Analysis and Enhancing Qos In Multihop MANET By Cross Layer Design

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Abstract---This work proposes a methodology for QoS improvement in MANET based on Medium Access Control (MAC) protocol that takes the above requirements into consideration. This protocol is based on IEEE 802.11 standard, and thus can be easily integrated into existing systems without much difficulty. Here 802.11 and 802.11e with different TCP mechanisms are used to analyze the QoS parameters for MANETs. The proposed system is designed to evaluate the performance of QoS and interaction between Transport layer and the MAC layer protocol operating in a mobile ad hoc network. The system will makes use of IEEE 802.11e MAC mechanism, to improve quality of service in MAC layer, which will improve the quality of service in Transport layer and to suggest a suitable mechanism for improving the quality of service in MANETs.

Keywords:- Mobile adhoc networks, Medium access control (MAC), Transport layer Protocol (TCP), Newreno , SACK, AODV and Quality of Service (QoS)

I. INTRODUCTION

An ad hoc wireless network (AWN) is a collection of mobile hosts forming a temporary network on the fly, without using any fixed infrastructure. In these networks, the Medium Access Control (MAC) protocols are responsible for coordinating the access from active nodes. IEEE 802.11 protocol is widely used in this network. These protocols are of significant importance since the wireless communication channel is inherently prone to errors and unique problems such as the hidden-terminal problem, the exposed-terminal problem.Transmission Control Protocol (TCP) is the transport protocol used in the most IP networks and recently in ad hoc networks like MANET. It is important to understand the TCP behavior when coupled with IEEE 802.11 MAC protocol in an ad hoc network.

In Adhoc networks, certain QoS parameters like error rate, delay and packet loss are increased and certain parameters like throughput and delivery ratio are decreased in Transport layer is due to MAC problems and disconnection is also possible due to mobility or power failure. So, we combine the mechanisms of these two layers to improve the QoS. We examine the effects of two different MAC protocols— IEEE 802.11and IEEE802.11e with congestion control mechanism of TCP.

The rest of the paper is organized as follows: Section 2, describes the routing protocols AODV (Adhoc On demand Distance Vector) and Mac protocol IEEE 802.11 and 802.11e. Section 3 describes the black hole attack, Section 4 describes the simulation study and results of routing protocols AODV and OLSR with attack and without attack using the different performance metrics and Section 5 describes the concluding remarks.

II. MAC IEEE 802.11 AND IEEE 802.11E AND TCP PROTOCOLS IN MANET

The IEEE 802.11 MAC [2] uses a distributed coordination function (DCF), which is based on Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), as the fundamental mechanism for channel access. In the DCF model, the medium must be sensed free for a time interval greater than the Distributed Inter Frame Space (DIFS) before a node is allowed to transmit. If the medium is not sensed free for DIFS time, the transmission is deferred a random time interval between 0 and Contention Window (CW) times the timeslot. IEEE 802.11 exponentially doubles its contention window when a collision occurs, and it returns to the minimum contention window upon a successful transmission. After the contention window is backed off to a maximum value, the MAC layer reports a transmission failure to the higher layer protocols and drops the packet. DCF uses a four way handshake, known as request-to-send (RTS)/clear-to-send (CTS)/Data/ACK. Before transmitting a packet, the source node sends an RTS message, and the destination sends CTS back to the source node. The nodes that can hear either the RTS or CTS set their network allocation vector (NAV) according to the amount of time [7] that will be used for exchanging the remaining data, as indicated in the RTS and CTS packets. This is designed to solve the “hidden terminal” problem. Providing support for real-time data transmission is an important yet challenging goal for MANETs and implements IEEE 802.11e to enhance QoS at the MAC layer.

IEEE 802.11e [3] is a standard based on IEEE 802.11 for support of QoS in MANETs. QoS is provided by setting up different Traffic categories (TCs). Each TC has different contention parameters such as Arbitration Inter frame Space (AIFS) values, maximum and minimum back off window size, and multiplication factors. Using these different contention parameters, virtual competition among traffic categories is created for accessing the channel.The DCF is supposed toprovide a channel access with equal probabilities to all stations contending for the channel access in a distributed manner. However, equal access probabilities are not desirable among stations with different priority frames [7]. The emerging EDCF is designed to provide differentiated, distributed channel accesses for frames with 8 different priorities (from 0 to 7) by enhancing the DCF as shown in Table1. The EDCF adopts eight different priorities that are further mapped into four access categories (ACs). ACs are achieved by differentiating the arbitration inter frame space (AIFS), the initial window size and the maximum window size [6].

