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Enhanced QoS and Improved Scalability for Multipath Multicast Routing in Manet

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Abstract: Mobile Ad hoc network (MANET) is an infra structure less multi-hop network where the mobile nodes moves randomly and communicates with other through the intermediate nodes. Due to mobility of the nodes, QoS aware multicast routing is more challenges to guarantee the Quality of Service (QoS) requirements and scalability for different applications. In order to improve the scalability in MANET, QoS based Priority Preemptive Routing Scheduling (QoS-PPRS) technique is introduced. QoS-PPRS technique is used for obtaining the scalable multipath multicast routing in MANET. Initially, multipath and multicast route discovery is performed through two control messages RREQ and RREP. After that, the priority is assigned to each discovered route path based on the weight value of the current and previous route path. The path with minimal weight has higher priority than the other route paths. Finally, the data packets also prioritized and scheduling the data packets through pre-emptive routing scheduling. Therefore, the higher priority data packets are transmitted through the higher priority route path to improve the packet delivery ratio. The simulation is carried out to analyze the performance of proposed QoS-PPRS technique with the parameters such as Packet delivery ratio, delay, packet loss rate and bandwidth.
Keywords: Multipath multicast routing, Priority preemptive routing, Scheduling, Scalability

I. INTRODUCTION

Multicasting is a major task in various applications of ad hoc wireless networks such as emergency search and rescue operations, military applications and so on. In MANET, mobile nodes forms a groups to perform certain tasks using single and multipath routing. The arbitrary movement of mobile nodes with the constraints of power source and bandwidth constructs multicast routing is challenging issues in MANET.

A structure of the MANET is shown in figure 1. The mobile ad–hoc network (MANET) which is structure less network where the mobile devices connected wirelessly without any fixed central authority. Due to the random movement of the mobile node, the QoS aware routing is the major challenging issues. QoS is described as a set of services while transmitting a packet from source to destination. Quality of service (QoS) is also used for improving the overall performance of multicast routing in MANET.

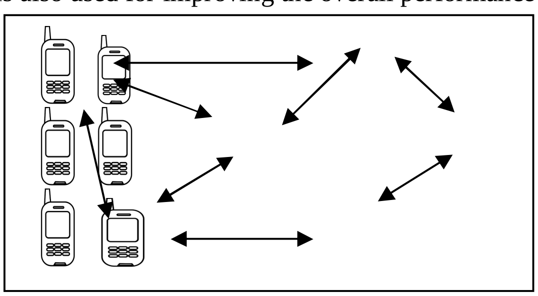

Fig. 1 Mobile Ad-hoc network

Multicasting is the process of simultaneously sending the packets from one source to multiple destinations node. It plays a significant part in video-conferencing, distance education and so on. Multicasting is used for group communication that supports distribution of information from a sender to all receivers in a group. In MANET, Various QoS metrics like PDR(Packet Delivery Ratio), various delay, jitter, throughput and overheads, available bandwidth, packet loss rate, error rate, time complexity and so on. These metrics are measured during the multicast multipath routing accurately by using standard formulas to improve the performances of a group communication and also increases the scalability of networks.

In our research work consider, QoS aware multipath and multicast routing is performed to enhance the scalability. Several techniques have been developed in MANET to improve the performance of multipath routing but it has a few problems.

A scheduled-links multicast routing protocol (SLMRP) was introduced in [1] based on mobility prediction. But it failed to achieve higher scalability. A QoS-Oriented Distributed routing protocol (QOD) was developed in [2] to enhance the QoS support of hybrid networks mobility-resilience and scalability. However, the multipath and multicast routing was not performed. The queue stability and throughput of a two-user cognitive radio system was examined in [3] with multicast traffic. However, QoS aware routing was not performed. Adaptive On-Demand Multicast Routing Protocol (A-ODMRP) was introduced in [4] to reduce the packet loss. However, it failed to adjust a route dynamically for optimizing the transmission rate.

Multicast transmission count (EMTX) was presented in [5] for reliable multicast routing in multi-hop wireless mesh networks. But the various QoS parameters were not considered. QoS-aware Shortest Multipath Source (Q-SMS) routing method was designed in [6] to provide significant network improvement in MANET. But the pre-emptive maintenance methods were not used to find a new route path. BAT meta-heuristic optimization and improved ad hoc on-demand multipath distance vector (AOMDV) was developed in [7]. But it obtains more end-to-end delay during the multipath routing. A quality of service enabled ant colony based multipath routing (QAMR) algorithm was designed in [8] to select the multipath and transmitting data packets. However, it has difficulty to assign the priority for route path in data packet transmission.

Ant based hierarchical on-demand routing was performed in [9] but it failed to provide better throughput for real time communication among the heterogeneous nature of nodes. Fuzzy controllers based multipath routing algorithm in MANET (FMRM) was introduced in [10] to improve packet delivery ratio with minimum end to end delay. But the multicast routing in MANET was remained unaddressed. Cuckoo Search Optimization AODV (CSO-AODV) protocol was introduced in [11] provides higher mobility and scalability. However, it failed to provide the robustness of the system. The QoS-PPRS technique performs efficient multicast and multipath routing hence the robustness also increased. Salvage capable opportunistic node-disjoint multipath routing (SNMR) protocol was designed in [12] for constructing the several routes for data transmission. But the data packets were not scheduled to obtain the efficient multicast routing. The QoS-PPRS technique performs preemptive routing scheduling to improve the data packet transmission.

