A DISTIBUTED ADMISSION CONTROL BASED QUALITY OF SERVICE IN MANETs

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***Abstract* - To provide an end-to-end quality of service in multi-hop wireless adhoc networks using admission control scheme, the local bandwidth is to be mainly considered. In this paper, we proposed a Distributed Admission Control (D-AC), implemented over AODV routing protocol, which admits the flow based on the per-hop basis. D-AC provides the required end-to-end bandwidth and available bandwidth in MAC layer. The simulation is carried out in ns-2 and the simulation result shows that control overhead is reduced in dynamic environment when compared to the non admission control.**

***Keywords* – Mobile Adhoc Networks (MANETs), Admission control, Quality of Service, Bandwidth Estimation**

I. INTRODUCTION

Mobile Ad hoc Network (MANET) [1] is a collection of independent infrastructure less mobile nodes that can communicate to each other via radio waves. Due to dynamic changes in topology in MANET [2,3] the routing is a challenging task, in which the existing path is inefficient and inflexible. One of the main characteristics of the mobile node is to discover and maintain the route in the network and quality of service provisioning. The QoS in wireless ad hoc networks explore QoS routing, QoS medium access control (MAC), power management, QoS provisioning model does not provide QoS because of system complexity and overhead. Instead of this, simple admission control with low complexity is implemented. Due to the mobility and the shared wireless medium, it offers guaranteed Quality of Service (QoS), such as delay, jitter, throughput, bandwidth, Packet delivery ratio, Packet loss rate, etc. Here, we propose a distributed admission control protocol with ad hoc on-demand distance vector (AODV) routing protocol which uses a route request (RREQ) packet to maintain the route discovery. To calculate the number of contending nodes within the interference range, DACP broadcast a Hello message which significantly reduces the complexity in establishing QoS session. Simulation results indicate that D-ACP can achieve higher throughput, low latency, low signaling overhead and complexity in dynamic environment than static.

II. RELATED WORK

To maintain the network stability many QoS mechanisms have been proposed. When there is a link break, probe packets are sent on reselected routes to maintain the route. Based on the available resources, each node predicts the QoS requirement. To calculate the route capacity, probe the end-to-end routes with the short interval between packet arrivals to provide a prioritized service model. Differentiated scheduling and medium access algorithms [7] are used to guarantee real-time traffic over best-effort traffic, in which control overhead is not reduced. The soft MAC architecture [8] is addressed. Between the MAC layer and the network layer establish link capacities, the experienced delay between transmissions. In this method, the control overhead is an issue to guarantee QoS. To guarantee QoS in multi-hop ad hoc networks under high traffic load for real-time traffic, only local data control and admission control conditions are focused without reduction in bandwidth [9]. Many admission control schemes have been proposed for multi-hop wireless networks [10, 11].Contention-aware admission control protocol (CACP) [10] considers the contention among flows within a node’s interference range which uses ondemand resource discovery-based scheme in which an admission request packet is flooded then transmitted and passive resource discovery-based approach is followed. This method provides an inaccurate estimation of bandwidth at each node for the admission decision. The perceptive admission control (PAC) protocol is proposed similar to CACP. This method uses passive monitoring to estimate the available bandwidth at the node by monitoring threshold value in which CS range is less than CACP.the level of interference is high in this method.. Admission control and bandwidth reservation (ACBR) [17] is proposed with AODV protocol, which predicts available capacity of the neighbor nodes in 1-hop routing. This method provides inaccurate estimation of bandwidth but here the contention of nodes is considered within a node's transmission range.

III. PROPOSED WORK

3.1 Estimation of available bandwidth and channel time:

In this paper, the available local bandwidth is estimated in terms of MAC throughput such as the available Channel time and the average MAC forwarding delay. In IEEE 802.11networks, a reliable transmission service in MAC layer is made with four way handshaking.

3.1.1 Available channel time (T_{act})

To estimate the available channel bandwidth, each node has to determine the available free channel after the measurement time. The measurement time (T_{mt}) defines the time Interval taken to broadcast the Hello

messages. Based on the carrier sensing range, the busy and free channel time are determined. Fig. 3 shows the remaining allocable bandwidth for a node during the measurement time .The IEEE 802.11 MAC detects the channel in 2 states.