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User priority	Access category	Designation
0	0	Best effort
1	1	Best effort
2	2	Best effort
3	3	Video probe
4	4	Voice
5	5	Voice
6	6	Video
7	7	Video

Table. 2: EDCF user priority table

ACs are achieved by differentiating the arbitration inter frame space (AIFS), the initial window size and the maximum window size. Four transmission queues are implemented in a station, and each queue supports one AC class, behaving roughly as a single DCF entity in the original IEEE 802.11 MAC. For the AC i(i= 0, 1, 2,3), the initial backoff window size is CWmin[i]= (Wi,0), the maximum backoff window size is CWmax[i] and the AIFS is AIFS[i].

– For 0 = i<j = 3, CWmin[i]=CWmin[j],
  CWmax[i] = CWmax[j], and
  AIFS[i] = AIFS[j],

And at least one of the above inequalities must be strict. If one class has a smaller AIFS or CWmin or CWmax, the class's traffic has a better chance to access the wireless medium earlier. Four transmission queues are implemented in a station and each queue supports one AC class, behaving roughly as a single DCF entity in the original IEEE 802.11[4].

Transmission Control Protocol (TCP) is the transport protocol used in the most IP networks and recently in ad hoc networks like MANET It has been shown that TCP does not work well in a wireless network. TCP associates the packet loss to the congestion, and then it starts its congestion control mechanism. Therefore, transmission failures at the MAC layer lead to the congestion control activation by TCP protocol then the number of packets is reduced. Several mechanisms have been proposed to address this problem, but most of them focus on the cellular architecture. The problem is more complex in MANET where there is base station and each node can act as a router.

III. AODV IN NETWORK LAYER

Providing QoS is desirable for many applications if the routing protocols are able to find the neighbors and the destination within a short interval with limited route messages like Route Request (RREQ) and Hello messages. AODV [9] is one of the most widely used table-based and reactive routing protocols. In AODV, a source host broadcasts a Route Request (RREQ) packet when it needs a route to a specific host. Each host that receives the RREQ packet checks whether it is the destination; if it is, it sends a Route Reply (RREP) packet; otherwise it rebroadcasts the RREQ packet. Intermediate hosts between the source and the destination create an entry in theirrouting tables and record the neighbor ID of the host from which the RREQ packet was received. The destination hostresponds to the first RREQ packet it receives by unicasting aRREP to the neighbor from which it received the RREQ packet. The intermediate hosts forward the RREP packet thesource according to their own routing tables. One unique feature in AODV is that hosts use "Hello" messages to probe their neighbors in order to validate routes.

IV. TCP CONGESTION CONTROL MECHANISM

In TCP NewReno [10], when a source receives a partial ACK, it does not exit fast recovery. Instead, it assumes that the packet immediately following the most recently acknowledged packet has been lost and hence retransmits the lost packet. Thus, in the case of multiple packet losses, TCP NewReno will retransmit one lost packet per round-trip time until all the lost packets from the same window have been recovered, avoid requiring multiple fast retransmits from a single window of data, and not incur retransmission timeout. It remains in the fast recovery phase until all the outstanding packets at the start of that phase have been acknowledged. Another way to deal with multiple packet losses is to tell the source which packets have arrived at the destination. When SACK [10] blocks are received by the source, they are used to maintain an image of the receiver queue, i.e., which packets are lost and according to the image source retransmit loss packets.

V. SIMULATION RESULTS AND COMPARISON GRAPHS

We used ns-2 to simulate the MAC performance and using this MAC performance will improve the transport layer performance. Using this cross layer design technique, we improve the QoS performance in Mobile Ad hoc Networks. Here we have a collection of n nodes over a common wireless medium, by exchanging 512 bytes of data. Each node is equipped with a transmitter, a receiver and a buffer used for storing data. We assume that a node cannot transmit and receive at the same time. (i.e., communication is half duplex).To increase the performance there should be different types of priority level for data transmission in MAC layer.The performance of 802.11e &802.11 are compared by taking four parameters into account. From the obtained results we can inferred that the performance of 802.11e are improved when comparing with 802.11. The following are the parameters which taken into account for comparison.