The issues are identified from above said methods such as lack of scalability, failed to solve multipath and multicast routing, difficult to find the priority of the route path and data packet for improving the QoS aware routing. In order to overcome such kind of issues, a QoS based Priority Pre-emptive Routing Scheduling (QoS-PPRS) technique is developed.

A. Contribution of the paper

A QoS based Priority Preemptive Routing Scheduling (QoS-PPRS) technique is introduced to enhance QoS and improve the scalability for multipath multicast routing in MANET. The QoS-PPRS technique includes three processing steps to improve the performance of scalable routing. At first, Multipath and multicast route path is constructed with the help of two control message RREQ and RREP. When a source node links other mobile node in a multicast group it creates a route request (RREQ) message and sends the neighboring node. Then the neighboring node receives RREQ and sends a reply to source node. Followed by the multiple paths are constructed.

Secondly, the priority is assigned to each discovered multiple paths for efficient packet transmission. The priority of the route path is assigned based on the shortest path criteria. The shortest path is identified through the sum of the weight value of the present and adjacent path between the nodes. The path which has the minimum weight values is said to be a shortest path and it has higher priority.

Finally, the data packets are prioritized using data rate. Based on the priority, the scheduling process is carried out using Pre-emptive routing scheduling for efficient routing. While the low priority data packets are transmitting, the high priority task is interrupted, and then the scheduler performs the high priority task first. Followed by, the transmission is performed on higher priority route path.

The rest of the paper is structured as follows: In Section II, QoS based Priority Pre-emptive Routing Scheduling (QoS-PPRS) Technique is described with neat diagram. In Section III, Experimental settings are presented and the discussion of the result is explained in Section IV. Section V introduces the background and reviews the related works. Section 6 provides the conclusion.

II. QOS BASED PRIORITY PREEMPTIVE ROUTING SCHEDULING

In MANET, QoS based Priority Preemptive Routing Scheduling (QoS-PPRS) Technique is introduced to improve the scalability in multipath and multicast route.

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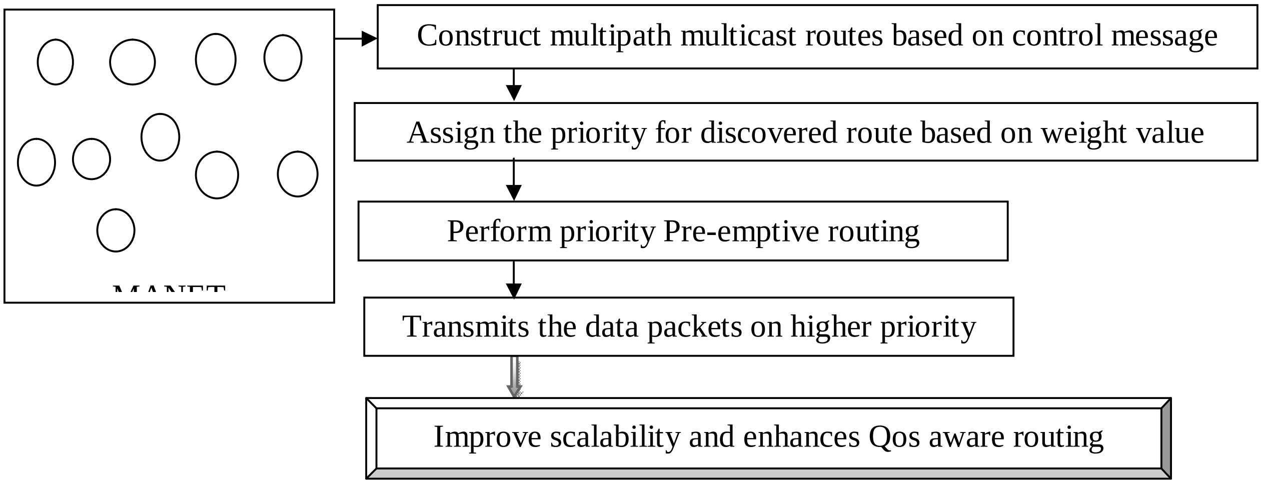

Fig. 2 Architecture diagram of QoS based Priority Pre-emptive Routing Scheduling Technique

Let us consider the design of MANET is organized in a graph '$G(V,E)$' where 'V' represents the number of mobile nodes $MN_i = MN_1, MN_2, MN_3 \ldots MN_n$ and 'E' is the connections between mobile nodes in network. In multicasting, a source node (SN) broadcasts a data packet to multiple destinations through the neighboring node (NN). Let i,j is the link between two nodes$i,j \in E$. During the frequent transmission, the intermediate node receives the data packets from source node to send a multiple destination node simultaneously. Through the multipath routing in MANET, the level of QoS over wireless networks is more challenging than for wired networks hence it degrades the scalability of the network performance. In order to overcome such kind of issues, the QoS based Priority Preemptive Routing Scheduling (QoS-PPRS) Technique is introduced in MANET.

