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QoS Enhancement in Hybrid Networks Using QoS Oriented Distributed Routing Protocol

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ABSTRACT: QoS routing is an important research issue in MANET, especially for mission-critical monitoring and surveillance systems which requires timely and reliable data delivery. As wireless communication gains popularity, significant research has been concerned to supporting real-time communication with stringent Quality of Service (QoS) requirements for wireless applications. At the same time, the wireless hybrid networks that accommodates a Mobile Ad hoc Network (MANET) and a wireless infrastructure network has been proven to be a better alternative for the next generation wireless networks. By directly taking resource reservation-based QoS routing for MANETs, hybrids networks derive invalid reservation and race condition problems in MANETs. The QoS-Oriented Distributed routing protocol (QOD) to enhance the QoS support capability of hybrid networks. QOD alter the packet routing problem to a resource scheduling problem.

KEYWORDS: Hybrid wireless networks, Routing algorithms, Quality of Service**.**

I. INTRODUCTION

A Mobile Ad Hoc Network is a self-configuring infrastructure less network of mobile devices connected by wireless. Each device in MANET is free to move independently in any direction and will therefore change its links to other devices frequently. Each must transmit traffic unrelated to its own use, and therefore be a router. The initial challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Civilian applications include peer-to-peer computing and file sharing, collaborated computing in a conference hall, and search and rescue operations. An ad hoc wireless network is a collection of wireless mobile nodes forming a temporary network. Its classical applications are in battlefield communications, disaster recovery, and search and rescue operations. More commercial applications are already being developed. In an ad hoc wireless network, connections among these mobile nodes occur via multi-hop wireless connections without the support from a fixed infrastructure such as a base station. As technology advances, wireless and portable computers and devices are becoming more powerful and capable. These advances are marked by an improves in Memory size, CPU speed, disk space, and a decrease in size and power consumptions. The need for these devices to periodically communicate with each other and with wired networks is becoming increasingly essential. Mobile ad hoc networks (MANETs) open the door for these devices to provides networks on the fly, i.e., formally, a MANET is a group of mobile devices which form a communication network with no pre-existing wiring or infrastructure. It allows to the applications running on these wireless devices to share data of different types and functions. There are many applications of MANETs, each with separate characteristics of network size (geographic range and number of nodes), node mobility, communication requirements, and data characteristics. Recent progresses in the network technologies have led to rapid development of new wireless networking techniques and possibilities. An example of such a new wireless network is Mobile Ad hoc Network. On the other hand, the demand for new applications with new requirements is developed. One of the most demanding applications is multimedia application. Multimedia application characterized with the -requirements for voice and video conferencing, and text and images sharing. These new requirements have led to necessity of supporting real-time traffic. Real-time applications are highly sensitive to latency and other quality of service parameters such as bandwidth. Ad hoc networks have numerous practical applications such as military and emergency operations. These practical applications need the support of one to many, and many to many connections. Therefore, in such practical

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applications, multicast communication is a must. QoS routing, especially QoS multicast routing, is very crucial for these applications. QOD incorporates five algorithms: 1) Neighbor selection algorithm to meet the transmission delay requirement, 2)Distributed packet scheduling algorithm to further reduce transmission delay, 3) Mobility-based segment resizing algorithm to adaptively adjusts segment size according to node mobility in order to reduce transmission time, 4)Traffic redundant elimination algorithm to increase the transmission throughput, and 5)Data redundancy elimination algorithm to eliminate the redundant data to further improve the transmission QoS.

II. RELATED WORK

Existing approaches for providing guaranteed services in the infrastructure networks are based on two models integrated services (IntServ) [1] and differentiated service (DiffServ) [2]. IntServ is a stateful model that uses resource reservation for individual flow, and uses admission control and a scheduler to maintain the QoS of traffic flows. DiffServ is a stateless model which uses coarse-grained class-based mechanism for traffic management. Number of queuing scheduling algorithms have been proposed for DiffServ to further minimize packet droppings and bandwidth consumption [3], Stoica et al. [4] proposed a dynamic packet service (DPS) model to provide unicast IntServ-guaranteed service and Diffserv like scalability. A majority of QoS routing protocols are based on resource reservation in which a source node sends probe messages to a destination to discover and reserve paths satisfying a given QoS requirement.Perkins et al. [5] extended the AODV routing protocol by adding information of the maximum delay and minimum available bandwidth of each neighbor in a node's routing table.Venataramanan et al. [6] proposed a scheduling algorithm to ensure the smallest buffer usage of the nodes in the forwarding path to base stations. However, these works focus on maximizing network capacity based on scheduling but fail to guarantee QoS delay performance. Some works consider providing multipath routing to increase the robustness of QoS routing. Weiet al. [7] proposed a two-hop packet forwarding mechanism, in which the source node adaptively chooses direct transmission and forward transmission to base stations. Unlike the above works, QOD aims to provide QoSguaranteed routing. QOD fully takes advantage of the widely deployed APs, and novelly treats the packet routing problem as a resource scheduling problem between nodes and APs.Ng and Yu [8] considered cooperative networks that use physical layer relaying strategies, which take advantage of the broadcast nature of wireless channels and allow the destination to cooperatively "combine" signals sent by both the source and the relay to restorethe original signal.

