Improved Architectural Framework for MANET

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Abstract: *We present a framework which implements improved QoS metrics for our mobile adhoc network by considering parameters like packet delivery rate and packet dropping for constant, dynamic and exponential distance between the nodes, traffic patterns. Performance of a typical MANET is investigated with various multicast routing protocols such as MAODV, ODMRP etc. Based on the parameters affecting QoS, routing load and packet retransmissions, this paper systematically analyzes the QoS of MANET routing protocols and concludes with new QoS aware routing protocol. The simulations are being carried out by using Network Simulator-2 (NS-2) tool.*

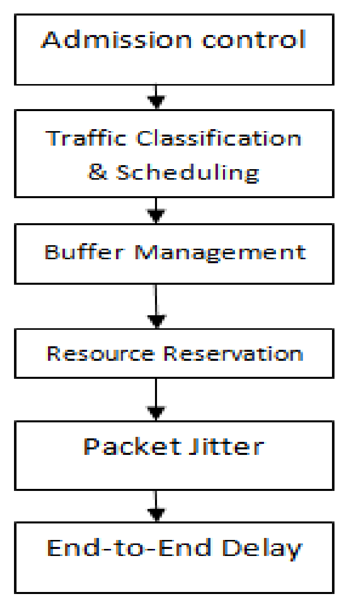
Keywords: *MANET, Admission Control, Traffic Classification & Scheduling, Buffer Management, Resource Reservation, Packet Jitter, End to End Delay, Band Width, NS2-Tool.*

Introduction

An architectural framework consists of a group of modules that are interdependent with each other. We focus on QoS routing, QoS signaling, QoS service providing and also media access control. They are much useful where an infrastructure is absent, destroyed or impractical e.g. disaster area or war zone, short range radios. Quality of Service (QoS) can be categorized into Intrinsic QoS (based on network performance), QoS Experienced (how it is received and how users feel about it) and QoS Perceived (user satisfaction). In this paper, we focus on adaptive QoS i.e. minimum quality requirements an application has to meet. QoS can be provided in some form or the other, at different layers of the protocol stack. At what layer and in what form the QoS is provided depends upon the requirements of an application. Depending upon the actual QoS requirements of an application, the issues involved in providing QoS are different. However, the major challenges involved are dynamic network topology of MANETs, error prone wireless channel, lack of central coordination, imprecise state information, hidden terminal problem and limited availability of resources. Our scope, in this paper is limited to improving these two QoS metrics – Delay and throughput. End-to-end delay is the accumulation of transmission, processing and queuing delays. Throughput is a measure of the no. of packets successfully transmitted to their final destination per unit time.

Proposed Work

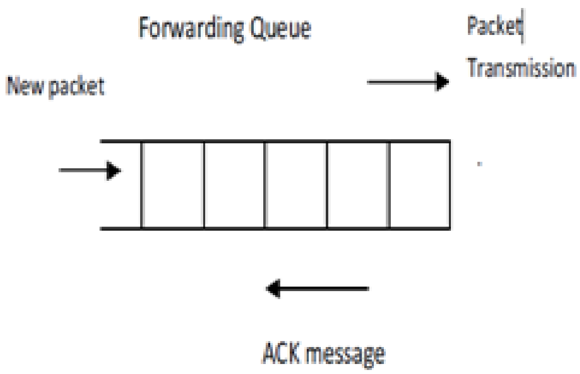
In NS2 Simulation, we provide QoS parameters based on the value, the protocol behavior will be changed. The overall framework consists of figure1. No. of nodes is compared with Packet Delivery Ratio (PDR) for constant, exponential and dynamic distance between nodes. Also, no. of nodes and PDR are compared by 1. Changing traffic pattern with uniform node movement 2. Varying power resource of nodes with random movement of nodes.



It provides the required end-to-end bandwidth and available bandwidth in MAC layer. It shows that control overhead is reduced in dynamic environment when compared to the non admission control. The available local bandwidth is estimated in terms of MAC throughput such as the available Channel time and the average MAC forwarding delay Available channel time (Tact)

To estimate the available channel bandwidth, each node has to determine the available free channel after the measurement time. The measurement time

(Tmt) defines the time Interval taken to broadcast the Hello messages. Based on the carrier sensing range, the busy and free channel time are determined. The available local bandwidth is determined in the forwarding queue of a node.