A. Throughput:

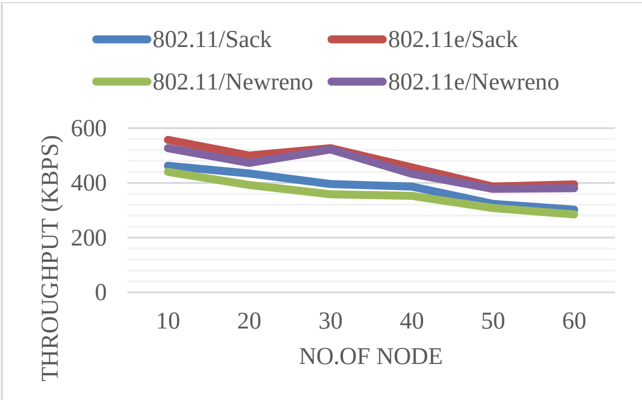

Fig. 1:

Throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packetsper time slot. Throughput value rises gradually with the nodesand 802.11e Protocol is having higher Throughput

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than 802.11 Protocol. Throughput variation is shown in the figure

B. Packet Delivery Ratio:

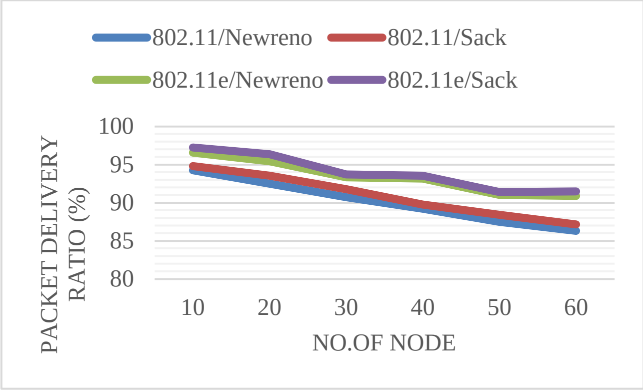

Fig. 2:

Packet delivery ratio (PDR) is the number of data packets delivered to multicast receivers over the number of data packets supposed to be delivered to the multicast receivers. Packet Delivery Ratio for 802.11e is higher than 802.11 protocol. PDR value is measured in terms of packets. Figure 10 shows the performance variation of Packet Delivery Ratio of 802.11 and 802.11e Protocol.

C. Delay:

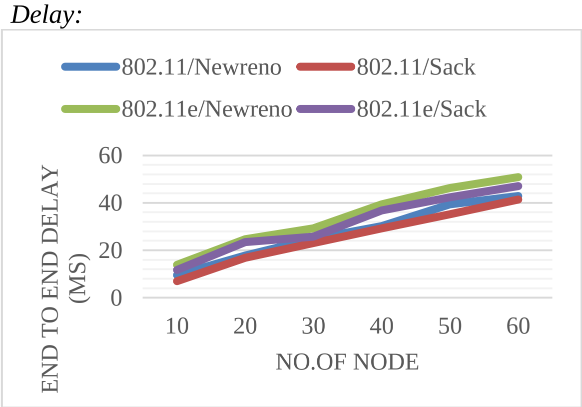

Fig. 3:

The 802.11e Protocol uses AIFS time interval and therefore it takes an arbitrary time interval to check for the priority of incoming packets. So delay value is higher for the proposed 802.11e Protocol than 802.11 Protocol. The delay variation is shown in the above figure.

D. Packet Loss:

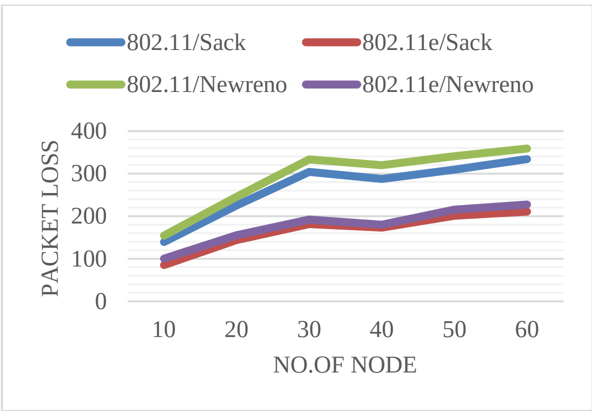

Fig. 4:

Packet loss is the number of packets missed to reach the destinationPacket loss for 802.11e is less than 802.11 protocol. Packet loss value is measured in terms of no. of packets. Figure 4 shows the performance variation of Packet loss of 802.11 and 802.11e Protocol with different TCP congestion control mechanism.

VI. CONCLUSION

This project measures the QoS by combining the MAC and Transport layer mechanisms in Mobile ad hoc networks. The two different MAC layer protocols namely IEEE 802.11 and IEEE 802.11e is combined with Newreno and SACK(selective acknowledgement) technique in the Transport layer and the performance measurement is taken. The result shows that 802.11e Protocol is having improved performance than IEEE 802.11 protocol in terms of the following parameters like Throughput, Packet Delivery Ratio and Packet loss.

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