III.PROPOSED WORK

In order to enhance the QoS support capability of hybrid networks, we propose a QoS-Oriented Distributed routing protocol (QOD). Commonly, a hybrid network has widespread base stations. The data forwards in hybrid networks has two features. First, an Access Point can be act as a sender or a receiver to any mobile node. Next, the number of transmission hops between a mobile node and an Access Point is small.

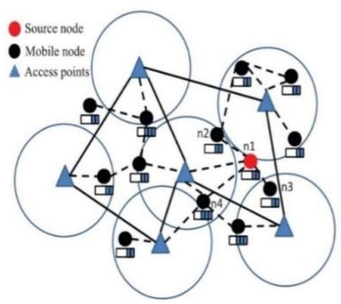

Fig 1. The network model of the Hybrid networks

The first feature allows a stream to have any cast transmission along multiple transmission paths to its destination through base stations, and the second feature enables a sender node to connect to an Access Point through an intermediate node. The source node allocates the packet streams to neighbors based on their channel condition, queuing condition, and mobility, aiming to increase network capacity and reduce transmission time and It's have less time delay on transmission between the nodes of wireless communication Here QOD can provide high QoS performance in terms of overhead scalability , mobility-resilience and .transmission delay.

IV.IMPLEMENTATION

The process is divided into several major tasks such as QoS-Guaranteed Neighbor Selection Algorithm, Distributed packet scheduling algorithm, Mobility-based segment resizing algorithm, Soft-deadline based forwarding scheduling algorithm, Data redundancy elimination based transmission.

A. QOS-GUARANTEED NEIGHBOR SELECTION ALGORITHM

The qualified neighbors are selected and deadline-driven scheduling mechanism is used to guarantee QoS routing Scheduling feasibility. Which is considered as the ability of a node to guarantee a packet to arrive at its destination within QoS requirements. When the QoS of the direct transmission between a source node and an Access Point cannot be guaranteed, A request message is send to its neighbor nodes from the source node. The neighbor node n with space utility less than a threshold replies the source node, the reply message contains information about available Space for checking packet scheduling feasibility. The selected neighbor nodes periodically report their status to the source node, here the scheduling feasibility is ensured and locally schedules the packet stream to them. The each packets are transmitted to the neighbor nodes that schedule in a round-robin fashion from a longer delayed node to a shorter delayed node, and it's focused to reduce the packet transmission delay.

Algorithm 1: Pseudo code for the QOD routing protocol executed by a source node.

```
    if receives a request from a source node then
        if this.SpaceUtilitySp(i) < threshold (T) then
        Reply to the source node.
        end if
 end if
if receive forwarding request replies for neighbor nodes then
Determine the packet size Sp(i) to each neighbori
Estimate the queuing delay D for the packet for each neighbor
Determine the qualified neighbors that can satisfy the deadline requirements based on D
Arrange the qualified nodes in descending order
   Allocate workload rate Ai for each node
   for each mediator nodeni in the sorted list do
        Send packets to ni with transmission interval
       end for
   end if
```

B. DISTRIBUTED PACKET SCHEDULING ALGORITHM

The Distributed packet scheduling algorithm, after qualified neighbors are identified. It assigns earlier generated packets to forwarders with higher queuing delays, when more recently generated packets are assigned to forwarders with lower queuing delays in order to reduce total transmission delay. The distributed scheduling algorithm is selected as mediator nodes can guarantee the QoS of the packet transmission to ensure their scheduling feasibility. Stream transmission time is reduced further, a distributed packet scheduling algorithm is used for packet routing. Packets that are generated earlier is assigned to forwarders with higher queuing delays, while assigns more recently generated packets to forwarders with lower queuing delays and scheduling feasibility, so that the transmission delay of an entire packet stream can be reduced, an mediator node assigns the highest priority to the packet with the closest deadline and

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the packet with the highest priority is forwarded first. A mediator node can determine the priorities of its packets based on their deadlines.