Figure 2 shows the architecture diagram of the QoS based Priority Preemptive Routing Scheduling (QoS-PPRS) technique to improve the network scalability. Initially, the multipath-multicast route path is constructed in MANET through the two control message RREQ and RREP. After that, priority is assigned to each discovered route based on the weight value. Finally, priority Preemptive routing scheduling is performed to transmit the data packets through the selected route path. The selected route path has higher QoS and improved scalability.

A. Multipath –Multicast route discovery

The first step in the design of the QoS-PPRS Technique is to construct the multipath multicast route. In MANET, the mobile nodes are moved randomly in network without any fixed infrastructure. Due to the mobility of nodes, the network is difficult to provide higher routing efficiency. In order to enhance Qos aware routing in MANET, the consistent routes are discovered among the multiple paths. In MANET, multicasting is the communication between one source nodes to multiple destination nodes. Hence QoS-PPRS Technique focuses on the QoS enhancement while routing the data packet in MANET. Quality of service routing is routing methods in which the multiple paths are constructed from the source to destination. In MANET, the multicast and multipath routing is performed through the QoS parameters.

The multipath and multicast route discovery is shown in figure 3. Multipath and multicast route discovery is performed to determine the path through the two control message RREQ and RREP. In MANET, multicast routing is performed with one source node to multiple destinations node (D). When a source node (SN) wishes to link other mobile nodes in a multicast group it originates a route request (RREQ) message. If a neighbouring node (NN) receives a join RREQ from the SN for a multicast group, only the members of the group can reply to the RREQ message.

The route request message is transmitted from source node (SN) to neighbouring nodes (NN) is formulated as follows,

$$\text{SN} \rightarrow \sum_{i=1}^{n} \text{RREQ(NNi)} \qquad (1)$$

From (1), source node (SN) transmits a route request RREQ to the neighboring node NN_i to construct the route path. After receiving the RREQ message from the SN, the NN maintaining the route table in which the source information and next hop information are presented.

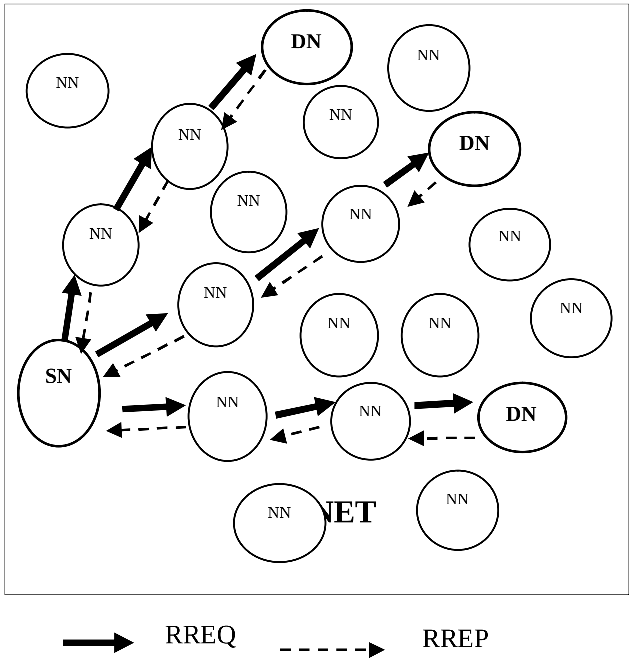

Fig. 3 Multipath–Multicast route discovery in MANET

TABLE I
ROUTING TABLE (EXAMPLE)

Network ID	Source address	Next_hop
0010	192.168.16.135	192.168.16.151

The route table information is shown in table 1.

Once the route requests are sent to the entire node, the Route Reply (RREP) messages is send from the neighboring node to source node. Followed by, the multiple route paths from source to destination are determined. The neighboring node sent reply message to source node (SN),

$$NNi \rightarrow RREP(SN) \qquad (2)$$

Based on the Route Reply (RREP) messages and request messages 'RREQ', the multipath-multicast route is discovered to perform efficient routing. During the routing process, the QoS based multipath multicast routing is significant to achieve the scalability. QoS-PPRS Technique also measures the distance between the nodes to find the minimum distance between the nodes for efficient routing. The distances between the nodes are evaluated for determining the nearest neighbor list. The distance between the nodes are measured as,

$$D(MN_1, MN_2) = \sqrt{(a_2 - a_1)^2 + (b_2 - b_1)^2} \qquad (3)$$

From (3), the distance between the nodes $D(MN_1, MN_2)$ will be calculated with the coordinates (a_1,a_2),(b_1,b_2). Based on the distance measurement, the nodes which has the minimum distance is selected to discover the route.

As shown in figure 4, Multipath-multicast route discovery algorithm is described to improve the scalability. Initially, the SN sends the route request to neighbor node and it sends the reply to SN. Followed by, the route path with minimum distance between the nodes is used to discover the route path for routing in MANET.

B. Assign priority for discovered route path

Once the multiple paths are determined, then the priority is assigned to the discovered route for efficient packet transmission. The priority of the route is assigned based on the shortest path from source to destination. In MANET, the multiple paths are discovered to perform routing. But the few of them has longer distance between sources and destination. From that, the path with minimum distance between the source and destination is assigned as higher priority to perform efficient QoS routing.

