Performance evaluation of EDCA and agent based congestion control routing in mobile adhoc network

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***Abstract*-MANET is a system of autonomous mobile nodes that communicate over wireless links without any preinstalled infrastructure. In MANET when there is too much of data traffic at a node then the channel access in the network slows down and it leads to congestion. It degrades quality of service and also leads to delay and packet loss. In proposed system congestion in a network is controlled by mobile agent. The Network Simulator (NS-2) was used for simulation.**

Keywords: congestion; MANET; AODV; Routing.

I. Introduction

A mobile ad-hoc network (MANET) is a self-configuring infrastructure less network of mobile devices connected by wireless. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each node should be capable of communicating with other nodes that are located within its transmission range. Each must forward traffic unrelated to its own use, and therefore be a router. In ad-hoc network nodes that are in the radio range of each other can directly communicate otherwise intermediate nodes are used to route the packet in between source and destination.

A. Congestion in mobile ad-hoc networks

In Ad-hoc networks, since there is no fixed infrastructure there are no separate network elements called routers and hence the mobile nodes themselves act as the routers.Congestion occurs when the resource demand exceeds the capacity of a network. During congestion, the network throughput decreases and packet drop will increases. In this work took congestion control in a network is achieved by using mobile agent.

II. PROPOSED SYSTEM

A. IEEE 802.11E

IEEE 802.11e MAC standard was proposed as an enhancement to the legacy IEEE 802.11 DCF in order to support quality of service in WLAN. It introduces two new access methods Hybrid Coordination channel access (HCCA) and the Enhanced Distributed Coordination Function (EDCF), renamed in latest 802.11e draft to EDCA (Enhanced Distributed Channel Access). The IEEE 802.11e EDCA mechanism provides differentiated, distributed access to the wireless medium .Original IEEE 802.11 treats all packets as equals and not differentiating time sensitive traffic. EDCA classifies the packets into four different classes voice(VO), video (VI), best effort (BE) and background (BK) and assigns each of these traffic types to four Access Categories.

EDCA defines four access categories (ACs) namely AC_VO for voice, AC_VI for video , AC_BE for best effort and AC_BK for background classes of traffic to provide priority among different traffic types. EDCA provides differentiated and distributed access to the wireless medium. Each AC achieves differentiated channel access by varying the amount of time, a node would sense the channel to be idle and the length of the contention window during a back off. Each frame from the higher layer carries its user Priority(UP).Eight User Priorities(UP) identical to IEEE 802.11D priority tags are defined which can be mapped to any four Access Categories. After receiving a frame ,the MAC layer maps it into one of the four ACs .Each AC is associated with one backoff entity and some AC specific parameters called the EDCA parameter set composed of Arbitrary Inter-Frame
Space Number (AIFSN[AC]), minimum contention window (CWmin[AC]), and maximum contention window (CWmax[AC]).

The Channel is idle for a contention period (CP) before a node can transmit data . If the channel is idle for the whole CP, the station can transmit immediately after the CP. So with multiple stations contending for one radio channel, the shorter the CP, the higher the chance is to access the wireless medium. The CP consists of Arbitration Inter-frame Space (AIFS) and a random backoff time. The AIFS is a distinct value for each AC. After the idle duration of AIFS, the contention entity generates a random backoff period for an additional deferral time before transmitting. Basically, the smaller AIFSN[AC], CWmin[AC], and max[AC], the shorter the channel access delay for the corresponding priority. However, the probability of collisions increases when
operating with smaller CWmin[AC].

B. Agent based congestion control routing

In MANET obstruction occurs due to packet loss and it can be reduced by congestion control. In the proposed system the mobile agent based congestion control technique is used. The mobile agent moves through the network and it select a less loaded neighbor node as its next hop and update the routing table. The mobile agent estimates the queue length and the channel contention of each path. Then total congestion metric is applied to the routing protocol to select the minimum congested route in the network.

Queue length estimation:

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Where is the queue length.
is the arrival rate.
is the service rate.