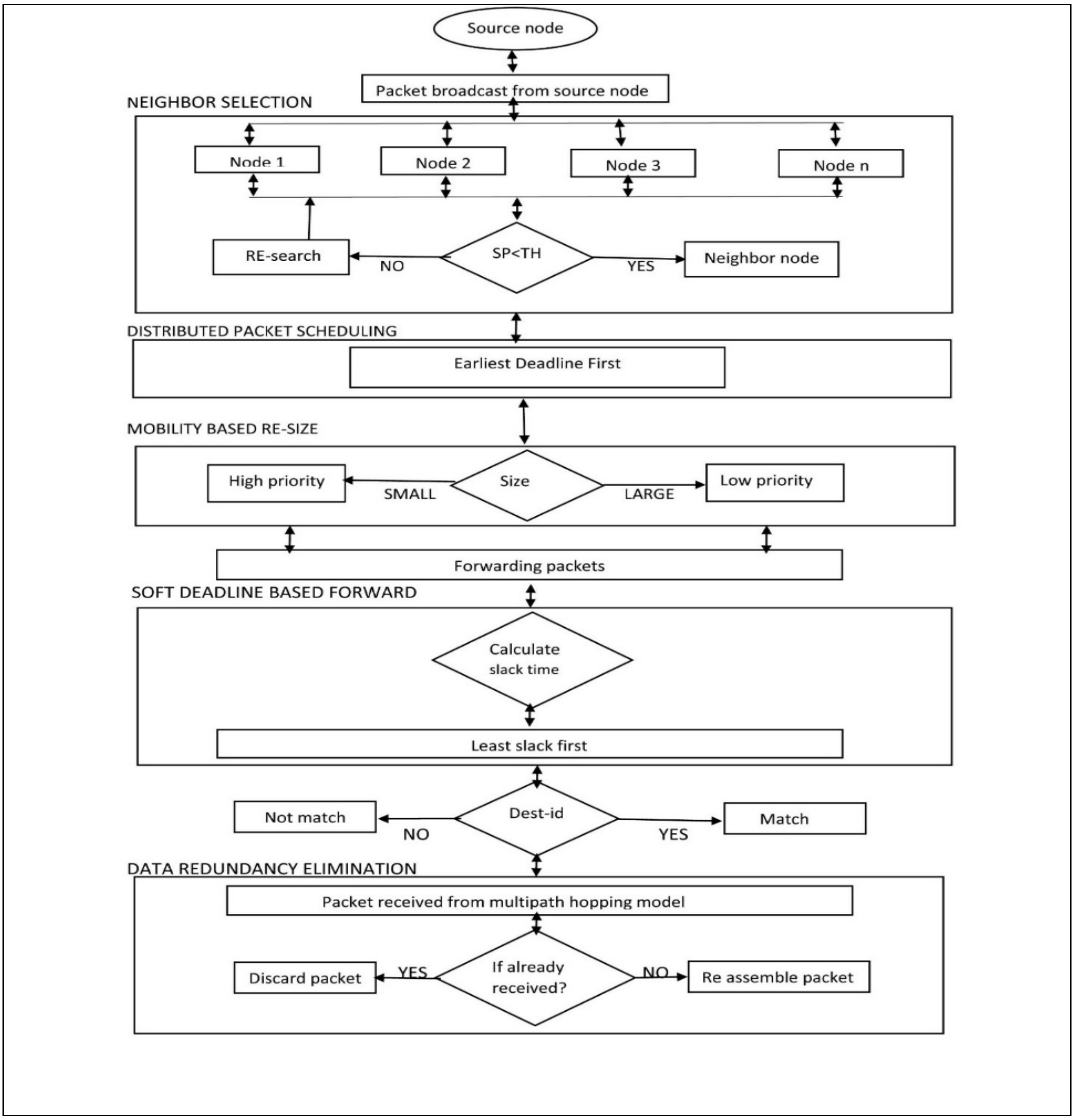

Fig 2. QOD System Model

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C. MOBILITY-BASED SEGMENT RESIZING ALGORITHM

Each packet is adaptively resized in its packet stream for each neighbor node according to the neighbor's mobility in order to increase the scheduling feasibility of the packets from the source node. The transmission link between two nodes is frequently broken down, in a highly dynamic mobile wireless network. The delay generated in the packet retransmission degrades the QoS of the transmission of a packet stream. On the other hand, a node in a highly dynamic network has higher probability to meet different mobile nodes and Access Points, which is beneficial to resource allocating, the space utility of an mediator node that is used for forwarding a packet, reduce packet size which increases the scheduling feasibility of an mediator node and reduce packet dropping probability. However, the size of the packet cannot be made too small because it generates more packets to be transmitted, producing higher packet overhead. By taking the advantage of node mobility, a mobility-based packet resizing algorithm is used for QOD. Here the basic idea is that the larger size packets are assigned to lower mobility mediator nodes and smaller size packets are assigned to higher mobility mediator nodes, which increases the QoS-guaranteed packet transmissions.

