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QoS enabled MAODV for Mobile Ad hoc Networks

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ABSTRACT - *QoS support in MANETS is a challenging task due to the dynamic nature of Mobile Ad hoc Networks. To achieve a desired QoS, the resources must be assigned or reserved. MANET constraints such as Bandwidth, Dynamic Topology, limited processing and storing capabilities of devices must be concentrated to support QoS in MANET. QoS in MANET can be achieved by the QoS model, QoS signaling and QoS routing. In this paper, QoS routing is achieved utilizing the protocol MAODV. QoS routing searches for a feasible path between the source and the destination which satisfies the QoS requirements and optimize the use of network resources.*

Key Words: MANET, MAODV, QoS.

1. Introduction

Routing problems in wireless networks suffer from hidden terminal problem or the frame collisions due to the shared medium. Also, the dynamic topology of the mobile nodes make difficult to achieve QoS. The QoS parameters such as communication delay, cost, and bandwidth should be considered for real-time and multimedia applications [9]. Quality of service (QoS) multicast routing is a Non-deterministic Polynomial-time-hard (NP-hard) problem. QoS multicast routing protocol [4] is developed using the concept of mobility prediction based on MAODV [6].Existing QoS provision is also achieved in view of different layered perspective. Hierarchical approach maintains the state of subset of the network nodes and routing is facilitated through state information. QoSMIC [2] minimizes the importance of pre-configuration decisions. Existing QoS based routing protocols are QOLSR, AODV, TBP, CEDAR and PLQBR. QoS guaranteed multicast routing protocol [1] searches for the near optimal branch to connect the receiver. QMPRCAH [3] provide qos sensitive routes in a scalable and flexible way in the networking environment with mobility

2. Q-MAODV

The objective of the proposed protocol Q-MAODV is to find the feasible path which satisfies the QoS constraints delay, hop count and bandwidth. Q-MAODV model the network as weighted graph G (N, E) in which N represents the numbers of nodes and E the set of links or edges connecting the nodes. Let S denote the source and D denotes the destination among N nodes. Q-MAODV aims to find the links that meet the QoS requirements between the source and the destination.

2.1. Operation

Source node initiates a RREQ to the multicast address, if it has data to send to a multicast group and there exists no route. RREQ packet contains the fields QoS extension (delay constraint and bandwidth constraint), sequence number and hop count before it is forwarded. If the intermediate node receives multiple RREQ packets, it selects the packet with lowest delay, maximum bandwidth, highest sequence number and the lowest hop count. RREQ packet with the highest sequence number, lowest delay, greatest bandwidth and the lowest hop count is selected if the group leader or a member of the desired multicast group receives multiple RREQ packets. It unicasts a RREP to the requesting node. When the receiving node receives more than one RREP packet, it forwards all the RREP packets. Among the RREP packets received by the source node, the packet which satisfies the QoS constraint is selected at the source on the reception of RREP. This optimized QoS enabled path is used to transmit data.
QoS extension delay constraint and bandwidth constraint must meet the following conditions.

- Delay $P(S, D) \leq d_{max} \rightarrow (1)$
- Bandwidth $P(S, D) \geq B_{min} \rightarrow (2)$

d_{max} and B_{min} values depend on the application requirements
The QoS constraint delay of the path P (S, D) is defined as the sum of the delays of link along the path. For any e € E,
Delay: $P(S, D) = \sum delay(e) \rightarrow (3)$
The bandwidth from S to D is the maximum of the bandwidth among links along P (S, D).Bandwidth:
$P(S, D) = \max(bandwidth(e)), e \in P(S, D) \rightarrow (4)$

3. SIMULATION RESULTS

Simulation of M-MAODV is performed and compared with MAODV using NS-2 [7] to evaluate the protocol. A total of 60 nodes were simulated for duration of 1000s in an area of 1000m * 1000m. The mobility model is the random way point [8] to model the mobility of the nodes in the network. The MAC layer protocol used was IEEE 802.11. The transmission range for each node was 250m and the channel capacity was 2 Mbps. The size of the packet was 512 bytes.

3.1. Evaluation Metrics

The following metrics are evaluated in this thesis for all the protocols developed.