Traffic Classification & Scheduling

- Priority awaiting packet.
- Bandwidth allocation to different node.

Packet scheduling thus controls bandwidth allocation to different nodes or types of applications. The desired service guarantees are realized independently at each router via proper scheduling.

Buffer Management

- Backlog controller
- Dropper
- Congestion control

Buffer management deals with the task of either storing or dropping a packet awaiting transmission. The key mechanisms of buffer management are the backlog controller and the dropper. The backlog controller specifies the time instances when traffic should be dropped, and the dropper specifies the traffic to be dropped. Buffer management is often associated with congestion control.

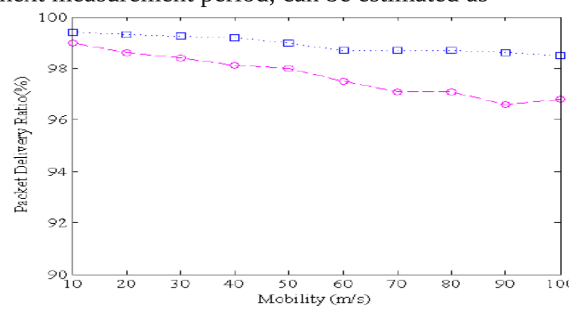
Multi-hop Admission Control

It provides the required end-to-end bandwidth and available bandwidth in MAC layer. It shows that control overhead is reduced in dynamic environment along with PZBRP when compared to other admission control. The available local bandwidth is estimated in terms of MAC throughput such as the available Channel time and the average MAC forwarding delay.

Available channel time (Tact)

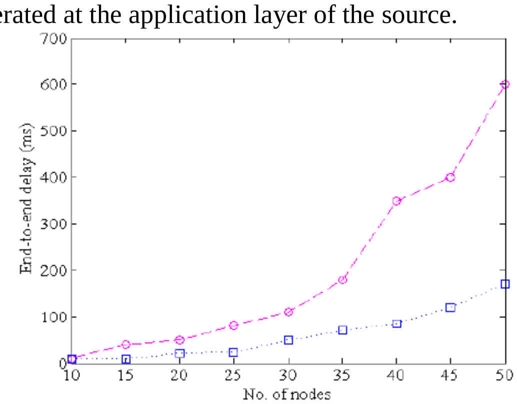
To estimate the available channel bandwidth, each node has to determine the available free channel after the measurement time. The measurement time (Tmt) defines the time Interval taken to broadcast the Hello messages. Based on the carrier sensing range, the busy and free channel time are determined. The available local bandwidth is determined in the forwarding queue of a node.

In real time network environments, the packet transmission will be different due to network congestion, queuing delay and so on. In this paper, the average value of the forwarding time is used with MAC access channel delay retransmission time. TMAC_FD is the current packet forwarding delay.
The MAC forwarding delay includes the overhead transmission in the contending area and RTS/CTS exchange. Due to collisions within the transmission range, the transmission is of the packet is delayed and the multiple numbers of back off periods, SIFS and DIFS may also included. With the average MAC forwarding delay and available channel time, the expected number of packets, N transmitted during the next measurement period, can be estimated as



End-to-end Delay

The Figure 5 shows measure of end-to-end delay for the QoS requirement 250 ms at different node mobility. The end-to-end delay increases as the node speed increases. Higher mobility causes more links broken and frequent re-routing and thus causes larger end-to-end delay. The end-to-end delay in PZBR is within the limit (250ms) and gives up to 60 % improvement. The end-to-end delay is calculated as the time when a frame is received by the destination's application layer minus the time when the frame was generated at the application layer of the source.



It shows end-to-end delay for number of nodes from 10 to 50 at 10 m/s mobile speed. It increases as the number of nodes increases because of more number of link failures.