D. SOFT-DEADLINE BASED FORWARDING ALGORITHM

A mediator node first forwards the packets with least time which is allowed to wait before being forwarded out to achieve fairness in packet forwarding. A mediator node forwards the packets in the order from the packets with the closest deadlines to the packets with the farthest deadlines. If a mediator node has no problem to meet all packets' deadline occurs in forwarding, that is, the packets are scheduled feasible, and the EDF algorithm works satisfactorily. However, when a mediator node has too many packets to forward out and the deadlines of some packets must be missed, EDF transmits out the packets with the closest deadlines but may delay the packets with the farthest deadlines.
Therefore, EDF is applicable for hard-deadline driven applications (e.g., online conferences) where packets must be transmitted before their deadlines but may not be fair to all arriving packets in soft-deadline driven applications (e.g., online TV), where the deadline missing is sometimes acceptable. In order to achieve fairness in the packet transmitting scheduling for soft-deadline driven applications, a transmitting node can use the least slack first (LSF) scheduling algorithm Therefore, the objective of LSF is different from that of EDF. LSF does not focus to complete transmitting the packet flows before their deadlines. Rather, it focus to make delays and the sizes of delayed part in the delayed packets (delayed size in short) of different packet flows almost the same. If the packets are scheduling feasible according to the LSF algorithm can meet all deadlines of packets. Otherwise, the transmitting node takes turns to forward the packets based on their slack times. Therefore, LSF can achieve more fairness than EDF. The priorities of the packets are determined by the chosen policy.

E. DATA REDUNDANCY ELIMINATION BASED TRANSMISSION ALGORITHM

Due to the transmitting feature of the wireless networks, the Access Points and mobile nodes can overhear and cache packets. This algorithm helps to eliminate the redundant data in order to improve the QoS of the packet transmission. The mobile nodes set their Net Asset Value (NAV) values based on the overhearing message's transmission duration period. A large NAV leads to a small available bandwidth and a small scheduling feasibility of the mobile nodes Therefore, by reducing the NAV value, we can increase the scheduling feasibility of the intermediate nodes and sequentially increase the QoS of the packet transmission. Due to the transmitting feature of the wireless networks, in a hybrid network, the Access Points and mobile nodes can overhead and cache packets, an end-to-end Traffic Redundancy Elimination (TRE) algorithm is used to removes the redundancy data to improve the QoS of the packet broadcasting in QOD. TRE uses a chunk scheme to determine the boundary of the chunks in a data stream. The source node caches the data it has sent out and the receiver also caches its received data. In QOD with TRE, the Access Point and mobile nodes overhear and cache packets. From the overhearing, the nodes know who have received the packets. When a source node starts to transmit packets, it scans the content for duplicated chunks in its cache. If the sender finds a duplicated chunk and it knows that the Access Point receiver has received this chunk before, it alters chunk with its signature (i.e., SHA-1 hash value). When the Access Point receives the signature, it seeking the signature in its local cache. If the Access Point caches the chunk associated with the signature, it sends acknowledgment message to the sender and replaces the signature with the matched data chunk. Otherwise, the Access Point requests the chunk of the signature from the sender.

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IV. CONCLUSION

Hybrid wireless networks that integrate MANETs and infrastructure wireless networks have proven to be a better network structure for the next generation networks. However, little effort has been devoted to supporting QoS routing in hybrid networks. Direct adoption of the QoS routing techniques 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 advantage of the unique features of hybrid networks, i.e., anycast transmission and short transmission hops, QOD transforms the packet routing problem to a packet scheduling problem. In QOD, a source node directly transmits packets to an Access Point if the direct transmission can guarantee the QoS of the traffic.QOD incorporates five algorithms: 1) Neighbor selection algorithm to meet the transmission delay requirement, 2)Distributed packet scheduling algorithm to further reduce transmission delay, 3) Mobility-based segment resizing algorithm to adaptively adjusts segment size according to node mobility in order to reduce transmission time, 4)Traffic redundant elimination algorithm to increase the transmission throughput, and 5)Data redundancy elimination algorithm to eliminate the redundant data to further improve the transmission QoS.

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