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Impact of Multimedia Traffic on Routing Protocols in MANET

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***Abstract*—** Mobile Ad Hoc Network (MANET) is a self-configuring network of mobile nodes without any support of centralized administration. Now a days, the use of mobile devices has increased very rapidly and thus multimedia applications based on audio and video transmission is widely in use. The major issue in multimedia based applications is Quality Of services (QoS). Although the number of researchers have worked in the direction to enhance the QoS for multimedia data transmission over the wireless network, but still it is an open issue. In this paper we will simulate the various routing protocols such as Destination-Sequenced Distance-Vector (DSDV), Ad Hoc On Demand Distance Vector Routing (AODV), Dynamic Source Routing (DSR), Temporally Ordered Routing Algorithm (TORA) etc. Further we will analyze the simulation results in terms of Packet Delivery Ratio (PDR), Throughput and Average End-To-End Delay.

***Keywords*-**MANET, AODV, DSDV, DSR, TORA, QoS, Packet Delivery Ratio, Average End-To-End Delay, Throughput, Multimedia Applications

I. INTRODUCTION

A mobile ad hoc network [1] is a collection of wireless mobile nodes that dynamically establishes the network in the absence of fixed infrastructure. In MANET, each node is able to act as a router to find out the optimal path to forward a packet. The topology of the network will change continuously because nodes may be mobile, entering and leaving the network. The field of wireless networking emerges from the integration of personal computing, cellular technology and the internet. This is due to increasing interaction between communication and computing, which is changing information from "anytime anywhere" into "all the time, everywhere". So the use of mobile devices is also increases. The main reason for increases in the use of mobile devices is decreased cost of mobile devices. It also increases the use of multimedia applications based on audio, video etc.

Now days, mobile devices such as mobile phones tablets are commonly used by the users therefore the demand of multimedia user is rapidly increases. The users use multimedia applications based on audio, video etc. However in MANET's there are no access points. So the nodes in the MANET are free to move from one place to another. So, it (mobility) causes path breakage because the node is no longer being in a position to receive packets from other nodes on the path. These are the problem which occurs in multimedia networking, where the loss and delay of packets occur. It affects the levels of QoS.

The major issue in multimedia applications is the Quality Of Service (QoS). The QoS is highly affected by the process for selecting the paths in network to transmit the physical data. Thus, routing protocols play an important role to improve the QoS in the environment. There are number of routing protocols used in MANET such as DSDV, AODV, DSR, TORA, OLSR etc. In this paper, we will simulate and analyze the various routing protocols such as DSDV, AODV, DSR and TORA over multimedia based traffic in network**.**

The rest of paper is organised as follows:

The section II deals with the related work with a focus on multimedia based application and briefly describes the MANET routing protocols classification and mainly the functionality of four routing protocols DSDV, AODV, DSR, and TORA. Section III, deals with the proposed work and simulation environment. Section IV, it contains the results and performance analysis of four routing protocols. In section V, concludes the analysis of overall performance of the protocols DSDV, DSR, AODV, TORA based on packet delivery ratio, throughput and end-to-end delay metrics.

II. RELATED WORK

Various routing protocols have been proposed in MANET, depending on how the protocols handle the packet to deliver from source to destination. But Routing protocols are broadly classified into three types such as Proactive [20], Reactive [16] and Hybrid protocols [5].

- **Proactive Protocols**: These types of protocols are called table driven protocols in which, the route to all the nodes is maintained in routing table. Example protocols: DSDV, OLSR (Optimized Link State Routing)

- **Reactive Protocols**: These types of protocols are also called as On Demand Routing Protocols where the

routes are not predefined for routing. Example Protocols: DSR, AODV.

- **Hybrid Protocols**: Hybrid protocols are the combinations of reactive and proactive protocols and takes advantages of these two protocols and as a result, routes are found quickly in the routing zone. Example Protocol: ZRP (Zone Routing Protocol).

In this section, a brief overview of the routing operations performed by the protocols DSDV, AODV, DSR and TORA are discussed.

- **Temporally Ordered Routing Algorithm (TORA)**: TORA [3] is a distributed, source-initiated on-demand routing protocol which provides loop-free multi-path routing and uses link reversal algorithms. Each node maintains information about adjacent nodes and has capability to detect partitions; this is why it performs well in highly dynamic networks.

- **Ad Hoc On-demand Distance Vector Routing (AODV) protocol: In [8, 11],** The Ad Hoc On-demand Distance Vector Routing (AODV) protocol is a reactive unicast routing protocol for mobile ad hoc networks. As a reactive routing protocol, AODV only needs to maintain the routing information about the active paths. In AODV, the routing information is maintained in the routing tables at all the nodes.

