ENRICHED QUALITY OF SERVICE IN WIRELESS CROSSBREED NETWORKS THROUGH QOS RELATED - DISTRIBUTED ROUTING PROTOCOL

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Abstract: Wireless technologies form an essential part in our daily life. A wide variety of real-time applications are expected to be provided by these technologies. Hence, there is a vital need to provide Quality-of-Service (QOS) support. The wireless and mobile devices are widely used and the demand for mobile multimedia streaming services is increasing thus leading to a promising near future where wireless multimedia services (e.g., Mobile Gaming, online TV, and online conferences) are widely deployed. The emergence and the promising future of real time and multimedia applications have increased the demand of high quality of service (QOS) support in wireless and mobile networking environments. In order to enhance the qos backing capability of hybrid networks, the proposed system advocates a QoS-Oriented Distributed Routing Protocol (QOD). Usually, a hybrid network [1] has boundless base stations. The data transmission in hybrid networks has two features. First, an AP (Access Point) can be a source or a destination to any mobile node. Second, the number of transmission hops between a mobile node and an AP is small. Taking full advantage of the two features, the packet routing problem is transformed into a dynamic resource scheduling problem by QOD. Specifically, in QOD, if a source node is not within the transmission range of the AP, a source node picks nearby neighbors that can provide QOS services to forward its packets to base stations in a shared manner. The source node lineup the packet streams to neighbors based on their queuing condition, channel condition, and mobility, aiming to minimize transmission time and increase network capacity. The neighbors then forward packets to base stations, which additionally forward packets to the destination. Mobility based neighbor selection for routing [2] increases the network performance. The proposed system focuses on the neighbor node selection for QoS-guaranteed transmission. Study and simulation results show that QoD can provide high QoS performance in terms of overhead, transmission, mobility resilience and scalability.

Index Terms - Hybrid wireless networks, Multi-hop cellular networks, routing algorithms, Quality of Service, QOD

I. INTRODUCTION

Hybrid Wireless [3] facilitates the effective and efficient integration of microwave transport networks, communications infrastructure components and high capacity broadband technologies, focusing on Internet Protocol (IP). Next-generation wireless systems support a wide range of advanced services: Both data and voice traffic Cellular systems: 1G concentrates on efficient frequency usage for voice transmission; 2G concentrates on efficient spectrum usage for voice transmission. 3G concentrates on efficient data traffic. Hybrid wireless network architectures combine multi-hop radio relaying and infrastructure backing to provide high-capacity wireless networks. Next-generation hybrid wireless architectures are Multi-hop cellular network (MCN), integrated cellular and replaying system (iCAR), Hybrid wireless network (HWN), Self-organization packet radio networks with overlay (SOPRANO), Multi-power architecture for cellular networks (MuPAC), Throughput enhanced wireless in local loop (TWiLL) and Systems with host-cum-relay (host-Cumulative-relay) stations. The committed relay stations do not originate data traffic on their own and assist in forwarding [14] on favor of the sender. Single-Mode systems: MHs operate only multi hop [15] mode. Multi-Mode Systems: The mobile host's deed either in single-hop mode or in multi-hop mode depending on the architecture.

Dedicated relay stations are used for relaying data traffic. With the advent of ubiquitous wireless technology, a wide range of advanced services[9] are supported including appealing services that currently exist in wired systems. The resource constraints in wireless environment may provide difficulty to realizing all the desirable services [10]. Thus, an infrastructure with high data rate is necessary to accompaniment the resource constraints and to act as anchor points linking mobile nodes to other fixed networks as the Internet.

