Performance Analysis of DSR: on 802.11 and CSMA Protocols

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ABSTRACT
This paper describes a simulation based performance analysis of DSR on the basis of comparison between 802.11 and CSMA protocols. Dynamic Source Routing protocol (DSR) provides simple and efficient routing for multihop ad-hoc network of mobile nodes. It utilises a specially designed framework which builds on the Global Mobile Information System Simulator (GloMoSim). Some optimizations of DSR have already been implemented in GloMoSim. Several different simulation results show that performance got better by 802.11 MAC layer protocol.

Keywords
Dynamic Source Routing (*DSR) protocol*, MAC, *802.11*, *CSMA*, Mobile Ad hoc network, *GloMoSim, Collisions, Throughput, Packet loss, Packet Delay*.

1. INTRODUCTION
A mobile ad hoc network (MANET) is a decentralised, self-organizing and selfconfiguring
wireless network, without any fixed infrastructure.This network is group of wireless nodes to establish a network without centralized supervision/management. In such a network, topology changes dynamically and due to limitations of bandwidth, transmission range and power routing becomes an important issue. A lot of work has been done in field of routing in ad-hoc network since 1990.

Since their emergence in the 1970s, wireless networks have become increasingly popular in the computing industry. There are currently two variations of mobile wireless networks. The first is known as the *infrastructure network* (i.e., a network with fixed and wired gateways). The bridges for these networks are known as *base stations*. A mobile unit within these networks connects to, and communicates with, the nearest base station that is within its communication radius. As the mobile travels out of range of one base station and into the range of another, a "handoff" occurs from the old base station to the new, and the mobile is able to continue communication seamlessly throughout the network. Typical applications of this type of network include office wireless local area networks (WLANs)[4].

The second type of mobile wireless network is the infrastructureless mobile network, commonly known as an *ad hoc network*[11]. Infrastructureless networks have no fixed routers; all nodes are capable of movement and can be connected dynamically in an arbitrary manner. Nodes of these networks function as routers which discover and maintain routes to other nodes in the network. Example applications of ad hoc networks are emergency search-and-rescue operations, meetings or conventions in which persons wish to quickly share information, and data acquisition operations in inhospitable terrain. An ad hoc mobile network is a collection of mobile nodes that are dynamically and arbitrarily located in such a manner that the interconnections between nodes are capable of changing on a continual basis[13]. In order to facilitate communication within the network, a routing protocol is used to discover routes between nodes. The primary goal of such an ad hoc network routing protocol is correct and efficient route establishment between a pair of nodes so that messages may be delivered in a timely manner[9]. Route construction should be done with a minimum of overhead and bandwidth consumption.

2. DSR OVERVIEW
The Dynamic Source Routing (DSR) protocol presented in is an on-demand routing protocol that is based on the concept of source routing. Mobile nodes are required to maintain route caches that contain the source routes of which the mobile is aware[12]. Entries in the route cache are continually updated as new routes are learned.

The protocol consists of two major phases: route discovery and route maintenance[3].

2.1Route Discovery
When a mobile node has a packet to send to some destination, it first consults its route cache to determine whether it already has a route to the destination. If it has an unexpired route to the destination, it will use this route to send the packet. On the other hand, if the node does not have such a route, it initiates route discovery by broadcasting a *route request* packet. This route request contains the address of the destination, along with the source node's address and a unique identification number. Each node receiving the packet checks whether it knows of a route to the destination. If it does not, it adds its own address to the *route record* of the packet and then forwards the packet along its outgoing links. To limit the number of route requests propagated on the outgoing links of a node, a mobile only forwards the route request if the request has not yet been seen by the mobile and if the

mobile's address does not already appear in the route record.

2.2Route Maintenance

Route maintenance is accomplished through the use of route error packets and acknowledgments. *Route error* packets are generated at a node when the data link layer encounters a fatal transmission problem. When a route error packet is received, the hop in error is removed from the node's route cache and all routes containing the hop are truncated at that point. In addition to route error messages, acknowledgments are used to verify the correct operation of the route links. Such acknowledgments include passive acknowledgments, where a mobile is able to hear the next hop forwarding the packet along the route[2].