- **Dynamic Source Routing (DSR) Protocol: In [9],** The Dynamic Source Routing (DSR) is a reactive unicast routing protocol that utilizes source routing algorithm. In DSR, each node uses cache technology to maintain route information of all the nodes. There are two major phases in DSR such as:
  - Route discovery
  - Route maintenance

- **Destination-Sequenced Distance-Vector (DSDV) protocol**: The Table-driven DSDV [10] protocol is a modified version of the Distributed Bellman-Ford (DBF) Algorithm that was used successfully in many dynamic packet switched networks. In DSDV, each node is required to transmit a sequence number, which is periodically increased by two and transmitted along with any other routing update messages to all neighboring nodes.

While there has been considerable research on streaming QoS in wired and wireless infrastructure networks many of the approaches are inappropriate for MANET. MANET is an infrastructure-less network, there are no access points. In wireless infrastructure network there are handoff algorithms to handle the mobility because algorithm are designed to transfer a device from one access point to another point depending on their movement. MANET consists of mobile wireless nodes. The communication between these mobile nodes is carried out without any centralized control.

In [4], The major requirements of a routing protocol was proposed by Zuraida Binti that includes minimum route acquisition delay, quick routing reconfiguration, loop-free routing, distributed routing approach, minimum control overhead and scalability.

In [14], In this paper author describes performance comparisons of mobile ad hoc network's protocol with its quality of service factors. It is seen that mobile ad hoc networks will be an integral part of next generation networks because of its flexibility, infrastructure less nature, ease of maintenance, auto configuration, self administration capabilities, and costs effectiveness. This research paper shows comparison within mobile ad hoc networks' routing protocols from reactive, proactive and hybrid categories.

In [17], the author describes a QoS support polling scheme based on the IEEE 802.11 medium access control (MAC) protocol. The scheme uses a two-level polling mechanism with the QoS classes differentiated by two different access policies. Stations with higher priority traffic such as key or real-time data form the first level and can access the common channel through an exhaustive access policy. Other stations with lower priority traffic form the second level and can access the channel through a gated access policy. A system model based on imbedded Markov chain theory and a generation function were setup to explicitly analyze the mean information packet waiting time of the two-level polling scheme. Theoretical and simulation results show that the new scheme efficiently differentiates services to guarantee better QoS and system stability.

In [18], the author introduce a multipath routing protocol (LIEMRO) to improve QoS demands of event-driven applications in wireless sensor networks. They evaluated LIEMRO and compared its performance with the single-path routing protocol that uses ETX and the residual battery life in its cost function. In order to achieve more accurate results, they implemented S-MAC as the underlying MAC protocol. Simulation results demonstrate significant performance improvement over the single-path approach in terms of data delivery ratio, latency, end-to-end throughput, and lifetime, which are the essential QoS parameters of Event-driven applications.

In [19], the author investigate the characteristics of VoIP traffic and the limitations of state-of-the-art rate adaptation algorithms, and then enhance the QoS of voice over WLAN (VoWLAN) by ameliorating the existing rate adaptation algorithms. Specifically, they design fast decrease to control

the transmission rate of retransmissions, and retry scheduling to avoid the deep fading of the wireless channel as well as hidden terminal interference. They comparatively evaluate the QoS of the revised rate adaptation algorithms via ns-3 simulations and MadWiFi implementations in various communication environments, and demonstrate that the proposed schemes improve the R-score performance by up to 80 percent depending on the network scenarios.

III. PROPOSED WORK AND SIMULATION SETUP

The ease of deployment and infrastructure less nature of MANETs make them highly desirable for the present day multimedia communications. As such, most of research into MANET streaming has focused on developing new mechanisms for handling QoS. Many approaches have focused on the path maintenance. Either multipath or single path approaches. In this paper, we will compare the performance of routing protocols with respect to different number of nodes. Environment setup is as follows:

Environment Setup for Simulation: Consider a environment for wireless network of area 1500x1500 m^2 in which routing protocols are used for simulation. In simulation, wireless network of different number of nodes i.e. 3, 5, 8, 11, 14, 17 are used. We compare the results of different types of routing protocols in MANET. The routing protocols are DSDV, AODV, DSR and TORA. We are analyzing the performance of reactive routing, proactive and hybrid routing protocols via increasing number of nodes are observing its effect on QoS of MANET. As we know routing protocols to make an important role in improving QoS in MANET. The data packet size sent by UDP agent is 512 bytes and packet type is Constant Bit Rate (CBR). Queue policy is Drop Tail. Simulation is run for 90 seconds. Simulation result are taken by increasing in the number of nodes from 3 to 5 and so on.

