Abstract: In the recent ascensions of wireless communications, Hybrid networks are considered to be a boon and plays a significant role for wireless based communication. In the highly dynamic environment of mobile ad hoc networks, the traditional multicast approaches used in wired networks are no longer suitable. Quality of Service for Hybrid Network gets affected at numerous times, whenever reservation oriented based Qos pertaining to MANET's is directly inculcated. QoS cannot be ensured in the hybrid networks. As a matter of fact, in the existing system, occurrence of race condition problems and invalid reservation is a quotidian problem that we are dealing with. In order to make sure of the presence of QoS in Hybrid networks, our propounded approach is implementing QoS-Based Distributed routing protocol (QOD), where the basic problem of packet routing is transformed into a problem of resource scheduling when QOD inculcates less number of transmission hops along with transmission to any cast properties of hybrid networks. The algorithms that we are implementing in our propounded approach in order to enhance QoS are as follows: firstly, a QoS-guaranteed channel allocation algorithm to reduce the delay in transmission, secondly, a distributed packet scheduling algorithm which reduces delay in transmission furthermore, thirdly, mobility-oriented packet rescaling algorithm that adapts segment size based on mobility of node in order to bring down time of transmission. Implementation of these algorithms ensures zero occurrence of communication overhead and at the same time performance is ameliorated by reduction in transmission delay. Our propounded approach also avoids race condition and invalid reservation, thus making it more robust.

Keywords: Hybrid wireless network, MANETs, Two-hop Relay, Quality of Service, routing algorithms, race condition, invalid reservation.

I. INTRODUCTION

Wireless networks is seemingly gaining popularity amongst the general mass, where it is generally used by the quotidian mass for electronic commerce, banking transactions, online streaming, wireless LAN and Ad hoc sensor networks. Hence it is vital for us to have an in-depth knowledge regarding their performance. Communicating in a wireless environment has gained much demand in today's day to day life. Wireless communication is widely used in numerous fields which involves playing online games, accessing YouTube videos, live audio or video streaming via wireless devices which aids in connecting directly to mobile users for the sake of playing videos and real time interaction are ameliorated.

Networks require high Quality of Service(QoS) [1] to support wireless and mobile networking environment. Now a days, generally performed data transmission is solely based on wireless networks. Performance analysis of wireless ad hoc networks is an intriguing task, as because such analysis must consider the interactions involved between the multiple access due to the traffic carried by the network. A wireless hybrid network is incorporated from a wireless infrastructure network and a mobile ad hoc wireless network in order to satisfy the requirements of Quality of Service(QoS), and aids in the transfer of data without reducing the quality of it . Direct transfer of data based on QoS has raised reservation based problem and race condition problems[2]. Invalid reservation problem states that the resources involved becomes invalid if there is a discontinuity between the transmission path present among source and a destination node. Race condition problem illustrates a double allocation of the single resource to multiple paths.

To make an amelioration, in this specific paper, we are propounding a synergistic approach based on QOD protocol implementation. This reservation based problem is rectified by QOD protocol, where routing of packets are done to the
destined destination, thus meeting the requirements of QoS. Hybrid wireless networks can be considered to be a more efficacious alternative network framework for the next generation wireless networks. Multi-hop cellular networks are an integral part of hybrid wireless network [3]. The data transmission in hybrid networks has got generally two prime features, which are as follows: i) access point can be either a source or a destination for any node. ii) The number of hops between a node and an access point is relatively small. Considering the positive outcome of the two features, packet routing problem is transformed to a problem of dynamic resource scheduling by the aid of QOD. A source node chooses nearby neighbors that can provide QoS services to forward its packets to base stations in a distributed way if a source node is not within the transmission range of the Access Point. Depending on their channel condition, queuing condition and mobility, scheduling of packet streams to neighbor is done by the aid of the source node. The algorithms that help in achieving the intended enhancements are as follows:-

- A QOS BASED CHANNEL ALLOTMENT ALGORITHM: Selection of qualified neighbors is done with the help of this algorithm and scheduling based on deadline is performed for QoS routing.
- A DISTRIBUTED PACKET SCHEDULING ALGORITHM: Scheduling of packet routing is done after neighbor selection. Packets generated earlier are assigned higher queuing delays while on the other hand the ones, which are generated recently are assigned with lower queuing delay to reduce transmission delay.
- A MOBILITY-ORIENTED PACKET RESCALING: Resizing of each packet is done by source node in its stream of packets for each nearby node based on the mobility of neighbor node so as to ameliorate the packet’s scheduling viability from the source node.

