ENERGY RESPONSIVE PATH SELECTION IN HYBRID WIRELESS NETWORKS

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Abstract— *Hybrid wireless networks is the combination of mobile wireless adhoc networks (MANET) and wireless infrastructure networks. QoS is the main problem concerned with hybrid wireless networks. The existing system incorporates QOD (Quality of Service oriented distributed) routing protocol increases throughput and reduces the transmission delay by forwarding the packets with highest priority with high energy consumption. Therefore, high energy consumption remains an open problem in hybrid wireless networks which cannot be resolved by QOD protocol. This proposed project uses Energy Aware Clustered-Based Multipath Routing protocol, which forms several clusters, finds energy aware node-disjoint multiple routes from a source to destination which increases the network life time by using optimal routes and improve the performance when compared with existing protocol.*

Keywords—*Hybrid wireless networks; QoS; QoS parameters; Routing protocols.*

1. INTRODUCTION

Wireless networks have been developed rapidly with various applications such as used in military, emergency operations, entertainment and education. Hybrid wireless networks are considered to be as one of the better network infrastructures for the next generation wireless networks. Hybrid wireless network is the combination of infrastructure networks and mobile adhoc networks. Infrastructure network is used to improve the scalability of MANET whereas MANET which extends the coverage of infrastructure networks. Hybrid wireless networks are networks in which any mobile node in a wireless network may have connectivity, either directly or via a gateway node, to an infrastructure network. The routing protocol should be able to provide a certain level of Qos as demanded by the nodes. The QoS parameters can be bandwidth, delay, throughput. Different applications have different requirements, their level of QoS and the associated QoS parameters also differ from application to application. For example, for multimedia, the bandwidth and delay are the key requirements, military applications have additional parameters as security and reliability. QoS parameters to be considered are

Throughput

Throughput is defined as the number of packets transmitted within the particular period of time.

Energy consumption

Energy management is defined as the process of managing the sources and consumers of the energy in a node or in the network as a whole for enhancing the lifetime of the network. Shaping the energy discharge pattern of a node's battery to enhance the battery life; finding routes that results in the minimum total energy consumption in the network.

Power consumption

The power consumed by the radio frequency (RF) module of a mobile node is determined by several factors such as state of operation, the transmission power, and the technology used for RF circuitry.

Load balancing

Load balancing is the main criteria for QoS where the load provided should be balanced among each path in the network.

Bandwidth efficiency

Since the channel is shared by all nodes in the broadcast region, the bandwidth available per wireless link depends on the number of nodes and the traffic they handle. Thus only a fraction of total bandwidth is available for every node.

Performance

A protocol should make minimum number of transmissions to deliver a data packet to all group members.

Security

Authentication of session members and prevention of non-members from gaining unauthorized information play a major role in military communications.

One of the major application areas of adhoc wireless networks is in hybrid wireless architectures such as multi- hop cellular networks (MCNs) and integrated cellular adhoc relay networks (iCAR). The major advantages of hybrid wireless networks are as follows:

- Higher capacity than cellular networks obtained due to the better channel reuse provided by reduction of transmission power, as mobile nodes use a power range that is fraction of the cell radius

- Provide increased flexibility and reliability in routing
- Better coverage and connectivity in holes (areas that are not covered due to transmission difficulties such as antenna coverage or the direction of antenna) of cell can be provided by means of multiple hops through intermediate nodes in the cell.

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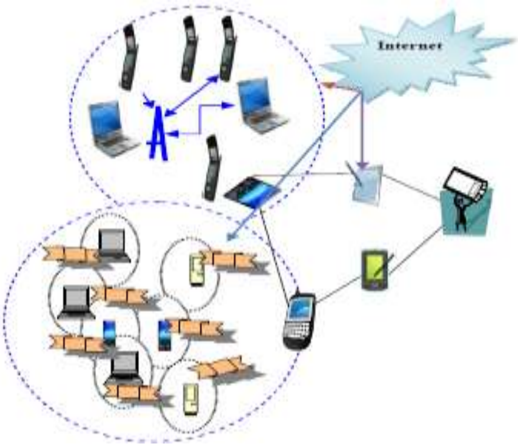

Fig -1: Hybrid wireless network

Figure 1.1 shows hybrid wireless network architecture. A hybrid wireless network (HWN) [16] is a blend to an infrastructure based network, where a Mobile Device (MD) may connect to a base station (BS) using wireless channels via other MDs or sensor nodes (SNs) over Internet. A large number of SNs capable of sensing, communicating, and actuating are the key elements of WSN [16]. These special nodes are having limited processing and communication capability due to limited energy. While MANET is a collection of wireless MDs, all of which may be mobile, that dynamically create a wireless network amongst them without using any infrastructure.

