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Performance Evaluation and Analysis of MAC protocol in Mobile Ad-hoc Wireless Network using NS-2

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***Abstract*: Mobile ad hoc network based on the IEEE 802.11 standards is one of the fastest growing wireless access technologies in the world today. it is a collection of wireless mobile host which forming a temporary network on the fly ,without the use of any existing network infrastructure or centralized administration DSR routing protocol was used to evaluate the MACA and CSMA performance. Results show that the CSMA simulation performs well as compared to MACA in sense of Throughput, Packet Delivery Ratio, Routing overhead under varying conditions with various node Density.**

***Keywords*: AWN , QOS , MAC , MACA , CSMA, DSR , Throughput , packet delivery ratio , Routing overhead wireless network.**

1. INTRODUCTION

Mobile ad hoc networks (MANETs) are autonomous, infrastructure-less networks in which mobile nodes organize themselves in a network without the help of any predefined infrastructure. Securing MANETs is an important part of deploying and utilizing them, since they are often used in critical applications where data and communications integrity in important. Existing solutions for wireless networks can be used to obtain a certain level of such security. However, these solutions may not always be sufficient for MANETs, since their characteristics create vulnerabilities that cannot be addressed by these solutions.

The responsibilities for organizing and controlling the network are distributed among the terminals themselves. Ad-hoc nodes and devices are able to detect the presence of other such devices and to perform the necessary handshaking to allow communications and the sharing of information of services.

The issue of routing packets between any pair of nodes becomes a challenging task. Ad hoc routing protocols can be classified into three main categories: Proactive, reactive and hybrid protocols. Mobile Ad Hoc Networks are wireless networks which do not require any infrastructure support for transferring data packet between two nodes [1], [2], [3], [4], [12]. In these networks nodes also work as a router that is they also route packet for other nodes. Nodes are free to move, independent of each other, topology of such networks keep on changing dynamically which makes routing much difficult. Therefore routing is one of the most concerns areas in these networks.

Normal routing protocol which works well in fixed networks does not show same performance in Mobile Ad Hoc Networks. In these networks routing protocols should be more dynamic so that they quickly respond to topological changes.

Quality of service (QoS) is the performance level of a service offered by the network to the user. The goal of QoS provisioning is to achieve a more deterministic network behavior, so that information carried by the network can be better delivered and network resources can be better utilized [4], [7], [8]. A network or a service provider can offer different kinds of services to the users. Here, a service can be characterized by a set of measurable Pre specified service

requirements such as minimum bandwidth, maximum delay, maximum delay variance (jitter), and maximum packet loss rate. After accepting a service request from the user, the network has to ensure that service requirements of the user's flow are met, as per the agreement, throughout the duration of the flow. A MAC protocol in a multi-access medium is essentially a distributed scheduling algorithm that allocates the channel to requesting nodes [2], [4], [12], [13]. Two commonly used access principles in wireless networks are fixed assignment channel access and random access method. In the former method, a pair of nodes is statically allocated a certain time slot (frequency band or spread spectrum code), as is the case for most of voice-oriented wireless networks. On the other hand, in random access MAC protocols, the sender dynamically competes for a time slot with other nodes. This is a more flexible and efficient method of managing the channel in a fully distributed way, but suffers from collisions and interference.

CSMA

Carrier Sense Multiple Access (CSMA) algorithm is based on the concept that each station on the network is able to sense the channel before transmitting the data packet. Sensing the channel means to monitor the status of channel whether it is idle or busy. If the channel is idle/free, then station can transmit the data. But if the channel is sensed busy, the station will wait and keep on sensing the carrier till it becomes free.

MACA

Multiple Accesses with Collision Avoidance (MACA) is a slotted media access control protocol used in wireless LAN data transmission to avoid collisions caused by the hidden station problem and to simplify exposed station problem [2], [12], [14],[15], [16]. MACA MAC layer protocol is three way hand shacking techniques, known as RTS-CTS-DATA. There is no acknowledgement packet (ACK) in MACA scheme. Before transmission of a packet, the nodes operate in RTS-CTS mode to reserve the channel by sending Request-to-send packet. The destination node send a Clear-to-send frame to acknowledge the receipt of an RTS frame, then data is transmitted after successful exchange of RTS-CTS. . This mechanism helps to solve problems only if the nodes are synchronized and packet sizes and data rates are same for both the transmitting nodes. This MACA protocol is not fully solve the hidden node and exposed terminal problem and nothing is done regarding receiver blocked problem.

- Contention Based Protocol
- Nodes are not guaranteed periodic access to the channel.
- They cannot support real time traffic.
- Three way handshaking.
- RTS—CTS—Data packet exchange
- Binary Exponential back off Algorithm
- Sender initiated Protocol
- RTS—CTS carrier information about the duration of time for neighbor nodes.