3. PROBLEM DESCRIPTION

In an ad hoc network when nodes move it create some problems to perfomance of network. As number of route request such as route discovery and route maintaince, increases which become overhead to the the existing network.

To analyze the performance of DSR, we are varying pause time of nodes. The computed Quality of Service (QoS) performance measures are collision, packet delivery ratio, latency time ratio and packet loss during the simulation and then compared collisions, throughput, delay and packet drops[7].

4. SIMULATION PARAMETERS FOR THE NETWORK IMPLEMENTATION

Parameters include the network size, as well as the channel characteristics. GLOMOSIM simulation tool is used for the evaluation of proposed model[6].

Global Mobile Information System Simulator (GloMoSim) is a scalable simulation environment for large wireless and wireline communication networks[5].GloMoSim simulates networks with up to thousand nodes linked by a heterogeneous communications capability that includes multicast, asymmetric communications using direct satellite broadcasts, multi-hop wireless communications using ad-hoc networking, and traditional Internet protocols[1].

Simulation is based on 30 wireless nodes to create an ad hoc network over the area of 1000 meters * 1000 meter and these 30 wireless nodes are positioned randomly in this area. The mobility is also involved in my simulation so the nodes are allowed to move. The mobility model which we used for simulation is RANDOMWAYPOINT due to that nodes select any point and move to that point with some constant speed. The minimum mobility speed is 1 meter/sec and maximum speed is 20 meter/sec. After staying there for some pause time it then moves to some other point. We used 6 different pause time: 0, 20, 40, 60, 80 and 100 seconds during my simulation. The CBR (constant bit rate) traffic streams are used for sending 10 packets per second and packet size is 512 bytes. For initial testing of my simulation 10 nodes are communicating with 10 different nodes. The pattern for CRB is as follows CBR <src> <dest> <items to send> <item size> <interval> <start time> <end time> Where src is source node and dest is destination node[8]

To compute the result and comparison, following traffic streams are implemented:

```
#    CBR <src> <dest> <items to send> <item size>
#        <interval> <start time> <end time>

CBR 1  10  10  512     50MS  0S    0S
CBR 2  8  10    512    50MS   21S  40S
CBR 3  7  10  512   50MS    40S   55S
CBR 4  16  10 512   50MS   60S   80S
CBR 5  18  10 512   50MS   85S   0S
CBR16  18  10 512   50MS  101S  0S
CBR 7  29  10 512   50MS   117S  130S
CBR  8  28 10  512   50MS  0S    170S
CBR 9   27  10  512   50MS  50S   200S
CBR 2  27  10 512   50MS    180S  274S
```

In the above traffic streams ten different source nodes are sending data towards ten different destination nodes and each source node sending ten data packets at the same time. Each data packet size will be 512 kilo bytes.

Performance Measures

To calculate/evaluate the performance of proposed model, the computed Quality of Service (QoS) performance measures are collision, packet delivery ratio, latency time ratio and packet loss during the simulation and then compared collisions, throughput, delay and packet drops.

Collision

The channel/resources through which transmission or communication will be progressed. When more then one mobile nodes try to acquire the channel/resources at the same time then there will be collision between them.

Throughput

Throughput is the rate at which mobile nodes are sending and receiving data packets divided by simulation time. It is measured in bits per second or bits per time slot. It is good measurement of channel capacity of a link/route used for communication

Latency Rate

When source node sends a data packet towards destination node, it takes some time to deliver and this time is called latency rate/delay or transmission time.

Packet Loss/Drop

Packet loss describes an error condition in which data packets appear to be transmitted correctly at one end of a connection, but never arrive at the other. There might be different reasons like corrupted packets will be dropped by nodes; the link/route between nodes is not working, insufficient bandwidth, etc.