Queue length distribution:

The channel occupation due to MAC contention is

Total Congestion Metric:

The Total Congestion Metric (TCM) can be estimated from the obtained queue length and the channel contention.

The agent based congestion routing Architecture can be explained from the following figure:

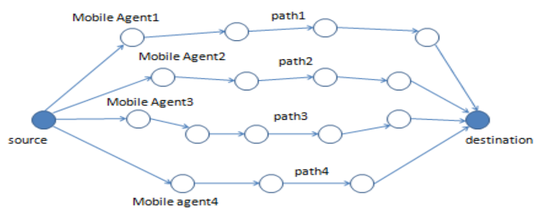

Figure1:Agent based congestion control routing

Step (1): The source S checks the number of available one hop neighbours and clones the Mobile Agent (MA) to that Neighbours.
Step (2): The Mobile agent estimate the queue length and channel contention of path1, path 2, path 3,path 4 as given in the figure1. TCM (total congestion metric) is the sum of queue length and channel contention of each path.
Step (3): The Mobile agent1 moves towards the destination D in a hop-by-hop manner in the path1 and Mobile agent2 in path2, Mobile agent3 in path3 and Mobile agent4 in path4 respectively.
Step (4): Then the Mobile agent1 calculates the TCM1 of that path1 and similarly Mobile agent2 calculates the TCM2 of path2 ,Mobile agent3 calculates the TCM3 of path3and Mobile agent4 calculates the TCM4 of path4.
Step (5): Now the destination D sends the total congestion metrics TCM1, TCM2, TCM3 and TCM4 of the path1, path2,path3 and path4 to the source.
Step (6): TCM is set to a threshold value. The path with TCM less than the threshold value are the active path and the path with TCM greater than the threshold value are the non active path.
Step (7): If the TCM is above the threshold then the traffic is distributed.
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III. IMPLEMENTATION

The wireless network scenario was generated using Tcl script and it was simulated using NS-2. The simulation was carried for 20,40,60,80,100 number of nodes, for the data rate 64,128,256,512 packets/sec and for the node mobility 10, 20, 30,40,50m/s. The simulation area is 1000m×1000m, the simulation time is 50sec and the mobility model is random way point. The simulation parameters are listed in Table1.The performance was evaluated by calculating performance metrics (i.e. packet delivery ratio, throughput, packet drop, routing over head and end to end delay)

TABLE-1
SIMULATION PARAMETERS

SIMULATION PARAMETER	VALUES
Routing protocol	AODV
Number of nodes	20,40,60,80,100
Area	1000m×1000m
Maximum speed	10,20,30,40,50 M/S
Packet rate	64,128,256,512 packets/sec
Mobility model	Random way point
Simulation time	50 sec

A. Performance Metrics

Throughput: It is defined as the average number of packets successfully received per unit time. This measurement used to know how fast packets can send through the network.

Packet delivery fraction (PDF): It is defined as the ratio of number of data packets received to the number of data packets sent.

End-to-end delay: It is defined as the total time taken by each packet to reach the destination. Average end-to-end delay is the ratio of total time delay for all the received packets to the number of packets received.

Routing Overhead: It is defined as the total number of routing packets transmitted during the simulation.

Packet drop: It is defined as the failure of one or more transmitted packets to arrive at their destination.

IV. Simulation results and analysis

A. Performance of EDCA at Various mobility:

The performances of EDCA are measured in terms of packet delivery ratio, throughput and average end-end delay , packet drop and routing overhead.

To analyze the performance of EDCA, the number of nodes is 20, data rate is 64 packets/sec and mobility is varied as 10,20,30,40,50 m/s. Figures 1, 2 ,3,4 and 5 shows the performance of EDCA in terms of various mobility.