Input: Mobile Nodes MNi=MN1, MN2, MN3….MNn, Source Node 'SN', Destination Node 'D' ', Neighboring nodes 'NNi=NN1,NN2,NN3….NNn
Output: Discover multipath-multicast route
Step 1: Begin
Step 2: For each mobile node MNi
Step 3: SN sends RREQ message to NNi using (1)
Step 4:NNi sends RREP message to SN using (2)
Step 5: If SN receives RREP message
Step 6: Select the node for multicast routing
Step 7: else
Step 8: Mobile nodes are not selected for multicast routing
Step 9: Measure the distance between the nodes to findthe distance using (3)
Step 10: End if
Step 11: End for
Step 12: End

Fig. 4 Multi path-multicast route discovery algorithm

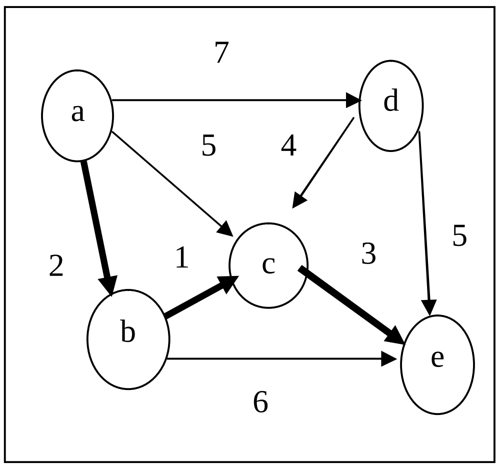

Fig. 5 Shortest path determinations

Let us consider multiple discovered route paths $P_i=P_1$, P2,…$P_n \in$ E.Therefore, the length of the path is measured as the sum of the weight values between the links. The length of the path is identified as follows,

$$\text{Length (P)} = \sum_{i=1}^{n-1} w(P_i, P_{i+1}) \qquad (4)$$

From (4),w is the weight function P_{i-1} is the current path and P_{i+1} is the adjacent path. The sum of the weight value of the current and adjacent path is measured to determine the shortest path from the source to destination in network.

In MANET, the shortest path is used for determining a path between source and destination such that the sum of the weights of its consecutive path is minimized. Therefore, the minimal weighted path is selected for efficient routing.

Figure 5 shows the shortest path between sources to destination. From the figure, the length of the path weight is <a, b, c, e> is 6. This path is considered as the shortest path among all available paths in MANET.Based on shortest path, the priority of the discovered route path is assigned. Therefore, the shortest path is determined from source node to destination in the network. This helps to perform efficient routing in MANET.

C. Priority preemptive routing scheduling

Preemptive routing Scheduling is the process of arranging, controlling and optimizing data packet to be sent and reduced the delay in a routing process. In order to develop the Priority preemptive routing scheduling in MANET, data packets delivered through wireless links is improved. Preemptive routing scheduling guarantees the quality of service and improves data packet transmission rate in wireless networks. It is the process used to select which data packet to be transmitted first. Therefore, QoS-PPRS techniques use Priority preemptive routing scheduling with various data packets. Initially, the priority of each data packets is identified. After that scheduling process is carried out to perform efficient data transmission in MANET.

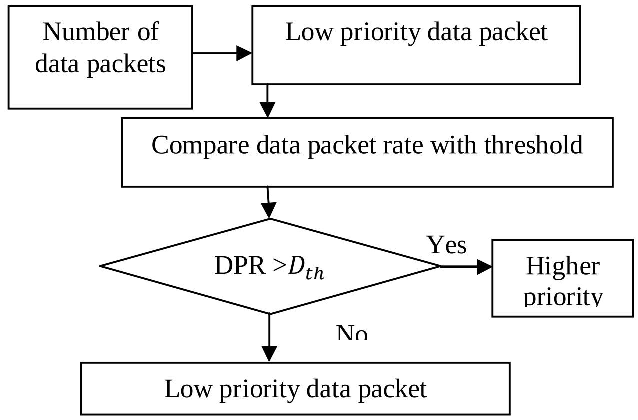

Fig. 6Priority assignment of the data packet

The above Figure 6 shows the process of priority assignment of the data packet. Let us consider the data packets DPi=DP1,DP2,DP3…DPn.A fixed priority ranks to every data packet and the scheduler arranges the data packets in order of their priority based on the rate. With a fixed priority preemptive scheduling, the scheduler guarantees that at any specified time, the highest priority data packets are currently ready to execute. The priority of the data packets are measured based on the data packet rate. It is a speed at which data packet is transferred from the node. It is measured in bits per second (bps).The data packet rate is compared with the data packet threshold value. If the data rate is greater than the threshold value, then the data packet is said to be higher priority. Otherwise it is called as low priority data packet. Once the priority of the data packet is assigned, then the scheduling process is carried out to perform efficient routing.

$$DP_1<DP_2<DP_3 \qquad (5)$$

The Preemptive routing scheduling is used to transmit a higher-priority data packet; the lower-priority data packet waits for an amount of time. The scheduling process is carried out as shown in figure 7.

Figure 7 shows the Priority preemptive routing scheduling to improve the multipath multicast routing in MANET. From the figure, the data packet with the highest priority always preempt low priority data packet (DP) when it to transmit. That means a transmit data packet is forced to block by the scheduler if a higher priority (HP) data packet becomes ready to transmit.