2. EXISTING SYSTEM

Very few methods have been proposed to provide QoS guaranteed routing for hybrid networks. Most of the routing protocols only try to improve the network capacity and reliability to indirectly provide QoS service but bypass the constraints in QoS routing that require the protocols to provide guaranteed service. QoS is the main problem concerned with hybrid wireless networks. Inorder to guarantee the Quality of Service in hybrid wireless networks, QOD (Quality of Service Oriented Distributed) protocol has been developed to reduce the transmission delay and to improve the throughput. The performance of the QOD protocol has been compared with E-AODV (Extended Ad-hoc On-demand Distance Vector) protocol and shown that QOD performs better than E-AODV. QOD aims to provide QoS guaranteed 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. QOD incorporates five algorithms as follows

- **QoS-guaranteed neighbor selection algorithm**: The algorithm selects qualified neighbors and employs deadline-driven scheduling mechanism to guarantee QoS routing
- **Distributed packet scheduling algorithm**: After qualified neighbors are identified, this algorithm schedules packet routing. It assigns earlier generated packets to forwarders with higher queuing delays, while assigns more recently generated packets to forwarders with lower queuing delays to reduce total transmission delay
- **Mobility-based segment resizing algorithm**: The source node adaptively resizes each packet 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
- **Soft-deadline based forwarding scheduling algorithm:** An intermediate node first forwards the packet with the least time allowed to wait before being forwarded out to achieve fairness in packet forwarding
- **Data redundancy elimination based transmission:** Due to the broadcasting feature of the wireless networks, the APs and mobile nodes can overhear and cache packets. This algorithm eliminates the redundant data to improve the QoS of the packet transmission

2.1 MODULE DESCRIPTION

NEIGHBOR SELECTION

Since short delay is the major 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. An intermediate node assigns the highest priority to the packet with the closest deadline and forwards the packet with the highest priority first. Let us use S to denote the size of the packet steam from node ni, use Wi to denote the bandwidth of node i, and Ta(i) to denote the packet arrival interval from node ni. Space utility Us(i) is the fraction of time a node ni is busy with packet forwarding over a unit time. In a communication network, the transmission time of a packet in packet stream from node nj can be regarded as the computing time Tcp(j) of a job from task j, the packet arrival interval Ta can be regarded as Tg, and the CPU utility can be regarded as node space utility in the job scheduling model. After the source node determines the Nq nodes that can satisfy the deadline requirement of the source node, the source node needs to distribute its packets to the Nq nodes based on their available workload rate Uas(i) Wi to make the scheduling feasible in each of the neighbor nodes. Then, the problem can be modeled as a linear programming process.

PACKET SCHEDULING

The problem of how to select intermediate nodes that can guarantee the QoS of the packet transmission and how a source node assigns traffic to the intermediate nodes to ensure their scheduling feasibility is demonstrated. In order to further reduce the transmission time, a distributed packet scheduling algorithm is proposed for packet routing. This algorithm assigns earlier generated packets to forwarders with higher queuing delays and scheduling feasibility, 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 intermediate node can determine the priorities of its packets based on their deadlines Dp. A packet with a smaller priority value x has a higher priority. After scheduling traffics to qualified intermediate nodes based on the earlier generated packet from source node is transmitted to a node with longer queuing delay but still within the deadline bound. Taking advantage of the different Tw in different neighbor nodes, the transmission time of the entire traffic stream can be decreased by making the queuing of previous generated packets and the generating of new packets be conducted in parallel.

As the throughput in two-hop transmission is normally 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 the range of an AP, and 2) APs in range are congested. In these two cases, the direct communication to an AP cannot provide QoS guarantee, and the two-hop transmission is needed.

MOBILITY-BASED PACKET RESIZING

In a highly dynamic mobile wireless network, the transmission link between two nodes is frequently broken down. The delay generated in the packet retransmission degrades the QoS of the transmission of a packet flow. On the other hand, a node in a highly dynamic network has higher probability to meet different mobile nodes and APs, which is beneficial to resource scheduling. As neighbor selection algorithm shows, the space utility of an intermediate node that is used for forwarding a packet p is Sp Wi Ta. That is, reducing packet size can increase the scheduling feasibility of an intermediate node and reduces packet dropping probability. However, we cannot make the size of the packet too small because it generates more packets to be transmitted, producing higher packet overhead. Based on this rationale and taking advantage of the benefits of node mobility, we propose a mobility-based packet resizing algorithm for QOD in this section. The basic idea is that the larger size packets are assigned to lower mobility intermediate nodes and smaller size packets are assigned to higher mobility intermediate nodes, which increases the QoS-guaranteed packet transmissions.