II. RELATED WORKS

A brief survey on the existing works pertaining to hybrid wireless networks, MANETs, wireless sensor networks have been discussed in this specific section. A MANET is an infrastructure less oriented network of mobile devices without any wires. Each device in a MANET is free to move in any direction. It can act as a router or a node. MANETs can be used in hybrid wireless ad-hoc networks and transfer data in multi hops relay. Due to certain unique features in MANET it becomes hard to satisfy QoS requirements like user mobility and bandwidth. In order to overcome this we use a hybrid wireless network ,combination of MANET network with wireless infrastructure network. Many algorithms were introduced based on the QoS routing of the packets and maintaining its quality till the destination of the packet is reached.

S. Aakasham et.al[4], has propounded the least stack first algorithm, where the packet is forwarded based on least waiting time allotted to any particular packet in order to achieve equity in packet forwarding. G. Santhi et.al[5], has given an in-depth survey on various QoS routing protocols. S. Jiang et.al [6], has propounded a scheme making it adaptable for various topologies pertaining to MANETs. Numerous algorithms had been propounded for creating routes formed by nodes and storing their respective links[7],[8]. Perkins et al. [9], has broadened the AODV routing protocol [10] by appending facts related to maximum delay and each neighbor’s minimum attainable bandwidth pertaining to the routing table of a node. Conti et al. [11], has propounded to implement the local knowledge related to the nodes to enumerate the solidity of routing paths and opt preferable routes, which can be relied upon.

For example, in a University there is base station( Access Point(AP) as per this paper). People who have no Wi-Fi access but close to a building can use a two-hop relay transmission to connect to the AP of that particular building. If the person is in building A and trying to connect to the building B which is at a farther distance, it won’t be possible as the range of building B is not that large to reach up to building A. This is the reason why two-hop relay is used so that the person can access the base station nearest to him.

A. HYBRID WIRELESS NETWORK

A hybrid wireless network, which is a blend of both MANET network and infrastructure oriented network, transfers data in multi-hops relay. This multi-hop network ensures the solution to the reservation based problem by acquiring the properties of MANET network, where mobility and bandwidth is an unique feature. The installation cost is reduced for the provider, the bandwidth is enhanced and energy consumption while transmitting the packets is reduced to a considerable extent, as shorter packets can be sent. Jiang et al.[12] propounded a method of resource provision involving WiMax for providing an improved service with better results and higher reliability. Semi distributed relaying algorithm for power allocation and optimizing relay selection was propounded by J. Cai et.al[13]. Wei et al. [14] propounded a scheme, where the first-order of the finite state of Markov channels are implemented to predict the relative time variations by taking the average of the procured signal-to-noise ratio (SNR) pertaining to the transmission of the packets, thus accomplishing an efficacious system with a high spectral efficiency. Lee et al. [15], has exhibited a system capable of analyzing the link capacity for optimum forwarding of data compared to uplink transmission of data in multihop cellular networks.

B. WIRELESS SENSOR NETWORKS

Wireless sensor networks are implemented to monitor the environmental conditions such as temperature, noise, etc. and transfer the data to the destined location. It consists of nodes which is connected to a sensor or several nodes connected to one sensor. RAP[16] and SPEED[17] gave a high priority to deliver the packets to the destination with long distance delay. Multipath routing technique[18],[19] was propounded to ameliorate routing reliability. In order to provide promising services in infrastructure networks integrated services (IntServ) [20] is a design that uses admission control and
resource reserving for particular flow and to maintain traffic flows. It is a stateful model. Differentiated services (DiffServ)[21] is a design that manages traffic using coarse-grained class based mechanism. It is a stateless model. Numerous algorithms have been propounded to reduce the dropping of packets considerably and the ubiquitousness of transfer of packets by the implementation of dynamic packet service model.