5. GRAPH ANALYSIS

1. Collisions

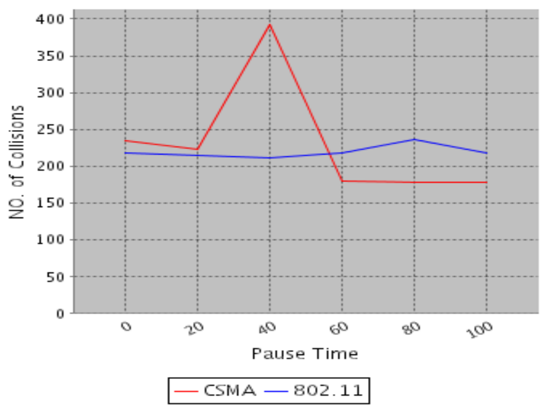

Figure 5.1: Collisions vs pause time

We have calculated the number of collisions at different pause rates: 0, 20, 40, 60, 80 and 100 seconds and then analyze (DSR) on the basis of comparision of two different MAC layer protocols named as 802.11 and CSMA in the above graph. It is clearly viewed that number of collisions is less in case of 802.11 than CSMA.

2. Throughput

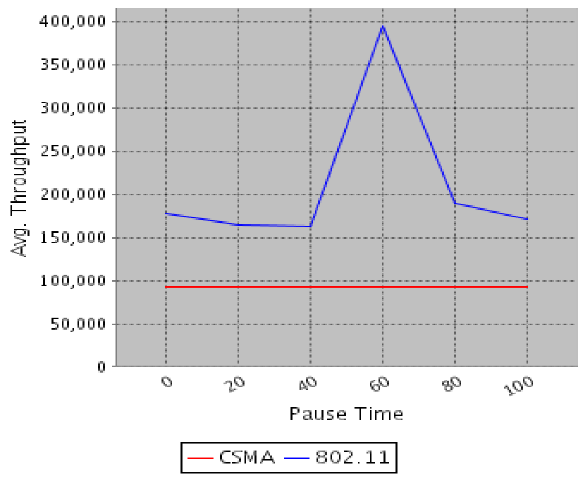

Figure 5.2: Avg. throughput vs pause time

The throughput is also better than the CSMA one in most cases. There are number of factors which affect the throughput like delay, collisions, bandwidth, battery/power, etc. If we carefully observe the above graph then it can be easily watched that in one case when mobility pause time is 40 seconds the throughput is increasing while in case of 0 to 40 and 60 to100 pause seconds the throughput is decreasing. The throughput decreasing in pause 60 seconds is might be the case when there involve only one or few number of replies and there is not much traffic/congestion , collisions and because of delay, reply will take more time to be delivered to source node which then send the data packet and transmission of data packets will be started.

3. Packet delivery ratio

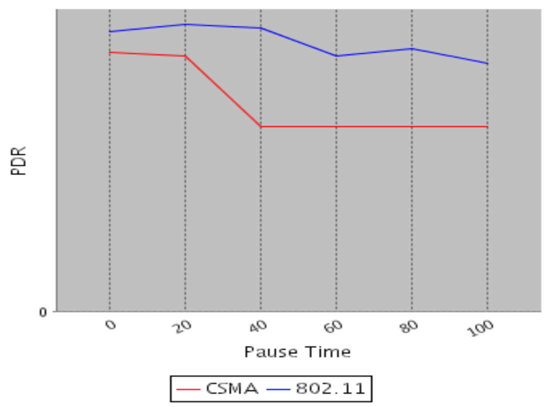

Figure 5.3: PDR vs Pause time

In this case also 802.11 is far better than CSMA. Packet delivered in case of 802.11 is large as compared to CSMA because no. of collisions are less in 802.11.

The packet delivery ratio increases as the mobility level decreases. Low node mobility leads to more stable routes, which generates less overhead packets. As a result, the average end-to-end delay is relatively low, whereas the packet delivery ratio is relatively high . On the other hand, high mobility level leads to increase the number of RREQ, RREP and RERR packets. As a result, the end-to-end packet delay and the normalized routing load become relatively high, whereas the packet delivery ratio becomes relatively low.