Figure 7 shows three data packets DP_1, DP2, DP3. DP1is the low priority (LP) compared to other two data packets. DP_2 has next higher priority than the DP1.DP_3 is the highest priority than the other two data packets DP_1,DP_2.The priority of the data packet is assigned as follows,

As shown in figure 7,DP_2 has higher priority hence it is ready to forward. But DP_3 is interrupted which has higher priority to be transmit first.

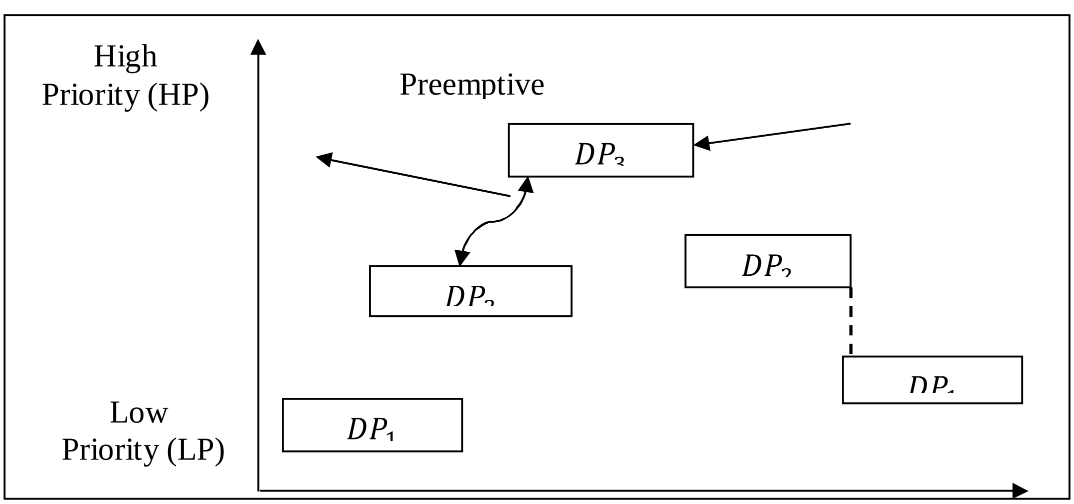

Fig. 7 Priority preemptive routing scheduling

After DP_3 is transmitted, the data packets DP_2 and DP_1 is transmitted. This helps to improve the data packet delivery ratio with minimum delay. As a result, the data packets are scheduled to perform routing through the prioritized route path. If any path failure occurred then the alternative route path is selected to perform efficient routing for improving the scalability.

The algorithmic process of preemptive scheduling is described in the figure 8. It shows the Priority preemptive routing scheduling algorithm to perform routing with minimum delay. The speed of the data packet is measured and compared with threshold value. If data rate is greater than the threshold, then the data packet is said to be a higher priority. Otherwise, the packet is said to be a low priority. Followed by, the preemptive routing scheduling is performed to schedule the data packets with their priority. As a result, the QoS-PPRS techniques schedule the data packets are transferred to the prioritized route to improve the packet delivery ratio with minimum delay.

```
Input: No.of data packets DPi = DP1, DP2 …DPn
Output: Improve packet delivery ratio with minimum delay
Step 1: Begin
Step 2: For each data packet
Step 3:    Measure data packet rate (DPR)
Step 4:    If (DPR >D_th)
Step 5:        Data packets considered as 'highpriority'
Step 6:     else
Step 7:        Data packets considered as 'Low priority'
Step 8:    End if
Step 9:    Perform priority preemptive routing scheduling to perform efficient routing
Step 10: End for
Step 11: End
```

Fig. 8 Priority preemptive routing scheduling algorithm

III.EXPERIMENTAL SETTINGS

A QoS based Priority Preemptive Routing Scheduling (QoS-PPRS) Technique uses NS2 simulator for improving the network scalability. Table 2 shows the lists of input parameters.

Totally 600 mobile nodes are deployed in a square area of A^2 (1500 m * 1500 m) in a random manner in the network that generates constant bit rate network traffic. The Random Way point mobility model is used for performing the simulation. A number of data packets are used in simulation is varied from 10 to 100. The simulation time is 300 sec.

TABLE II
SIMULATION PARAMETERS

Parameters	Values
Simulator	NS2.34
Network area	1500 m * 1500 m
Number of nodes	50,100,150,200,250,300,350,400,450,500,550,600
Mobility model	Random Way point model
Speed	2m/s – 20m/sec
Number of data packets	10,20,30,40,50,60,70,80,90,100
Speed of node	0 – 20 m/s
Simulation time	300s
Protocol	DSDV
Number of runs	10

IV. RESULTS AND DISCUSSION

The result analysis of QoS-PPRS Technique is performed and compared with existing Scheduled-Links Multicast Routing Protocol (SLMRP) [1] and QoS-Oriented Distributed routing protocol (QOD) [2]. In order to evaluate the performance of QoS-PPRS technique, a network consisting of 600 nodes within the area and uses Random Waypoint Model as the mobility model. The various simulation parameters such as packet delivery ratio, delay, packet loss rate and bandwidth are explained with the help of tables and graphs.

A. Impact of packet delivery ratio

Packet delivery ratio is defined as the ratio of number of data packets received at the destination to the number of packets sent from the source nodes. The formula for packet delivery ratio is defined as follows,

$$PDR = \frac{NPR}{NPS} * 100 \qquad (6)$$

NPR-Number of packets received at the destination
NPS-Number of packets sent from source node
From (6), PDR represents the packet delivery ratio. Higher packet delivery ratio, more efficient the method is said to be.