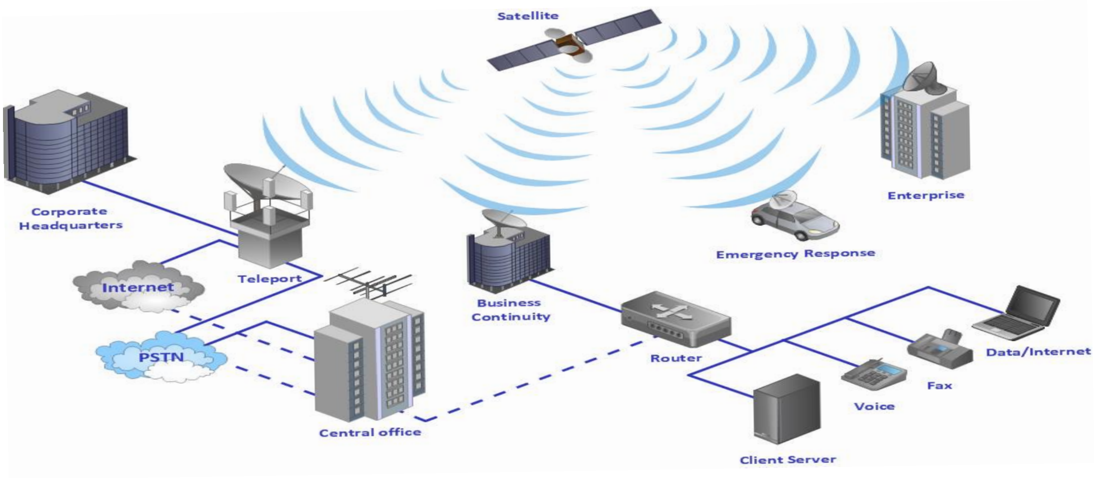

Fig. 1 Hybrid Network

Hybrid wireless networks (Fig.1) have emerged as a promising solution. It allows mobile clients to attain higher performance and service access in a seamless manner independent of their existence in wireless LAN (WLAN) communication range. Here we have addressed the benefits of hybrid wireless networks, showing their achievable applications and presenting a classification for their emerging architectures. Finally, a potential architectural model is proposed, which is expected to provide useful services by the network operator or the service provider in such a hybrid environment.

1.1 Qos - Oriented Distributed Routing Protocol (QOD)

The QoS-Orient ed Distributed routing protocol (QOD) helps to enhance the QoS support capability of hybrid networks. A hybrid network has widespread base stations. The hybrid networks have two features for data transmission. First, an AP can be a source or a destination to any mobile node. Second, the number of transmission hops is small between a mobile node and an AP. The first feature allows a stream to have anycast transmission onward numerous transmission paths to its destination through base stations, and the second feature empower a source node to connect to an AP through an intermediate node. Taking full advantage of the two features, QOD converts the packet routing problem into a dynamic resource scheduling problem. In QOD, a source node prefers nearby neighbors that can provide QoS services to forward its packets to base stations in a distributed manner if a source node is not within the transmission range of the AP. Based on the queuing condition, channel condition, and mobility of neighbors, the source node schedules the packet streams to neighbors aiming to reduce transmission time and increase network capacity. Then neighbor forward the packets to base stations, which further forward packets to the destination. QOD incorporates five algorithms: 1) a QoS-guaranteed neighbor selection algorithm to meet the transmission delay requirement, 2) a distributed packet scheduling algorithm to further reduce transmission delay, 3) a mobility-based segment resizing algorithm that adaptively adjusts segment size according to node mobility in order to reduce transmission time, 4) stable neighbor selection for routing and 5) Soft-Deadline-Based Forwarding Scheduling.

II. RELATED WORK

Existing approaches for providing guaranteed services in the infrastructure networks are based on two models: integrated services (IntServ) [9] and differentiated service (DiffServ). IntServ is a stateful model that uses resource reservation for separate flow, and uses admission control [9] and a scheduler to maintain the QoS of traffic flows. In contradiction, DiffServ is a stateless model which uses coarse-grained class-based mechanism for traffic management. To further decrease packet droppings and bandwidth consumption a number of queuing scheduling algorithms have been proposed for DiffServ. A majority of QoS routing protocols are based on resource reservation [5], in which a source node sends probe messages to a destination. Then it discovers and reserve paths to satisfy a given QoS requirement. Perkins et al protracted the AODV routing protocol by adding information of the maximum delay and minimum available bandwidth of each neighbor in a node’s routing table.

Very few methods have been proposed to provide QoS-guaranteed[5] routing for hybrid networks. All most all routing protocols only try to improve the network capacity and reliability to indirectly provide QoS service but circumvent the constraints in QoS routing that require the protocols to provide guaranteed service. RAP and SPEED give a high delivering preference to the packets with longer distance/delay to the destination. However, both methods crave each sensor to know its own location, thus they are not suitable for a highly dynamic environment.