As shown in figure 2, sender wants to send some data so it transmit RTS packet to neighboring nodes, with RTS detail of data is also added in it. Receiving node sense the RTS and send CTS to its neighboring nodes so that other nodes in range do not transmit and intercept. A node after receiving CTS send data.

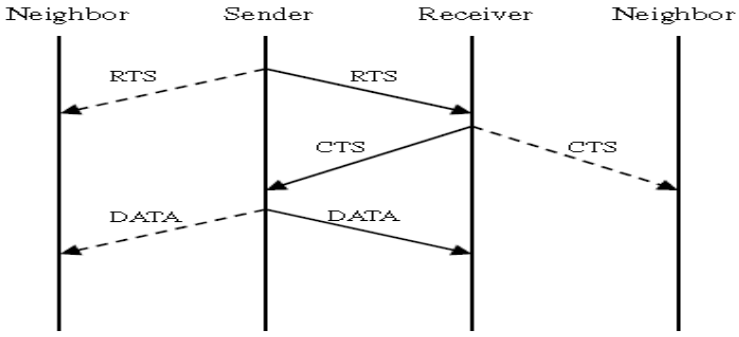

Figure 1 RTS-CTS-DATA in MACA Protocol

2. ROUTING PROTOCOL

Routing is the act of moving information from source to a destination in an internet work. During this process, at least one intermediate node within the internet work is encountered. The routing concept basically involves two activities: firstly, determining optimal paths and secondly, transferring the information groups (called packets) through an internet work. The latter concept is called as packet switching, which is straight forward, and path determination is very complex. Routing protocol uses several matrices to calculate the best path for the routing the packet to its destination. These matrices are a standard measurement that could be number of hops, which is used by the routing algorithm to determine the optimal path for the packet to its destination [21], [22]. The process of path determination is that, routing algorithms initialize and maintain routing tables, which contain the total route information for packet. This route information varies from one routing algorithm to another. Routing tables are filled with a variety of information which is generated by routing algorithms. Most common entries in the routing table are ip-address prefix and the next hop. Routing tables Destination/next hop associations tell the router that a particular destination can be reached optimally by sending the packet to router representing the "next hop" on its way to final destination and ip-address prefix specifies a set of destinations for which the routing entry is valid for.

Figure 2 Routing Protocols

3. EXPERIMENTAL SETUP

In this work simulation methodology and parameters set for the work ns2 version 2.35 for the simulation purpose was adopted with simulation parameter which shows in table.

TABLE 1: - PARAMETERS SET

PARAMETERS	VALUES
AREA	1500mX1500m
Number Of nodes	20,40,60,80,100
Traffic Type	CBR (constant bit rate)
Data packet	512 bytes
Simulation Time	300 seconds
MAC Protocol	CSMA and MACA
Routing Protocol	DSR Routing Protocol
Node placement	Random
Antenna model	Omni directional Antenna
Channel Type	Wireless Channel
Radio propagation model	Two Ray Ground
Seed	1
Simulator model	NS-2

As shown in Table 1, wireless scenario of 1500mX1500m area is set. The number of nodes are taken in increasing order 20,40, 60, 80 and 100 and variation in parameters(throughput, packet delivery ratio and Routing overhead and Average Jitter) are measured one by one. The scenario is run up to 300 sec. Data packets are of 512 bytes. Traffic type used is CBR (constant bit rate) , output is taken in terms of CBR. To set wireless scenario routing protocol used is DSR. Nodes placement is randomly distributed. Two ray ground is radio propagation model and Antenna model is Omni antenna The measurements are taken by using CSMA. Then calculations are done using MACA and other parameter set are same as in CSMA.

4. RESULT AND DI.SCUSSION

The performance metrics used for comparison are:-

1. Throughput
2. Packet delivery ratio
3. Routing overhead

Throughput for CSMA and MACA

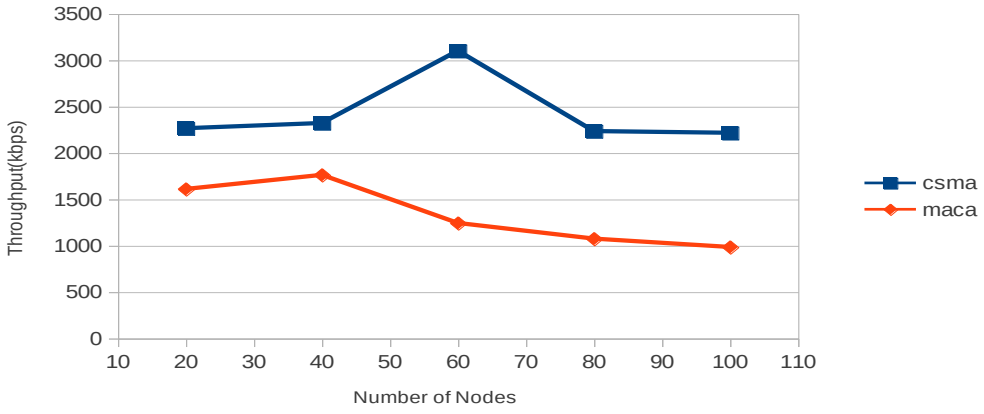

Figure 3 Throughput verses number of nodes

Analysis from figure 3 Here throughput of CSMA is Better than MACA because increase in number of nodes create overflow problem and in MACA due to RTS-CTS overflow is more.