TABLE III
TABULATION FOR PACKET DELIVERY RATIO

Number of nodes	Packet delivery ratio (%)		
	QoS-PPRS	SLMRP	QOD
60	91.36	80.12	73.21
120	92.10	82.57	75.36
180	93.65	83.13	78.10
240	94.12	84.75	79.56
300	95.43	85.46	81.23
360	96.47	87.65	82.64
420	97.21	88.10	83.41
480	98.12	89.36	85.47
540	98.67	90.12	86.75
600	99.13	92.36	88.13

Table 3 clearly describes the packet delivery ratio with respect to number of nodes in the network is varied from 60 to 600. Let us consider the number of data packets sent is 10. Among the 10 data packets, number of data packet are correctly received at the destination is 9 using proposed QoS-PPRS technique.
Figure 9 shows the performance analysis of packet delivery ratio with respect to number of nodes. The number of nodes is varied from 60 to 600. From the figure, it is clearly illustrates that the packet delivery ratio is considerably increased while increasing the number of mobile nodes in all the methods. But comparatively, the QoS-PPRS technique improves the packet delivery ratio than the

existing methods [1] [2]. This is because, the proposed QoS-PPRS technique constructs the multipath and multicast routing with route request and reply messages. In addition, data packet rate is measured and compared with threshold value. If data rate is greater than the threshold, then the data packet is said to be a higher priority. Followed by, the priority preemptive routing scheduling is performed for routing the higher priority data packet with higher priority route path. This helps to improve the packet delivery ratio. Therefore, the packet delivery ratio is increased by 11% and 18% compared to existing SLMRP [1] and QOD [2] respectively.

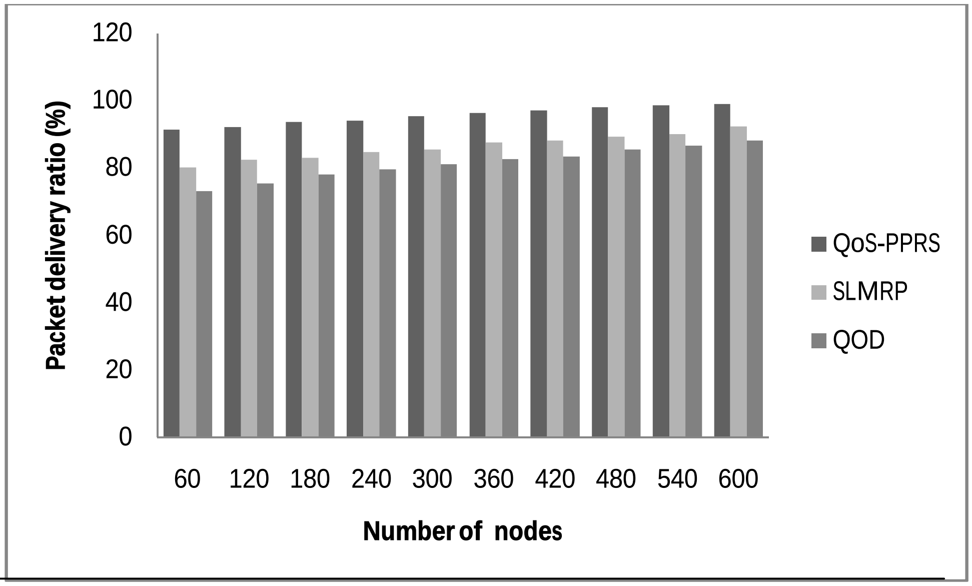

Fig. 9 Measure of packet delivery ratio

B. Impact of dela

Delay is defined as the amount of time taken to transmit the specified number of packets from source to multiple destinations. It is measured in terms of milliseconds (ms).The delay (D) is measured as follows,

$$D = \text{Number of data packets} * \text{Transmitting Time} \tag{7}$$

Let us consider, the number of data packets is 10. For the first iteration, the 10 data packets transmitting time is measured.

TABLE IV
TABULATION FOR DELAY

Number of nodes	Delay (ms)		
	QoS-PPRS	SLMRP	QOD
60	25.4	32.4	43.1
120	28.3	35.7	48.7
180	32.7	40.8	53.4
240	35.8	42.9	58.2
300	39.3	45.7	63.9
360	42.1	50.2	68.7
420	45.7	56.9	70.4
480	49.4	60.7	73.5
540	52.4	62.4	75.6
600	59.3	68.2	78.4

Table 4 describes the performance analysis of delay measurement with respect to number of mobile nodes is varied from 60 to 600. The QoS-PPRS technique reduces the delay than the existing SLMRP [1] and QOD [2]. Lower the delay, more efficient the method is said to be. Figure 10 depicts the performance analysis of delay between three different methods namely QoS-PPRS technique, [1] and [2].

From the figure 10, while increasing the number of nodes, delay is increased in all the methods. But it is comparatively reduced in QoS-PPRS technique. This is because, Preemptive routing Scheduling is used in QoS-PPRS which is the process of arranging the data packet based on the priority of the data packets. The higher priority data packet is transferred first. After transmitting a higher priority data packet, the low priority data packets are transferred. This helps to improve the routing with minimum delay. In addition, if any path failure occurred in the routing path another alternative route path is selected to perform efficient routing with minimum delay. Therefore, the delay is considerably reduced by 18% and 36% compared to existing SLMRP [1] and QOD [2] respectively.