The following QoS scenarios were used. For 3 node scenario 1 video call and 1 video stream, for 5 node scenario 1 video call and 1 video stream, for 8 node scenario 2 video call and 2 video stream, for 11 node scenario 3 video call and 3 video stream, for 14 node scenario 4 video call and 4 video stream, for 17 node scenario 5 video call and 5 video stream. Each video call consisted of two nodes sending CBR packets of size 512 bytes and with the send rate of 58 packets per second. Video streams also use 512 bytes packets but have only one node sending and use higher send rate of 128 packets per second. We will simulate the above scenario using NS2 simulator [12, 2, 13 and 15].

- **Simulation Model:** NS 2.34 is simply an event driven simulation tool that has proved useful in studying the dynamic nature of communication networks. Simulation of wired as well as wireless network function and protocols can be done using NS2.

The various parameters used for simulation have been specify in Table I

Parameters	Value
Network Type	Wireless Network
Data Packet Size	512 bytes
Radio model	TwoRayGround
Protocols	DSDV,AODV,DSR,TORA
Traffic source	Constant Bit Rate
Packet Size	512 bytes
Area	1500 x 1500
Number of nodes	3,5,8,11,14,17
Simulation time (sec.)	90
Application	UDP
Simulator used	NS2

Table I Parameter Value For Environment Setup

IV. RESULTS AND DISCUSSION

We have simulated the various routing protocols such as DSDV, AODV, DSR and TORA. Over the multimedia based traffic. Now we will analyze the simulated results based on following metrics:

- Packet Delivery Ratio (PDR)
- Average End-To-End Delay
- Throughput

Packet delivery Ratio: Packet Delivery Ratio (PDR) is the ratio between the total number of packets transmitted by a traffic source and the total number of packets received by a traffic sink.

$$PDR = \frac{Total\ number\ of\ packets\ received}{Total\ number\ of\ packets\ transmitted}$$

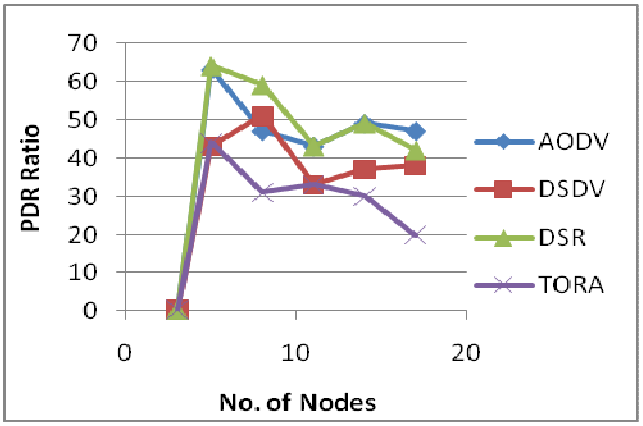

Figure 1: Packet Delivery Ratio w.r.t. Number of Nodes

As the Figure 1 shows the Packet Delivery Ratio with respect to the number of nodes i.e 3, 5, 8, 11, 14, 17 respectively. In the 3 node scenario, all protocols have zero percent PDR. In the 5 node scenario, DSR protocol has the highest PDR percentage with 64%, then the AODV protocol has 63% PDR i.e it decreases by 1%, the TORA protocol has 44% PDR i.e it decreases by 20% and the DSDV protocol has 43% PDR i.e it decreases by 21%, with the least percentage of PDR. When the number of nodes and multimedia traffic is increased then the AODV has 47% PDR, with the highest PDR percentage, the DSR protocol has 43% PDR i.e it decreases by 5%, the DSDV protocol has 38% PDR i.e it decreases by 9% and the TORA protocol has 20% PDR i.e it decreases by 20%. From the above analysis we analyze that AODV has the highest PDR percentage and TORA has the lowest PDR percentage.

Average End-to-End delay: The packet End-to-End delay is the average time that a packet takes to traverse the network.

This is the time from the generation of the packet in the sender up to its reception at the destination's application layer and it is measured in seconds. It therefore includes all the delays in the network such as buffer queues, transmission time and delays induced by routing activities and MAC control exchanges.

