

- **Proactive Routing Protocols (DSDV and OLSR):** Proactive protocols generally exhibit lower end-to-end jitter delay, especially in stable network conditions with a low number of nodes. As routes are pre-established, proactive protocols provide stable paths for packet transmission, resulting in minimal variation in end-to-end delay.

- **Reactive Routing Protocols (AODV and DSR):**
  Reactive protocols may experience slightly higher end-to-end jitter delay compared to proactive protocols, particularly in dynamic network conditions. This is because the reactive nature of these protocols may introduce some variation in route establishment and maintenance. However, the impact on end-to-end jitter delay is usually within acceptable limits.

➢ CONCLUSION

In conclusion, the comparative analysis of proactive routing protocols (DSDV, OLSR) and reactive routing protocols (AODV, DSR) in Mobile Ad-hoc Networks (MANET) using NS-3 has provided valuable insights into their respective performances. Reactive routing protocols, exemplified by AODV, demonstrate commendable performance metrics in specific scenarios, exhibiting superior average throughput, high packet delivery ratios, low packet loss ratios, and efficient total sent and received packets. These characteristics make them particularly well-suited for dynamic and resource-constrained environments where on-demand route establishment is crucial. On the other hand, proactive routing protocols such as DSDV and OLSR exhibit lower performance metrics in terms of end-to-end delay and end-to-end jitter delay. While proactive protocols maintain updated routing information, they may incur higher overheads, making them less efficient in scenarios with frequent topology changes and mobility.

It is essential to recognize that the choice of the appropriate routing protocol heavily depends on the specific requirements and characteristics of the MANET deployment. In scenarios where real-time communication and low latency are critical, reactive protocols like AODV may prove to be the preferred option. Conversely, proactive protocols like DSDV and OLSR might find better application in relatively stable networks with a more predictable topology, where the overhead of maintaining routing tables is less of a concern. The results of this analysis underscore the need for hybrid or adaptive routing approaches that can dynamically switch between proactive and reactive modes based on the current network conditions.

In conclusion, this analysis contributes valuable insights to the field of MANET routing protocols, facilitating informed decision-making in selecting the most appropriate protocol for a given scenario, and inspiring further advancements in the design of efficient and adaptive routing solutions for future MANET deployments.

➢ FUTURE SCOPE:

Mobile Ad-hoc Networks (MANET) holds significant promise for enhancing the understanding and performance of routing protocols in dynamic and resource-constrained environments. As technology rapidly advances, MANETs are becoming more prevalent in various applications, such as emergency response systems, military operations, and Internet of Things (IoT) scenarios. With the increasing complexity of these networks, it becomes crucial to evaluate and optimize routing protocols to ensure efficient and reliable data transmission. This comparative analysis will pave the way for identifying the strengths and weaknesses of different routing strategies, leading to the development of hybrid or adaptive routing protocols that can dynamically switch between proactive and reactive modes based on network conditions. Additionally, advancements in the NS-3 simulation tool will enable researchers to create more realistic and intricate MANET scenarios, simulating diverse mobility patterns and node behaviours. Consequently, the findings from this paper will contribute to the design and implementation of robust and adaptive routing solutions, further improving the performance and stability of MANETs in future applications.

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