SOFT-DEADLINE-BASED FORWARDING SCHEDULING

The EDF algorithm is proposed which selects an intermediate node forwards the packets in the order from the packets with the closest deadlines to the packets with the farthest deadlines. If an intermediate node has no problem to meet all packets' deadlines in forwarding, that is, the packets are scheduling feasible, the EDF algorithm works satisfactorily. However, when an intermediate node has too many packets to forward out and the deadlines of some packets must be missed, EDF forwards out the packets with the closest deadlines but may delay the packets with the farthest deadlines. Therefore, EDF is suitable for hard-deadline driven applications (e.g., online conferences) where packets must be forwarded 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.

Below, we use an example of an intermediate node's packet forwarding scheduling to compare the effect of EDF and LSF. To help readers understand the process more clearly, in the supplementary file, which is available online, we present a more complex example where each packet flow has multiple packet arrivals during a certain time period.

DATA REDUNDANCY ELIMINATION

The mobile nodes set their NAV values based on the overhearing message's transmission duration time. A large NAV leads to a small available bandwidth and a small scheduling feasibility of the mobile node. 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 broadcasting feature of the wireless networks, in a hybrid network, the APs and mobile nodes can overhead and cache packets, we use an end-to-end traffic redundancy elimination (TRE) algorithm to eliminate the redundancy data to improve the QoS of the packet transmission in QOD. TRE uses a chunking 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 AP and mobile nodes overhear and cache packets. From the overhearing, the nodes know who have received the packets. When a source node begins to send out packets, it scans the content for duplicated chunks in its cache. If the sender finds a duplicated chunk and it knows that the AP receiver has received this chunk before, it replaces this chunk with its signature (i.e., SHA-1 hash value). When the AP receives the signature, it searches the signature in its local cache. If the AP caches the chunk associated with the signature, it sends a confirmation message to the sender and replaces the signature with the matched data chunk. Otherwise, the AP requests the chunk of the signature from the sender.

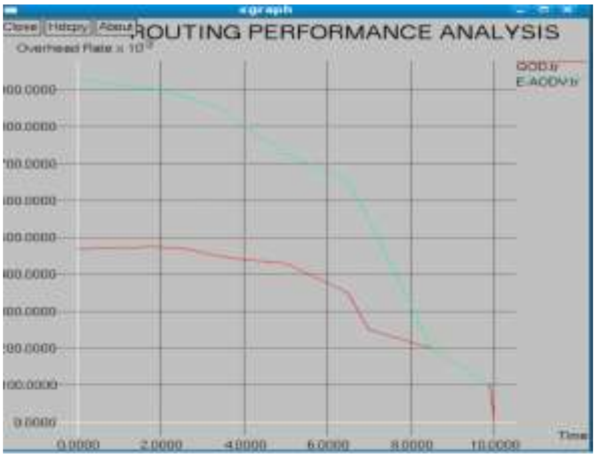

Chart 1- PERFORMANCE GRAPH OF QOD PROTOCOL

2.2 DRAWBACKS OF EXISTING SYSTEM

- High energy consumption remains an open problem in hybrid wireless networks
- The existing system incorporates QOD (Quality of Service oriented distributed) routing protocol increases throughput and reduces the transmission delay by forwarding the packets with highest priority with high energy consumption. Therefore, high energy consumption remains an open problem in hybrid wireless networks which cannot be resolved by QOD protocol.

3. PROPOSED SYSTEM

In order to overcome the issues of high energy consumption, Energy Aware Clustered-Based Multipath Routing is proposed, which forms several clusters, finds energy aware node-disjoint multiple routes from a source to destination and increases the network life time by using optimal routes and performance can be improved when compared to QOD protocol.

4. 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. QoS oriented distributed routing protocol (QOD) for hybrid networks has been proposed to provide QoS services in a highly dynamic scenario. Still high energy consumption remains an open problem in hybrid wireless network due to transmission of data by assigning highest priority. Energy aware cluster based routing will be used to reduce the high energy consumption and the performance can be compared with QOD protocol to show better results.

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