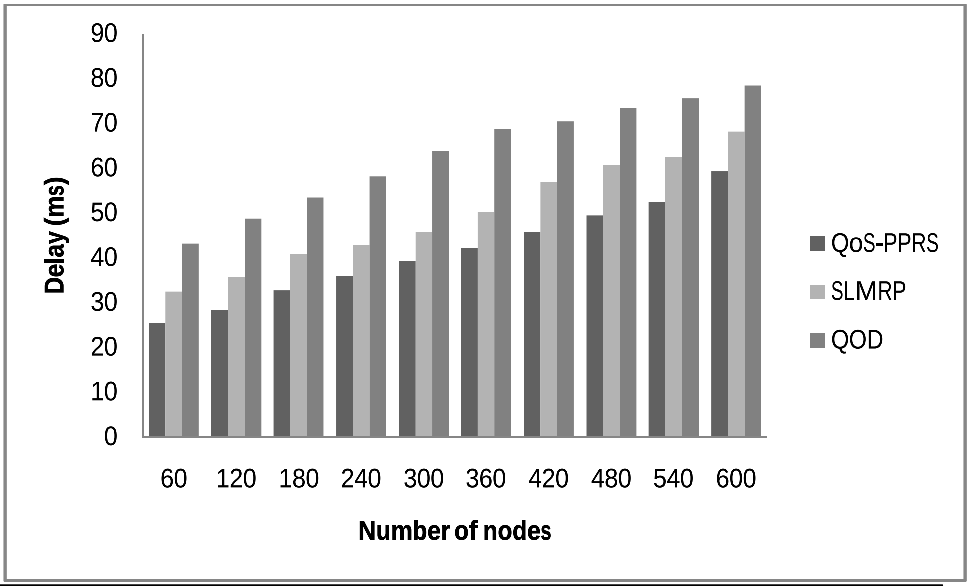

Fig. 10 Measure of delay

C. Impact of packet loss rate

$$PLR = \frac{\text{Number of packet loss}}{\text{Number of data packet sent}} * 100 \qquad (8)$$

From (8), PLR is the packet loss rate. Let us consider 10 data packets for performing the simulation. For the node mobility is 2m/sec, the number of data packet loss is measured among the total number of packets being sent.

TABLE V
TABULATION FOR PACKET LOSS RATE

Node mobility (m/sec)	Packet loss rate (%)		
	QoS-PPRS	QOD	SLMRP
2	20.12	30.12	40.20
4	25.23	33.47	42.35
6	28.2	37.75	44.75
8	30.10	42.10	48.65
10	32.85	46.79	51.20
12	34.65	48.12	52.42
14	38.52	50.36	56.35
16	40.12	52.13	58.47
18	43.20	55.48	60.12
20	48.75	60.12	63.20

The comparison of packet loss rate is presented in table 5 with respect to node mobility 2 m/sec to 20m/sec is presented. While increasing the number of node mobility, the packet loss rate gets increased in all the methods. The packet loss rate is considerably reduced in QoS-PPRS technique compared to existing methods SLMRP [1] and QOD [2].

Figure 11 depicts the performance analysis of packet loss rate with respect to node mobility. While increasing the nodes mobility, the loss rate is reduced in proposed QoS-PPRS technique than the existing methods. This significant improvement is achieved in QoS-PPRS technique due to assign the priority to the route path. The priority of the route path is assigned based on the weight value. If the path has minimum weight value, then it is selected as efficient route for packet transmission among the entire paths in network. In addition, the distance between the nodes is also measured to perform routing. This helps to obtain optimal communication path for effective transmission with minimum packet loss. Therefore, the packet loss rate is considerably reduced by 35% and 26% compared to existing SLMRP [1] and QOD [2] respectively.

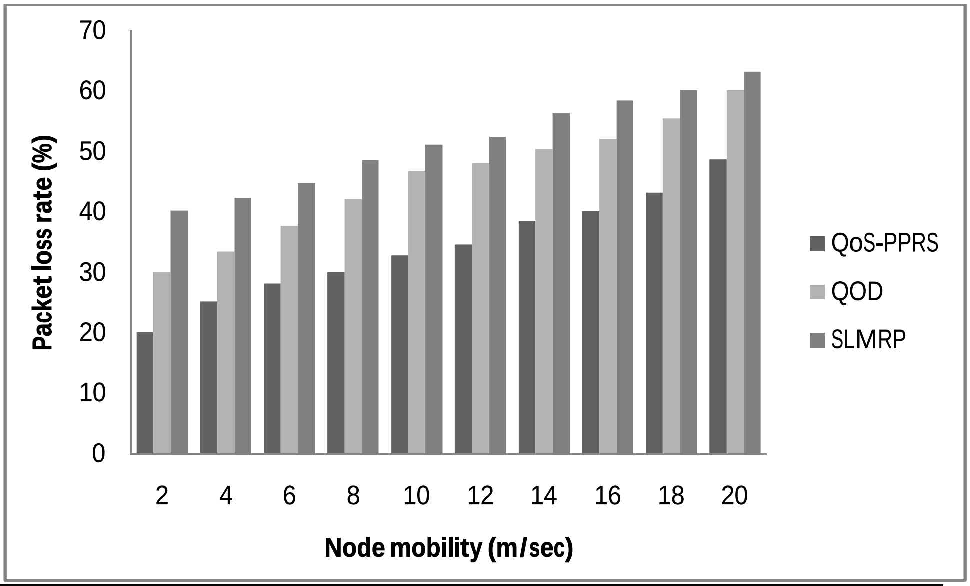

Fig. 11 Measure of packet loss rate

D. *Impact of bandwidth:* Bandwidth is defined as the amount of data to be transmitted in a fixed amount of time and it is measured in terms of kilo bits per second (Kbps).