III. PROPOSED SYSTEM

In hybrid wireless Networks [4] based on the proposed routing mechanism, if forwarding node have high mobility, there is the contingent for local topology inaccuracy. If the node involved in the forwarding path moves frequently then there is the position of link failure which leads to packet loss. Hence it is required to select the nodes with low movability which means selection of stable node as forwarder based on its mobility. Mobility based forwarding node selection scheme boosts the routing performance.

Source node predicts the distance of each neighbor from itself at particular time (t) using the current location of neighbor and speed of the neighbor. After certain time (t+T), it anticipate the distance again using the present location of neighbor and speed of the neighbor. In both times if the node comes under neighbor status then it is highly stable neighbor. To apply highly stable greedy forwarding amid between destination and highly stable neighbors are calculated. The neighbor which is having the minimum distance is selected as forwarder.

IV. ALGORITHMS OF QOD

An efficient improved Qos-Oriented Distributed routing protocol is proposed which implements the following algorithm to provide high Quality of Service.

[1] Packet forwarding initiate

[2] QOS-Guaranteed Neighbor Selection Algorithm

[3] Distributed packet scheduling algorithm

[4] Mobility based packet resizing algorithm

[5] Stable neighbor Selection for Routing

[6] Soft-Deadline-Based Forwarding Scheduling

[7] Performance Evaluation

4.1 Packet Forwarding Initiate

Packet forwarding is the relaying of packets from one network segment to another by nodes in a network. The Network Layer of the OSI layer is responsible for Packet Forwarding. The simplest forwarding model—unicasting—involves a packet being sent from link to link along a chain leading from the packet's source to its destination. However, other forwarding strategies are frequently used. Broadcasting requires a packet to be duplicated and copies sent on multiple links with the ambition of delivering a copy to every device on the network. In practice, broadcast packets are not forwarded here and there on a network, but only to devices within a broadcast domain, making broadcast a relative term. Less common than broadcasting, but perchance of greater utility and theoretical significance, is multicasting, where a packet is selectively duplicated and copies are conveyed to each of a set of recipients.

The forwarding decision is generally made using one of two processes: routing, which uses clue encoded in a device's address to infer its location on the network, or bridging, which makes no assumption about where addresses are located and depends heavily on to locate unknown addresses

The QOS of the direct transmission amid a source node and an AP cannot be guaranteed. The source node sends a request message to its acquaintance nodes. After receiving a forward request from a source node, a neighbor node n_i with space utility less than a threshold acknowledges the source node.

4.2 Qos-Guaranteed Neighbor Selection Algorithm

Short delay is the considerable real-time QoS requirement for traffic transmission. QOD incorporates the Earliest Deadline First scheduling algorithm (EDF) , which is a deadline driven scheduling algorithm for data traffic scheduling in intermediate nodes. Here an intermediate node assigns the highest priority to the packet with the closest deadline and forwards the packet with highest priority.

Let us use Sp(i) to denote the size of the packet steam from node ni, use Wi to denote the bandwidth of node i, and Ta(i) to stand for the packet arrival interval from node ni. The QoS of the packets going through node ni can be satisfied if

$$Sp(i)/Ta(i)+sp(j)/Ta(j)+\ldots.+Sp(m)/Ta(m) <= Wi$$

Source node selects the qualified neighbor based on bandwidth. When we choose the maximum bandwidth link, delay will be reduced.

4.3 Distributed Packet Scheduling Algorithm

A distributed packet scheduling algorithm is recommended for packet routing in order to further reduce the stream transmission time. Distributed packet scheduling algorithm accredit earlier generated packets with higher queuing delays and scheduling feasibility, while accredits more recently generated packets to forwarders with lower queuing delays and scheduling feasibility. Thus transmission delay of an entire packet stream can be reduced. We use t to denote a time when a packet is developed, and use Tqos to denote the delay QoS requirement. Let Ws and WI denote the bandwidth of a source node and intermediate node respectively. We use $TS\rightarrow I = Sp/Ws$ to denote the transmission delay between a source node and an intermediate node , and $TI\rightarrow D = Sp/Ws$ to denote the transmission delay between an intermediate node and an AP. Let Tw denote the packet queuing time and Tw(i) denote the packet queuing time of ni. The queuing delay requirement is calculated as $Tw < Tqos - TS\rightarrow I - TI\rightarrow D$.