4. Packet loss

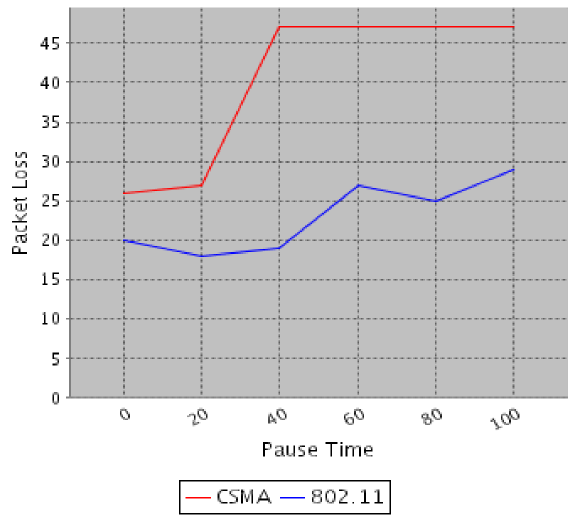

Figure 5.4: Packet loss vs Pause time

In case of packet loss CSMA line move upwards more frequently. So, packet loss is very high. This is not good for Qos. Hence 802.11 is better. Packet drops will be reduced in case of pause 20, 60 and 80 seconds but increase in pause 0, 30 , 50 and pause 100 seconds. Packets are dropped because for every request for route there will be time to live and when this time is Packet Loss over the transmission will be cancelled and as in improved delay is introducing so that can be reason when packet is dropping. Packets drop will be reduced when the congestion at specific node will be decreased so time to transmit will be decreased which helps in decreasing number of data packets.

5. End-to-end delay

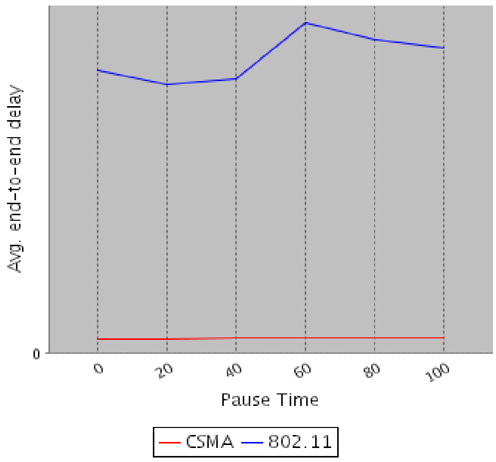

Figure 5.5: End-to-End delay vs pause time

In End-to-End delay case, 802.11 is not showing better performance than CSMA. Here, CSMA has better performance as end to end delay is very low. If we observe the graph then it can be seen that average end to end delay is increasing as delay is introducing for control packets which will result in more delay for data packets so that's why delay is increasing.

In general, the average end-to-end delay decrease as the node mobility decreases, i.e. the pause time increases.

6. CONCLUSION AND FUTURE ROAD-MAPS

From the above comparisons it is concluded that performance for collisions, throughput, and packet dropped will be improved in most cases but decrease for delay. As in improved version delay is introduced that's why it is increasing but because of that delay congestion is decreased for one node, collisions and packet drop improve significantly. On the basis of results we can say that there is tradeoff between delay and collisions which results in less packet drops and slightly better throughput than CSMA. Simulation results show that DSR performs well with low mobility on 802.11.

In this project, readings revealed that performance for collisions, throughput, and packet dropped will be improved in most cases but decrease for delay. As in improved version delay is introduced that's why it is increasing but because of that delay congestion is decreased for one node, collisions and packet drop improve significantly. 802.11 is far better than CSMA in case of collisions, throughput, and packet dropped. But in case of End-to-End delay, 802.11 is not showing better performance than CSMA. CSMA has better performance as end to end delay is very low.

Hence, the present project work shows that in Ad-hoc networks with moderate number of nodes , DSR behaves well when we use 802.11 as MAC layer protocols.

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