Packet Delivery Fraction for CSMA and MACA

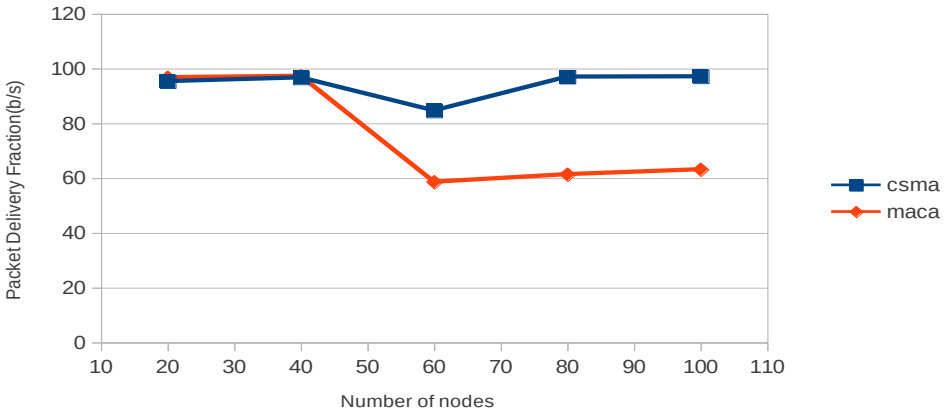

Figure 4 PDF verses number of nodes

Analysis from figure 5 for MACA packet delivery ratio is lower than CSMA as there are more number of packet i.e. RTS-CTS so channel congestion problem is more.

Routing Overhead for CSMA and MACA

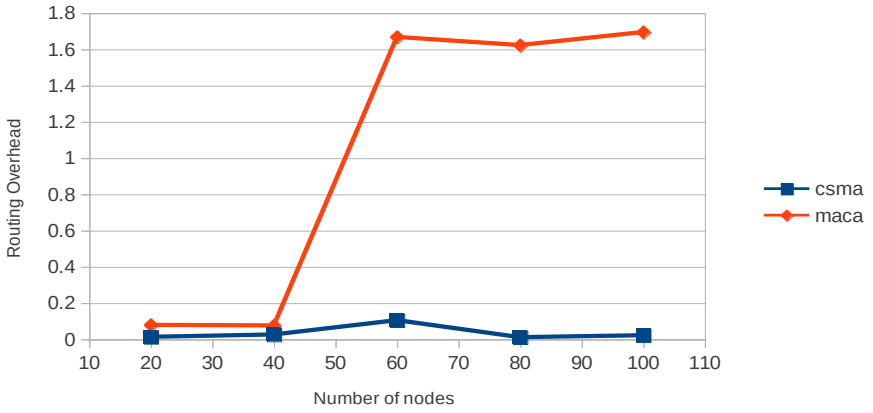

Figure 5 routing overhead verses number of nodes

Analysis from figure 5 routing overhead of CSMA is lower than MACA therefore we can say that CSMA is better than MACA in terms of Routing overhead.

From the above three graphs, it concludes that CSMA perform best in terms of throughput, packet delivery ratio and routing overhead as compare to MACA.

5. CONCLUSION

The career sense multiple access protocol (CSMA) provides excellent performance for routing in multi-hop wireless ad-hoc networks. As shown in our detailed simulation studies and in our implementation of the protocol in a real ad-hoc network , CSMA has very low routing overhead and is able to correctly deliver almost all originated data packets, even with continuous, accelerated motion of all nodes in the network. The CSMA protocols can provide significant benefits to mobile ad hoc networks, in terms of both performance and security. The simulation results show that the protocol CSMA has been found better in performance than MACA protocol. Preparatory simulation results presented here validate the operational correctness of CSMA and show the potential for significant throughput improvement (at least in selected topologies). So CSMA protocol is more reliable.

6. FUTURE WORKS

In this discussion of Medium access control layer protocol used are CSMA and MACA. These are compared on the basis of performance metrics and their features. This can be further extended by performing simulation on different parameter like number of nodes, simulation time and network topology. By this the behavior of protocols can be studied. MANET provide a dynamic environment, thus for minimizing data packet loss in such environment is a challenging task. MACA protocol can be improved by improving the length of data packets that fallow each successful RTS-CT. various schemes can be applied for secure exchange of data.

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