QOD incorporates EDF, in which an intermediate node assigns the highest preference to the packet with the closest deadline and forwards the packet with the highest priority first. An intermediate node can predispose the priorities of its packet based on their deadlines Dp. After receiving the reply messages from acquaintance nodes that includes the scheduling information of all flows in their queues, the source node determine the T_w of its packets in each intermediary node and then chooses the intermediate node n_i that satisfies $Tw < Tqos - TS{\rightarrow}I - TI{\rightarrow}D$. After scheduling traffics to qualified intermediate nodes, the earlier generated packet from source node is transmitted to a node with lengthy queuing delay but still within the deadline bound. Taking advantage of the different T_w in different neighbor nodes, the transmission time of the entire traffic stream can be decreased by making the queuing of earlier generated packets and the generating of new packets be conducted in parallel. As the throughput in two-hop transmission is commonly less than the throughput of direct transmission, the two-hop transmission is only used in two cases: 1) when the packet sender is out of range from AP, and 2) APs in range are congested. In these two cases, the direct transmission to an AP cannot provide QoS guarantee, and the two-hop transmission is needed.

4.4 Mobility Based Packet Resizing Algorithm

The transmission link between two nodes is frequently broken down in a highly dynamic mobile wireless network. The QoS of the transmission of a packet flow is degraded by the delay generated in the packet retransmission. A node in a highly dynamic network has higher probability to meet different mobile nodes and APs, which is beneficial to resource scheduling. The space utility of an intermediate node that is used for forwarding a packet p is Sp/Wi.Ta. Thus reducing packet size can increase the scheduling feasibility of an intermediate node and reduces packet dropping probability. As well as, we cannot make the size of the packet too small because it generates more packets to be transmitted, generating higher packet overhead. Based on this rationale and taking advantage of the benefits of node mobility, we introduce a mobility-based packet resizing algorithm for QOD in this section. The basic idea is that the larger size packets are appointed to lower mobility intermediate nodes and smaller size packets are assigned to higher mobility intermediate nodes, which boosts the QoS-guaranteed packet transmissions. Specifically, in QOD, as the mobility of a node rises, the size of a packet S_p sent from a node to its neighbor nodes i decreases as following:

$$Sp(new) = \Upsilon / v_i \; Sp(unit)$$

Where γ is a scaling parameter and Vi is the relative mobility speed of the source node and intermediate node and Sp(unit)=1 kb.

4.5 Stable Neighbor Selection For Routing

Based on the distance between neighbor and destination, greedy neighbors are selected. If the distance between neighbors and destination is less than the distance between itself and destination then a node classifies its neighbors as greedy neighbors. Neighbor with less space utility means, it utilizes minimum amount [6] of bandwidth for its individual data transmission and hence its available bandwidth becomes high. A node is selected as qualified neighbor for data transmission if it has less space utility (high available bandwidth) and low speed. Low speed neighbor ensures stable router. The number of flows involved in the network has different deadline, so the priority is given to the flow with low deadline. According to the mobility of the node packet size is adjusted. If the node is having low mobility then it is capable of sending large data. Node with high mobility may create link breakage during its large data transmission. Hence packet size is fixed as small for data transmission for the node with high mobility.

In hybrid wireless Networks based on the proposed routing mechanism, if forwarding node have high mobility, there is the chance for local topology inaccuracy [7]. If the node involved in the forwarding path moves periodically then there is the situation of link failure which leads to packet loss. Hence it is required to select the nodes with low movability which means selection of stable node as forwarder based on its mobility. Mobility based forwarding node selection scheme boosts the routing performance.

Source node predicts the distance of each acquaintance from itself at particular time (t) using the current location of neighbor and speed of the neighbor. After certain time (t+T) it anticipates the distance again using the current location of neighbor and speed of the neighbor. In both times if the node comes under neighbor status then it is highly stable neighbor. To apply highly stable greedy forwarding distance amid destination and highly stable neighbors are calculated. The neighbor which is having the minimal distance is selected as forwarder.