Packet Jitter

A crucial component of end-to-end delay is the random queuing delays in the routers. Because of these varying delays within the network, the time from when a packet is generated at the source until it is received at the receiver can fluctuate from packet to packet. This effect is called *jitter.*

A Drop Dependency Based (DDB) scheme is proposed, where basic information of the packet priorities was provided in the packet header and a buffer management was done based on this information. An optimized algorithm operates on the packet which resides longest in the buffer group of packets. By dropping it with the lowest priority, a significant improvement in end to end delay is achieved. This is incorporated with combination of scheduler and packing dropping algorithm.

Fair allocation of available resources is done to achieve the expected quality. It means that more resources are allocated for higher QoS requirement flows. The lower QoS requirement flow packets are dropped while giving more access to important flows. This can lead to starvation of resources

Once the address of a packet is resolved by the Link layer, it passes it to the MAC for transmission. In case of congestion, the MAC may not be able to schedule the packets immediately. Hence, these packets get stored in the buffer (IFQ). The packets may get lost depending on the length of the Queue due to buffer overflow or they might expire in the Queue. By carefully managing the buffer between the Link layer and the MAC, it is possible to achieve higher successful transmission rates during congestion in the network.

Interface Queue (IFQ) is the queue between the Link Layer and the MAC layer. There are two types of packets that can appear at the IFQ

1. Control Packets - These include the Route Request (RREQ), Route Reply (RREP) and Acknowledgement (ACK) packets. This packet has P1 priority.

2. Data Packets - These include the actual data to be transferred. It can be text, images or video. This packet has P2, P3 and P4 priorities. By default, the Control packets are the higher priority packets and the Data packets are the lower priority packets. In the IFQ, when a Control packet appears, it is placed at the front of the Queue ahead of the Data packets.

Based on the drawback of FIFO scheme, we have designed a Smart Queue. It drops packets based on their priorities and flushing the stale packet where TTL of packet is expired. There are four different packet priorities (P1, P2, P3 and P4). P1 is highest and P4 is lowest priority packets respectively.

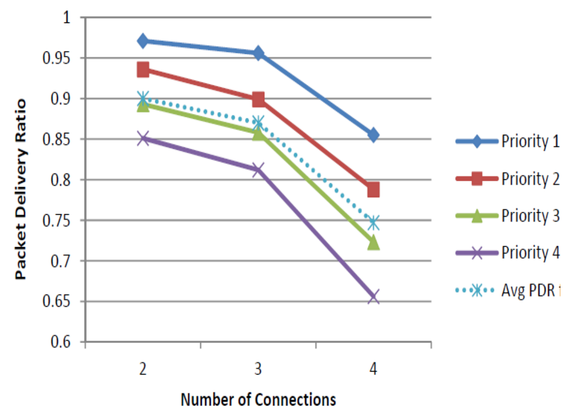
Packet Dropping Algorithm

One way of avoiding the buffer overflow is by periodically checking the buffer fullness. In order to avoid the loss of important P2 and P1 priority packets, packet will be intelligently dropped as follows

If the current queue length is >= 85% of the total queue size, drop all the priority four (P4) packets in the second half of the queue.

If the current queue length is >= 90% of the total queue size, drop all the priority three (P3) packets in the second half of the queue.

If the current queue length is >=95% of the total queue size, drop all the priority four (P4) packets and second half of the priority three (P3) packets of the queue.



Based on the priority of the packet, each packet is assigned a pre-determined value of TTL. A higher priority packet has larger TTL value. To make sure that the P3 and P4 packets are not blocked in the first half of queue for a longer time. Packet sorting is done to rearrange P3 and P4 packets from first half of queue to second half based of time stamp and TTL value of packets

As the mobility of node increases, the throughput of the network increases in the dynamic environment than in static environment. The Throughput of the network is increased due to admission control admitted in the packet flow.

Conclusions:-

The simulation is carried out in ns-2 with the simulation parameters involved the simulation area of about 1000x1000m with 100 nodes. The transmission range is about 250 m, packet size is 1500 bytes and the simulation time is 300 s. In this paper, PZBR is used as routing protocol. This protocol predicts next location of nodes the multi-hop admission control which estimates available local bandwidth, Smart Queue with packet dropping algorithms is used in buffer management. The metrics used to measure the protocol's performance are the throughput, the number of admitted flows and routing overhead. PZBR routing algorithm is compared against ODMRP protocol.

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