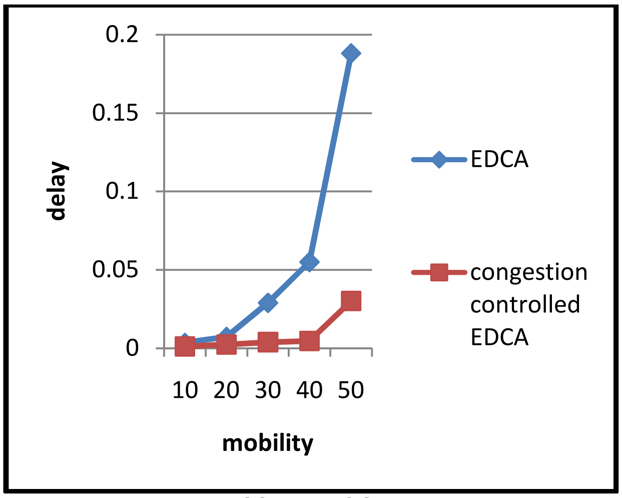

Fig 2.delay Vs mobility

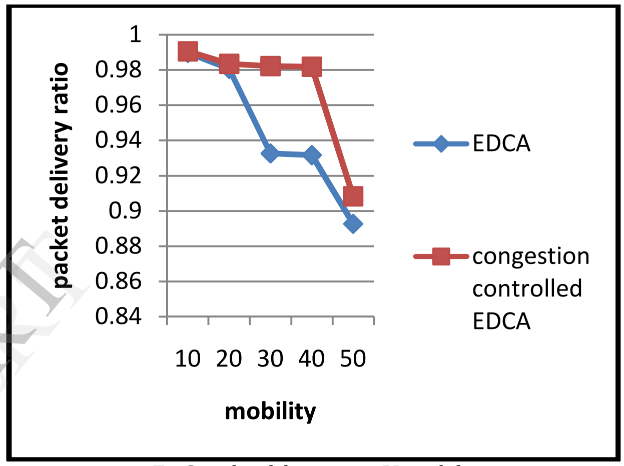

Fig 3.packet delivery ratio Vs mobility

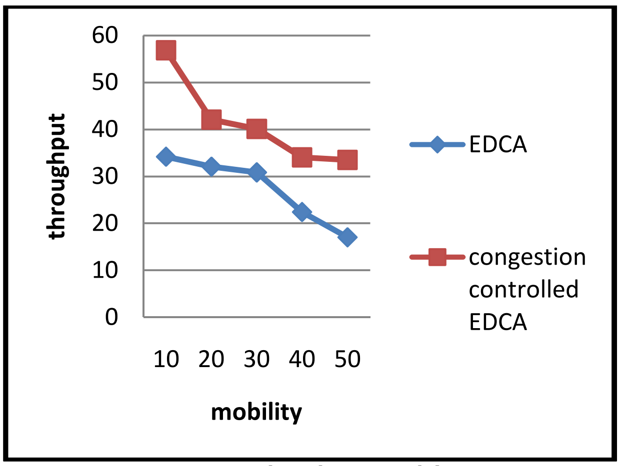

Fig 1.throughput Vs mobility

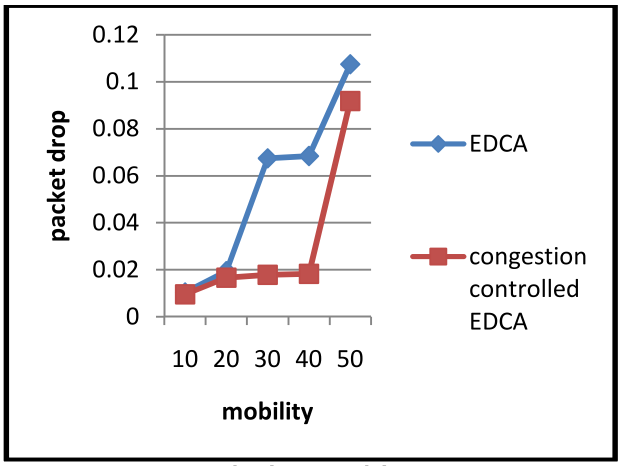

Fig 4.packet drop Vs mobility

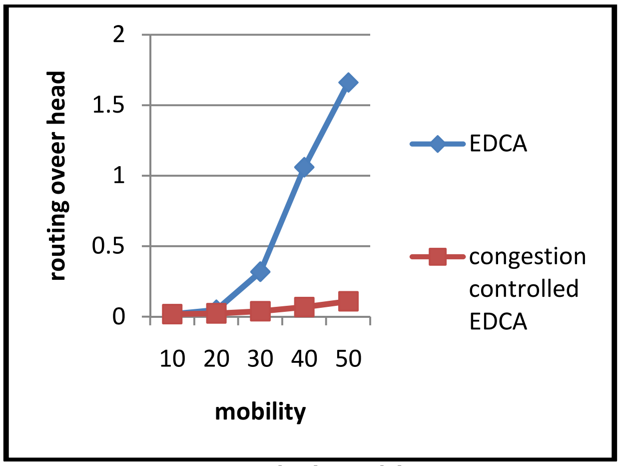

Fig 5.routing over head Vs mobility

B. Performance of EDCA at various number of nodes:

To analyze the performance of EDCA, the mobility is 10, data rate is 64 packets/sec and number of nodes is varied as 20,40,60,80,100. Figures 6,7,8,9 and 10 shows the performance of EDCA in terms of various numbers of node.