III. PROPOSED SYSTEM

The transmission of data from source node to destination without any interruptions is possible by removing the reservation based problem. This is done by the admission control system that checks if there are required amount of resources to satisfy the QoS requirements. Depending on the following two activities, the QOD protocol works: firstly, optimal routing path needs to be determined and secondly, transferring packets with QoS requirements. The potentiality of a node to promise arrival of packet to its destined location by satisfying the QoS requirements is defined as the Scheduling viability. Here, in this case, first the source node sends a request i.e., RREQ. The adjacent nodes with lesser space utility compared to the threshold value, replies first. The information attached with the neighbor (adjacent) node is the interval time in which the packet will appear, the delay in transmission of packets, packet scheduling viability, mobility speed of the node is determined. Among all the neighbors that have replied, the source node chooses the neighbors that guarantee to satisfy QoS requirements. These neighbor nodes report to the source node and guarantee to reduce the delay in packet transmission. Once the destination receives the message it sends a reply i.e., RREP to the source node following the recorded path in the request. The transmission is done in wave relay format where hop by hop or two-hop relay transmission is done to deliver the packets to destination.

A. CHANNEL ALLOCATION

Long delay transmission of packets is a disadvantage for QoS Oriented Distributed protocol. To avoid this and let the transmission be accomplished in short delays the QOD protocol integrates the Earliest Deadline First algorithm [21], which determines the traffic between the intermediate nodes and sets a deadline based on the destination to be reached in a particular time interval. In this algorithm the packets are assigned a deadline based on the priority. The packet which has the closest deadline is allotted the highest priority and sent first. Based on the size of the packet and the bandwidth the workload in node can be found. According to the Random Early Detection algorithm [22] where a threshold is assigned to the queue length to avoid congestion in the path, we assign a space utility threshold to each of the nodes in order to avoid queue scheduling viability. The source node forwards a request. On seeing an active request, the adjacent neighbors request replies to the source node with their space utility less than the threshold value assigned. The information in the form of reply to the source node comprises of the workload rate, the interval time required for the packets to deliver, the required information to calculate the delay of packets and the delay transmission time:

\[ \text{Workload rate} = \text{Space utility} < \text{Threshold} \quad (1) \]

The source node analyses the neighbor nodes and chooses the one which satisfies the QoS requirements. It then distributes the packets to all the neighbor node selected based on the workload rate in order to avoid congestion. This makes the scheduling viable for each of the neighbor nodes. Based on this selection the channel is allocated and the shortest and less busy path is finalized to transfer the packets in short interval.

B. A DISTRIBUTED PACKET SCHEDULING ALGORITHM

While QoS is guaranteed by channel allocation algorithm by selecting intermediate nodes ensures QoS of transmission of packets and assigning of traffic by source node to the neighbor nodes, a proposal for distributed packet scheduling algorithm is to be given for routing of packets so as to bring down the transmission span of stream.

\[ \text{Node 1} \quad \text{Node 2} \quad \text{Node N} \]

\[ \text{CONTROL SYSTEMS} \quad \text{CHANNEL ALLOCATION} \quad \text{PACKET SCHEDULING} \quad \text{PACKET RESIZING} \]

\[ \text{HIGH PRIORITY} \quad \text{LOW PRIORITY} \]

\[ \text{MULTIPLE USERS} \quad \text{MULTIPLE DATABASES} \]

Figure 1: Architecture Diagram for QoS Oriented Distributed Protocol

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This algorithm ensures reduction in transmission delay of an entire packet by generating packets having more queuing delays as well as scheduling feasibility. Not only this, on the other hand, it also assigns recently generated packets with less queuing delays as well as scheduling feasibility.

Let \( T_q \) denote the queuing time of packets. In order to send its packets by the deadline, the source node needs to calculate \( T_q \) of each available intermediate node to select intermediate nodes that can perform the desired action. Before getting into the basics of the distributed packet scheduling algorithm, we need thorough knowledge of estimating the queuing time of a packet with priority, say “x”. After getting replies of neighbor nodes that consists information regarding scheduling of the queues, the calculation is performed by source code in order to calculate \( T_q \) of its packet in each intermediate node which in turn helps in choosing the next intermediate node \( n_i \).