4.6 Soft-Deadline-Based Forwarding Scheduling

In the EDF algorithm, an intermediary node progress the packets in the order from the packets with the closest deadlines to the packets with the furthest deadlines. If an intermediate node [8] has no dispute to meet all packets deadlines in forwarding, that is, the packets are scheduling achievable, the EDF algorithm works satisfactorily. However, when an intermediate node has too many packets to onward out and the deadlines of some packets must be missed, EDF progress out the packets with the closest time limit but may delay the packets with the farthest deadlines. Therefore, EDF is suitable for hard-deadline driven applications where packets must be forwarded before their deadlines but may not be fair to all arriving packets in soft-deadline driven applications, where the deadline missing is occasionally acceptable. In order to achieve fairness in the packet forwarding organizing for soft-deadline driven applications, a forwarding node can use the least slack first (LSF) scheduling algorithm. The slack time of a packet p is defined as Dp – t - c’ where t is the current time and c’ is the remaining packet transmission time of the packet .With the LSF algorithm, an intermediate node periodically calculates the slack time of each of its packets, and progress the packet with the least slack time. If all packets have the same slack time value, one packet is chosen at random to be sent out. Therefore, the objective of LSF is different from that of EDF. LSF does not aim to complete transmitting the packet flood before their deadlines. Rather, it aims to make delays and the sizes of delayed part in the slowed packets (delayed size in short) of different packet flows almost the same. If the packets are scheduling feasible, the LSF algorithm can meet all deadlines of packets. Otherwise, the forwarding node takes turns to forward the packets situated on their slack times. Therefore, LSF can achieve more fairness than EDF. QOD can choose either LSF or EDF based on the applications

4.7 Performance Evaluation

Performance evaluation is done in terms of number of nodes versus overhead, throughput and delay.

Overhead:

Overhead is defined as total number of beacon update messages participated in the communication.

Overhead = Number of messages involved in beacon update process.

Transmission Delay

Transmission delay is the time taken for a packet to reach the destination from the source node.

$$\text{Transmission delay (ms)} = \frac{\sum \text{(Delay of each entities data packet)}}{\text{Total number of delivered data packets}}$$

Throughput:

Throughput is the measurement of the number of packets passing through the network over a unit of time.

V. RESULTS AND DISCUSSION

The performance of QOD and iQOD is analyzed using network simulator2. The experimental model is built with 50 nodes.

5.1 Throughput

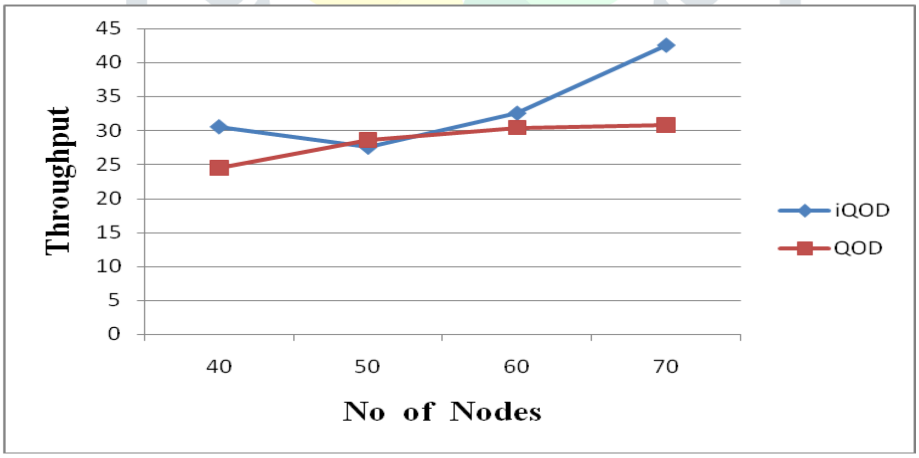

Fig.2 Comparative graph on Throughput

Fig 2 shows the comparative graph on Throughput. Here the x-axis represents the Number of Nodes and y-axis represents the Throughput. When the number of nodes gets increased the throughput is increased. The improved QOD provides better throughput when compared to the existing QOD.