$$\text{Bandwidth} = \frac{\text{Amount of data packet sent}}{\text{Total consumed time}} \quad (9)$$

TABLE VI
TABULATION FOR BANDWIDTH

Data packet size (MB)	Bandwidth (Kbps)		
	QoS-PPRS	QOD	SLMRP
15	5.8	3.4	2.8
30	7.2	5.7	3.7
45	9.5	7.5	5.4
60	12.7	10.8	9.4
75	15.9	12.9	10.7
90	21.5	15.4	13.5
105	24.7	18.7	15.4
120	30.8	22.6	20.6
135	35.9	28.4	24.9
150	42.4	35.1	29.1

Table 6 clearly describes that the bandwidth measurement with respect to data packet size. The data packet size is varied from 15MB to 150MB. The table value clearly illustrates that the QoS-PPRS technique improves the performance results than the existing SLMRP [1] and QOD [2]. Higher the bandwidth, more efficient the method is said to be.

Figure 12 depicts the performance analysis of the bandwidth with different data packet size. The bandwidth is measured based on the amount of data to be sent per specified amount of time. The bandwidth using QoS-PPRS technique significantly improved than the existing methods. This is because, QoS-PPRS technique perform quality aware multipath multicast routing in MANET. The multipath multicast routing is achieved through the priority preemptive scheduling. Based on the scheduling, the data packet is sent with minimum time. Let us consider, 15MB of the data, the bandwidth of the QoS-PPRS technique is 5.8Kbps whereas, 3.4Kbps for QOD [2] and 2.8 for SLMRP [1]. This shows the better improvement using QoS-PPRS technique. Therefore, the bandwidth is considerably improved by 57% and 29% compared to existing SLMRP [1] and QOD [2] respectively.

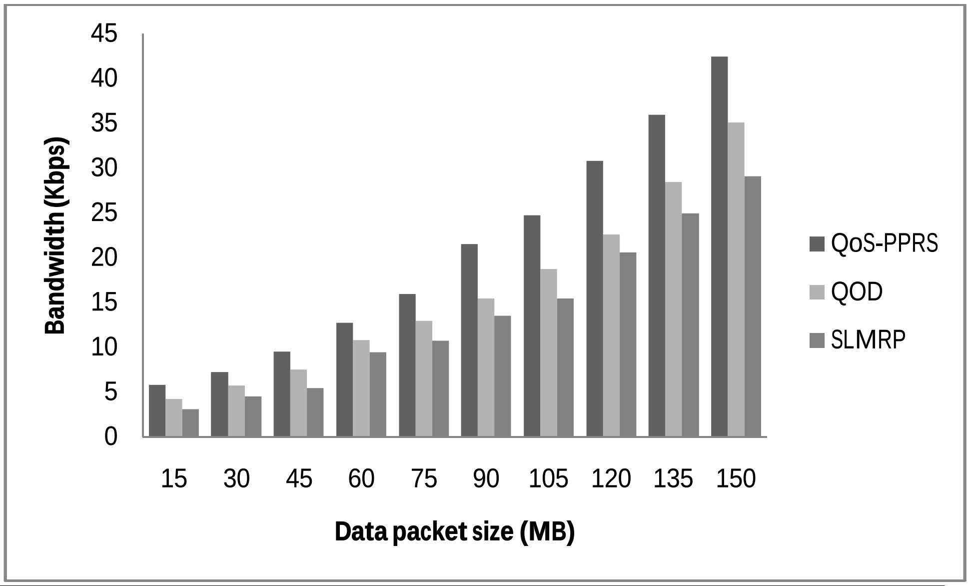

Fig. 12Measure of bandwidth

V. CONCLUSION

An effective QoS based Priority Preemptive Routing Scheduling (QoS-PPRS) technique is developed in MANET for improving the scalability in multipath multicast routing. The QoS-PPRS technique includes three processing steps to improve the network scalability. Initially, multipath and multicast route discovery is carried out using two control message RREQ and RREP to construct the route path. After that, priority is assigned to the discovered route path based on the weight value of the present and adjacent path for data packet transmission. Finally, the data packets are prioritized based on the data rate. Preemptive routing scheduling is carried out to schedule the data packets along with their priority. This helps to improve the Scalability of network to handle a more data packets simultaneously. The simulation is carried out for different parameters such as packet delivery ratio, delay, packet loss rate and bandwidth. The performance results show that the QoS-PPRS technique improves the QoS Aware routing in terms of higher Packet delivery ratio, bandwidth and reduces packet loss rate with minimal delay compared state-of-art methods.

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