We will consider an example in which a source node generates three same size packets \( p_0, p_1, \) and \( p_2 \) at times \( t_x, t_y, \) and \( t_z \) \((t_x < t_y < t_z)\), respectively. Since generation of all these packets are from the same node, the transmission delay from the source node to each intermediate node are almost the same.

Suppose delay in queuing in every intermediate nodes fulfills the criteria of ascending order of queuing time of packets, then packet \( p_0 \) is supposed to be sent towards the first intermediate node and same is followed respectively by other packets as well. Consequently, the reduction in final delivery time can be observed.

In order to reduce throughput as in case of direct transmission, we opt for two-hop transmission which is suitable for following two cases: I) when sender is not within range of an Access Point, and need to connect to a node out of its bandwidth range and II) There is a congestion in range of Access Points, the packets adapt another neighbor which is less busy comparing to the present one. Two-hop transmission is needed in both the cases as direct transmission cannot give QoS guarantee.

C. MOBILITY ORIENTED PACKET RESCALING

In today’s world of immense mobile wireless networks, data transfer from one place to another becomes a common thing. Due to tremendous amount of data being transferred at a time congestion occur and the chances of dropping of data (packets) becomes high. Due to this the link between the nodes breaks down and transmission is delayed and the QoS in the flow is lost. This forces the source to resend the data. Retransmission of packets causes delay in transmitting the data to target. At the same time a node in a big dynamic network has the chances to meet various nodes and APs in their path towards destination which reduces the problem of resource scheduling. Thus to avoid such breakdowns in between the nodes the size of the packet has to be reduced into smaller packets. Reducing the size of the packet increments scheduling viability and scales down the dropping of packets. Too many smaller packets may increase the number of packets which is also not suitable for short delay transmission. Taking leverage of this justification on node mobility we propose a QOD based mobility oriented packet rescaling algorithm. Here the packets with larger size are transferred through decreased mobility and packets of smaller size are transferred through higher mobility. This mechanism raises the QoS guaranteed transmission of packets. The concept behind this is that when the size of the packet is smaller it can be transferred easily and at a high speed through high mobility and if the packet size is larger it is transferred at a low speed through decreased mobility as it needs some time to reach its destination. Thus this reduces the traffic between the nodes and is easily scheduled from the source node itself. In a QOD protocol the data transmission guarantees reduced traffic among the nodes and short delay transmission to satisfy the QoS requirements in a highly dynamic situation.

IV. EXPERIMENTAL OUTCOMES

We have implemented HeIdSql for storing the information in the form of a database and Java as the programming language to implement the algorithms mentioned in this specific paper. The main server is run at the first, and eventually, some nodes are registered along with the port number and IP Address of the main server, so that the user can login with those nodes, at a later time. We then implement the database connector which aids in connecting the data with the database. A topology is constructed which in turns helps us in choosing the best available path for the packets by using channel allocation algorithm, which is displayed in figure 2.

![Figure 2: Channel Allocation for Packets](image)

The packets which are generated earlier has got higher queuing delay and vice-versa. Due to this waiting time gets reduced, and data transmission becomes swift. These packet scheduling is shown in figure 3.

![Figure 3: Packet Scheduling](image)
V. CONCLUSION

Data transmission in hybrid wireless networks has guaranteed better results comparing to the wireless networks in MANETs (Infrastructure less network). Due to certain unique features of MANET networks it is not possible to maintain the QoS requirements. Thus a combination of both wireless network and MANET network overcomes these drawbacks. By introducing a QoS Oriented Distributed protocol (QOD) the quality of data is maintained and traffic is reduced between the nodes. The Access Point guarantees the QoS of the packets among the nodes. Based on the three algorithms, the channel allocation algorithm lets us to select the trusted neighbors, the distributed packet scheduling algorithm lets to divide the packets and reduces the transmission time and the mobility oriented packet rescaling distributes the packets based on rescaled sizes and mobility. The target node gets the data and replies (RREP) to the source claiming that the packet was received without any loss of data. Thus QOD proves to be a better way to provide mobility, scalability, short delay transmission and distributed environment. The future work can be done by providing security to the data being transferred using RSA algorithm. Encrypting the data at the source node which can be decrypted at the receiver end only.

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