Packet delivery ratio: Data packet delivery ratio is defined as the number of packets delivered to the destination to number of packets to be received.

End-to-end delay: The end-to-end delay is the total delay the packet experiences when it travels across the network.

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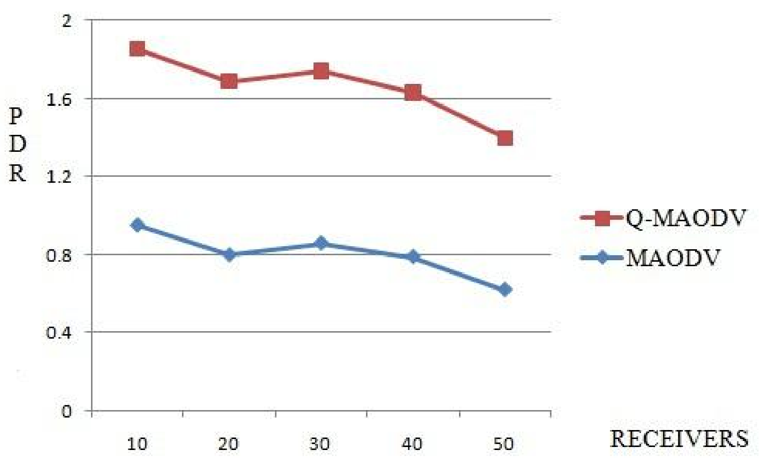
Throughput: Throughput is the rate at which the packets are transmitted in the network

3.2. PDR vs. Number of Receivers

Table 1 shows the packet delivery ratio (PDR) against the variation in the number of receivers. Less number of control packets are utilized to establish the path, since the source node selects the RREP only if the QoS constraints are satisfied. Hence from the Table 1, it is inferred that the PDR of Q-MAODV is increased compared to MAODV. The increase of the PDR values ranges from 0.02 to 0.10.

TABLE.1 Comparison of PDR vs. Number of Receivers of MAODV and Q-MAODV

S.No	Receivers	MAODV	Q-MAODV
1	10	0.953	0.9
2	20	0.799	0.89
3	35	0.86	0.88
4	40	0.79	0.84
5	50	0.62	0.78



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3.3. Throu

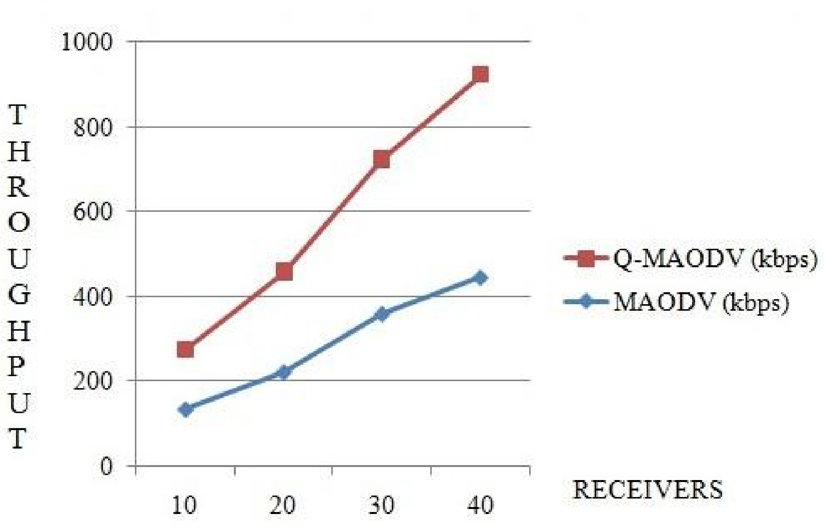
Table 2. Show the throughput of the protocol evaluated against the variation in the number of receivers. The path which satisfies the QoS constraint delay and bandwidth is selected to transmit the data. Hence, the throughput of Q-MAODV has been increased from 6 kbps to 33 kbps when compared with MAODV.