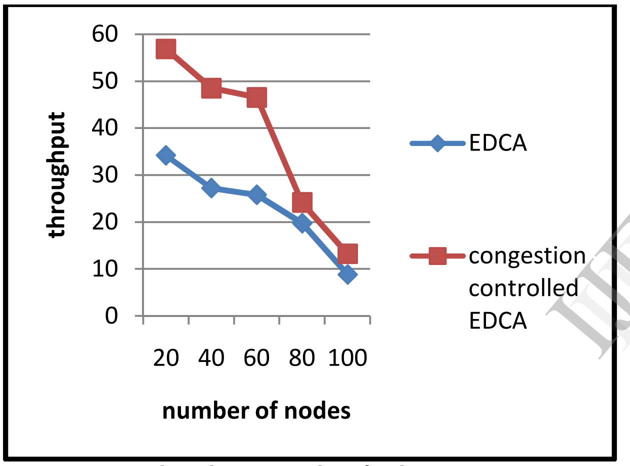

Fig 6. throughput Vs number of nodes

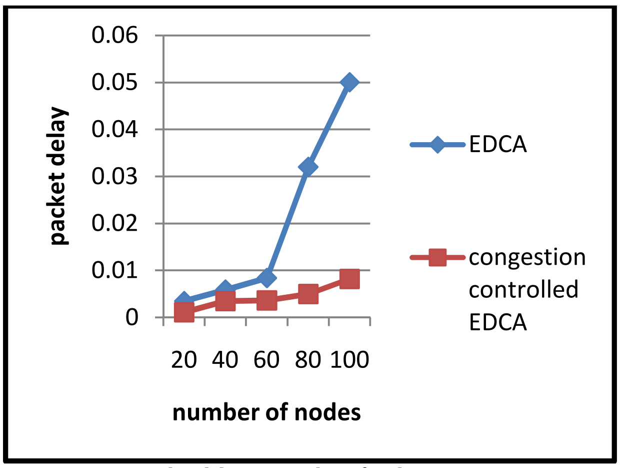

Fig 7. packet delay Vs number of nodes

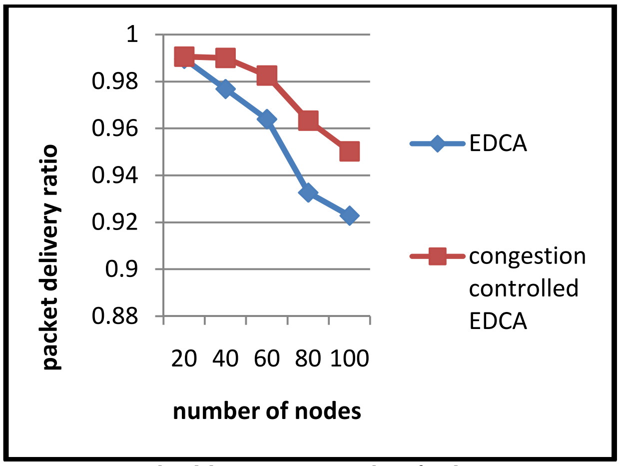

Fig 8. packet delivery ratio Vs number of nodes

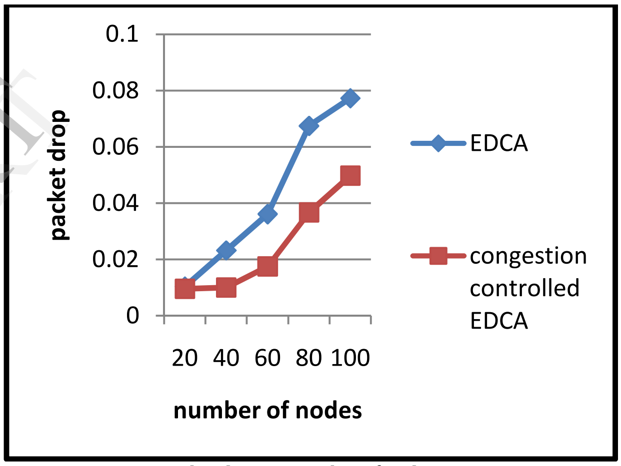

Fig 9. packet drop Vs number of nodes

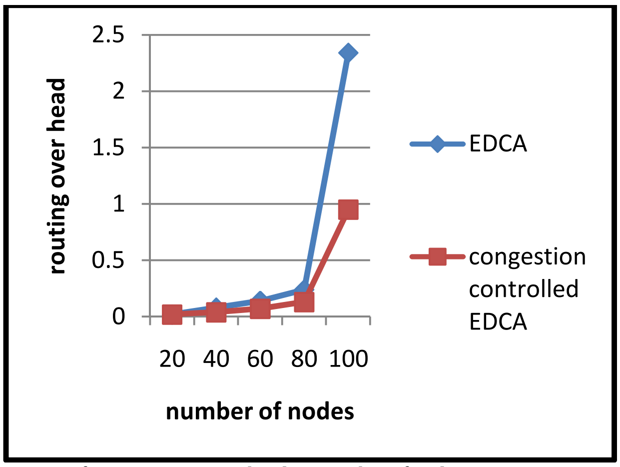

fig 10. routing over head Vs number of nodes

C. Performance of EDCA at various datarate:

To analyze the performance of EDCA, the mobility is 10, number of nodes is 20 and datarate is varied as 64,128,256,512 and 1024. Figures 11,12,13,14 and 15 shows the performance of EDCA in terms of various datarate.