The End-to-End delay is therefore a measure of how well a routing protocol adapts to the various constraints in the network and represents the reliability of the routing protocol.

$$Average\ end-to-end\ delay = \frac{Total\ end-to-end\ delay\ of\ received\ packets}{Total\ number\ of\ packets\ transmitted}$$

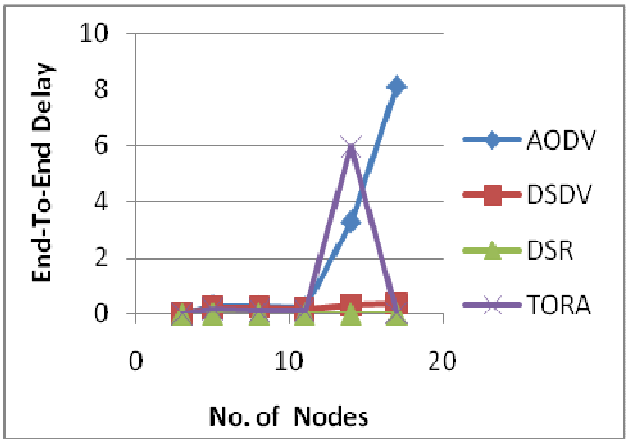

Figure 2: Average End-To-End Delay w.r.t. Number of Nodes

The Figure 2 depict the average End-to-End delay for the DSDV, AODV, DSR and TORA protocols for the number of nodes 3, 5, 8, 11, 14 and 17 respectively. In the 3 node scenario, all protocols have zero average end-to-end delay, it reflects that no packet is received. In the 5 node scenario, DSR protocol has the lowest average end-to-end delay i.e 0.51%, TORA has 15% average end-to-end delay, DSDV has 18% average end-to-end delay and AODV has the highest percentage of average end-to-end delay i.e. 28%. When the number of nodes and multimedia traffic is increased then the AODV protocol increased as compared to all other three protocols. DSR protocol has the lowest average end-to-end delay i.e 0.84%, TORA has 4.33% average end-to-end delay, DSDV has 35% average end-to-end delay and AODV has the highest percentage of average end-to-end delay i.e. 810%. From the above analysis we analyze that AODV protocol has the highest average end-to-end delay and DSR and DSDV has the lowest average end-to-end delay.

Throughput: Throughput refers to how much data can be transferred from one location to another in a given amount of time.

$$Throughput = \frac{Total\ number\ of\ packets\ received}{Total\ simulation\ time}$$

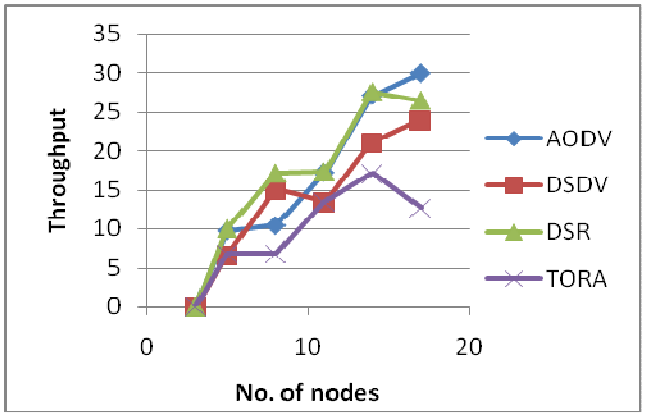

Figure 3: Throughput w.r.t Number of nodes

The Figure 3 depict the average End-to-End delay for the DSDV, AODV, DSR and TORA protocols for the number of nodes 3, 5, 8, 11, 14 and 17 respectively and the simulation time is 90s. In the 3 node scenario, all protocols have zero throughput value. In the 5 node scenario, DSR protocol has the highest throughput value as compared to AODV, DSDV and TORA protocols. When the number of nodes and multimedia traffic is increased then the AODV has the highest throughput value. From the above analysis we analyze that AODV has the highest throughput value and TORA has the lowest throughput value.

V. CONCLUSION

In this paper, the performance of the four MANET's routing protocols such as DSDV, AODV, DSR and TORA was

analyzed using NS-2 simulator. We have done comprehensive simulation results of packet delivery ratio and average end-to-end delay over the routing protocols DSDV, DSR, AODV and TORA by varying the number of nodes. DSDV is proactive protocol, AODV and DSR are reactive protocols and TORA is hybrid protocol. So, we conclude in packet delivery ratio reliability of AODV protocol is greater than DSDV, DSR and TORA and in average end-to-end delay the reliability of DSR is greater than AODV, DSDV and TORA. DSR has the least average end-to-end delay with cost of PDR TORA and the throughput of AODV protocol is greater than all other three protocols and TORA has the lowest throughput value.

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