TABLE.2 Comparison of Throughput of MAODV and Q-MAODV

S.No	Receivers	MAODV (kbps)	Q-MAODV (kbps)

3

1	10	134	140
2	20	222	236
3	30	359	365
4	40	445	478



3.4. Delay

Table 3 Show the delay evaluated against the variation in the number of receivers with the senders as 10. The delays include all the delays that are occurred by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC and the time taken to propagate and transfer. The delay of Q-MAODV is reduced by 1 to 3 milliseconds when compared with MAODV.

TABLE.3 Comparison of Delay for MAODV and Q-MAODV

S.No	Receivers	MAODV (millisecond)	Q-MAODV (millisecond)
1	10	14	13
2	20	17	14
3	35	17	14
4	40	18	17
5	50	20	19

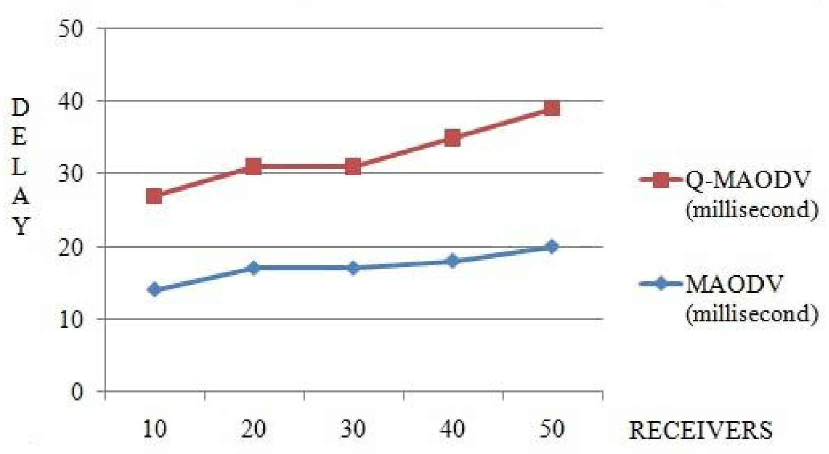


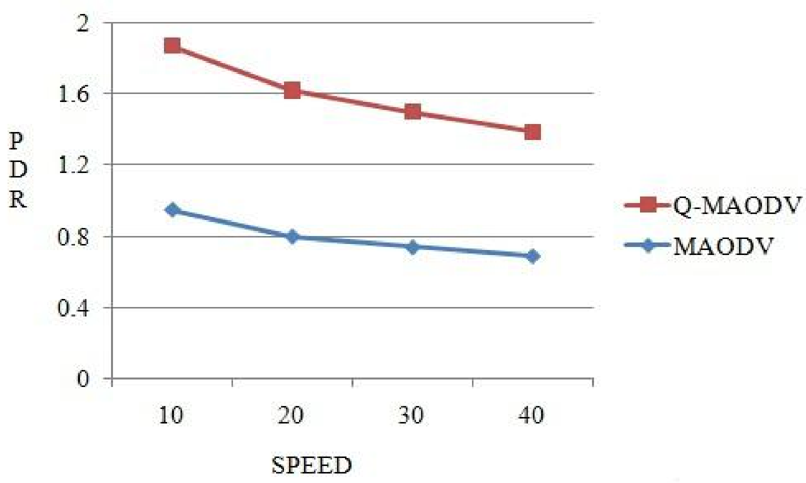
Figure 3 Comparison of Delay for MAODV and Q-MAODV

3.5. Speed

Table 4 show the variation of speed against the packet delivery ratio with the number of receivers as 20 and the number of senders as 10. Multicast paths generated by the protocol QoS-MAODV concentrate the factor stability of the node which leads to the increase in the PDR.

TABLE.4 Comparison of PDR vs. Speed of MAODV and Q-MAODV

S.No	Speed (m/s)	MAODV	Q-MAODV
1	10	0.95	0.92
2	20	0.80	0.82
3	30	0.74	0.76
4	40	0.69	0.70



4 CONCLUSION

Q-MAODV established a route to the destination satisfying the QoS constraints delay, and bandwidth. The QoS constraints are used to optimize the path. Depending on the application, the application requirements could be transformed to QoS requirements. The performance is enhanced compared to the protocol MAODV. PDR and throughput is significantly increased. Delay is also reduced which is due to the selection of the path that satisfies the QoS requirements.

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