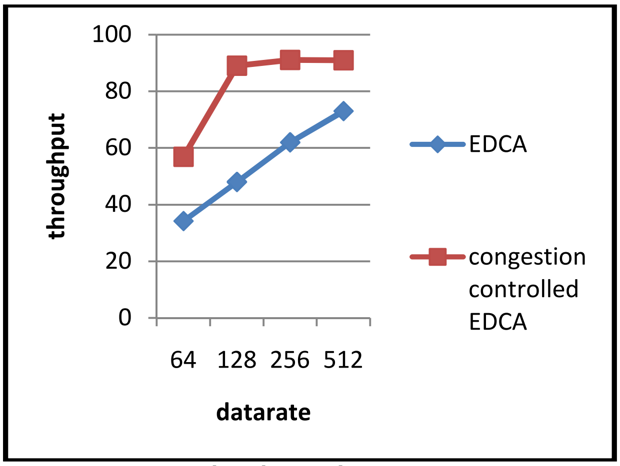

Fig 11. throughput Vs datarate

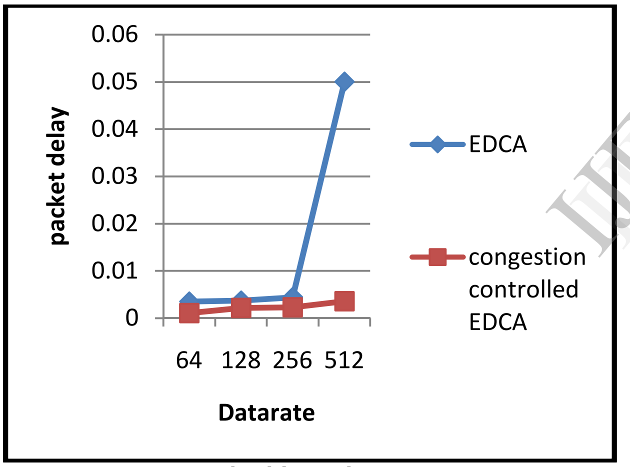

Fig 12. packet delay Vs data rate

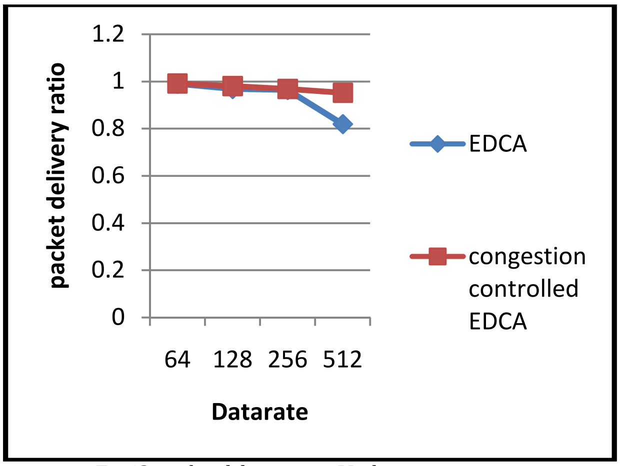

Fig 13. packet delivery ratio Vs datarate

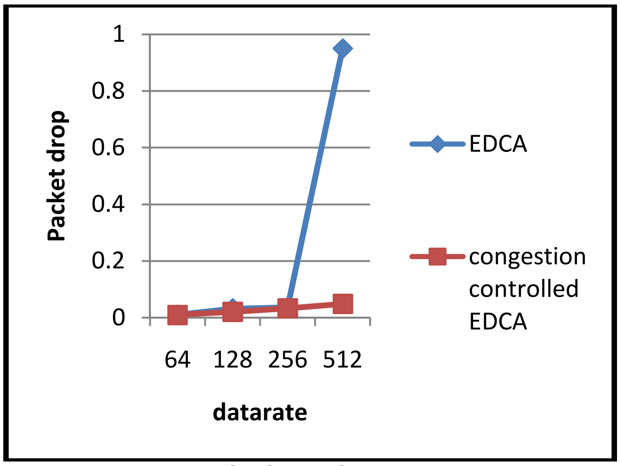

Fig 14. packet drop Vs datarate

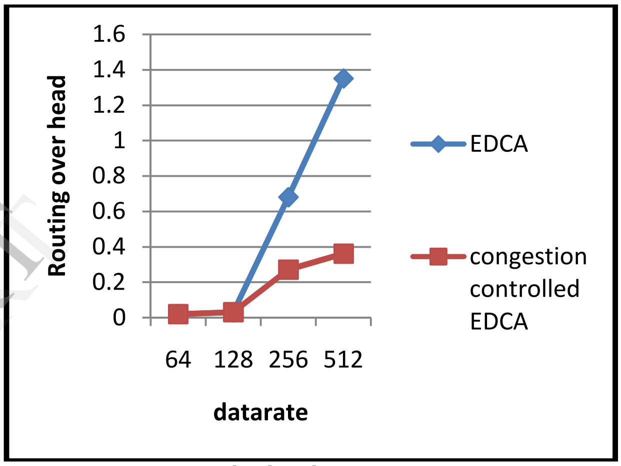

Fig 15. routing over head Vs datarate

V.CONCLUSION

From the above analysis the performance of congestion controlled EDCA is evauated. In this technique, the Mobile agent estimates the queue length and channel contention of each path. Based on the TCM value the traffic is distributed.

Thus the proposed technique attains high delivery ratio and throughput with reduced delay when compared with the EDCA.

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