5.2 Overhead

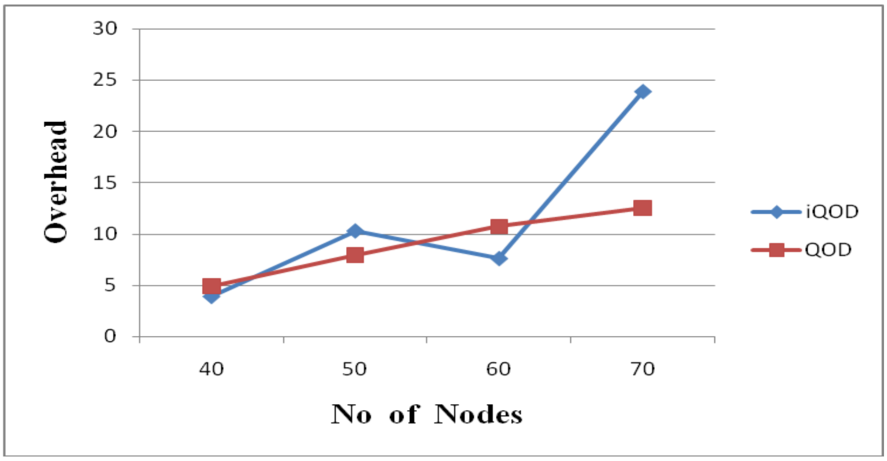

Fig.3 Comparative graph on Overhead

Fig 3 shows the comparative graph on Overhead. Here the x-axis represents the Number of Nodes and y-axis represents the Overhead. When the number of nodes gets increased the overhead is increased. The improved QOD incurs increased overhead when compared to the existing QOD.

5.3 Delay

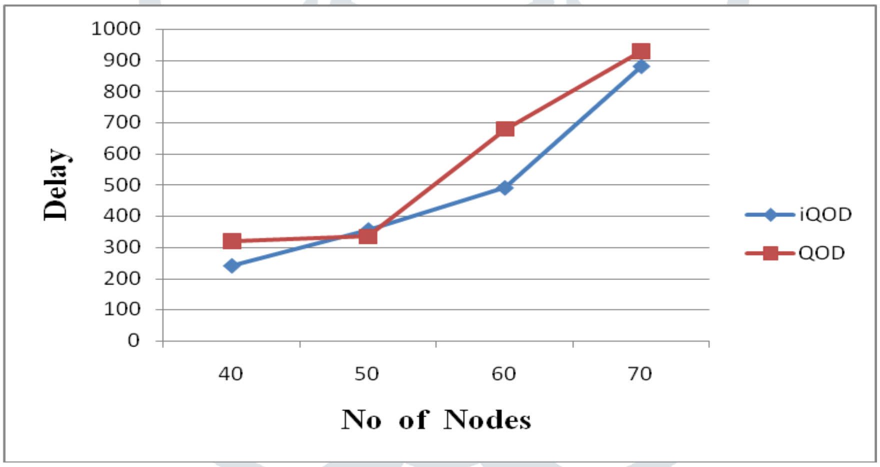

Fig.4 Comparative graph on Delay

Fig 4 shows the comparative graph on Delay. Here the x-axis represents the Number of Nodes and y-axis represents the Delay. When the number of nodes gets increased the delay is decreased. The improved QOD incurs reduced delay when compared to the existing QOD.

VI CONCLUSION

Hybrid wireless networks that combine MANETs and infrastructure wireless networks have proven to be a better network structure for the next generation networks. How-ever, minimum effort has been devoted to supporting QoS routing in hybrid networks. Direct adoption of the QoS routing approaches in MANETs into hybrid networks inherits their drawbacks. In this paper, we propose a QoS-oriented distributed routing protocol (QOD) for hybrid networks to provide QoS services in a highly dynamic scenario. Taking asset of the unique features of hybrid networks, i.e., anycast transmission and short transmission hops, QOD converts the packet routing problem to a packet scheduling problem. In QOD, a source node directly transmits packets to an AP if the direct communication can guarantee the QoS of the traffic. Otherwise, the source node lineup the packets to a number of qualified neighbor nodes. Specifically, QOD incorporates five algorithms. The QoS-guaranteed neighbor selection algorithm elects qualified neighbors for packet forwarding. The distributed packet scheduling algorithm schedules the packet transmission to further reduce the packet transmission time. The mobility-based packet resizing algorithm resizes packets and assigns smaller packets to nodes with faster mobility to guarantee the routing QoS in a highly locomotive environment. The traffic redundant elimination-based transmission algorithm can further increase the transmission throughput. The soft-deadline-based forwarding scheduling achieves fairness in packet forwarding scheduling when some packets are not scheduling achievable. Experimental results show that QOD can achieve high mobility-resilience, scalability, and contention reduction. In the future, we plan to evaluate the performance of QOD based on the real test bed.

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