• Busy State: if network allocation vector (NAV) is greater than current time, then the receiver state is of any other state (except for idle) and the transmitter state is not idle.

• Free State: if the NAV is lesser than the current time, then the receiver and transmitter state is idle.

3.1.2 Available bandwidth estimation

The bandwidth requirement for end-to-end route is calculated according to the number of hops.

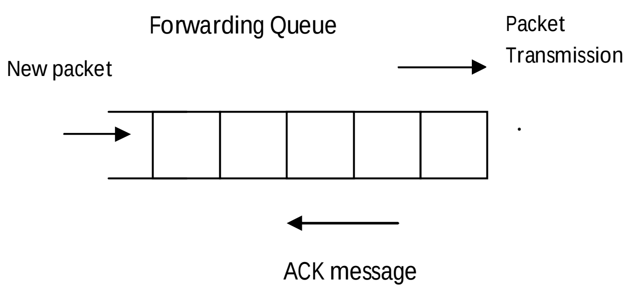

Fig 1.MAC Forwarding Delay

From the channel time and average MAC forwarding delay, the available local bandwidth is determined in the forwarding queue of a node. The average MAC forwarding delay is defined as the average time between the arrivals of new and the time when the node receives the MAC ACK after successful transmission of the packet as shown in Figure 1.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. The MAC forwarding delay, T_{MAC_FD} is given as

$T_{MAC\_FD} = T_{ack} - T_{newpckt}$ ----------------------- (1)

The weighted moving average is used to smooth the estimated MAC forwarding delay in forwarding queue is given as

$T_{MAC\_FD} = \alpha\, T'_{MAC\_FD} + (1 - \alpha)\, T_{MAC\_FD}$ -------- (2)

Where T'_{MAC_FD} is the average value of the previous packet, a < 1 (0.9)

T_{MAC_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

$N = Tact / T'_{MAC\_FD}$ -------------- (3)

Then the available local bandwidth is given as

$BW_{avl} = N \times L / T_{mt}$ ------------- (4)

Where L is MAC layer payload length transmitted

3.2 Admission Control based on AODV protocol

While admitting distributed admission control, node receives the RREQ packet and it checks the destination node within the interference range and it predicts the hop count of the first neighbor nodes and second neighbor nodes. By using Hello message in AODV protocol, it reduces the number of a RREQ packet during the route discovery for a QoS session to improve the network performance.

3.2.1 The connectivity tables

Each node interrupts the information about the first and second neighborhood nodes in the connectivity table as shown in Figure 2. The reason is to check whether the contention link, affects intra-flow network. When a node makes the admission decision, the number of contention links within its interference range is to be calculated. By broadcasting hello messages, the first neighbor nodes are obtained directly whereas the high transmission power is needed to obtain the second neighborhood node. In this paper, the hello message is used to provide the information of the second neighbor nodes, in which each node

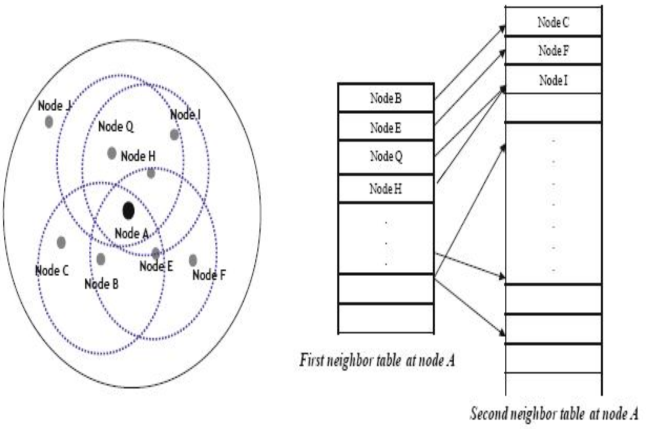

Fig.2 Connectivity table-first and second neighborhood table

Tracks the connectivity and broadcasts the hello message which consist the information of its own first neighbor nodes and it determine the second neighbor nodes from the first neighbor nodes. This information is updated periodically in the second neighbor table. The node's interference and transmission ranges are different as shown in fig 2. The Outside circle indicates node A's interference range, and the other dotted circles indicate each node's transmission range. From the fig, although the node J does not fall into node A's second neighbor node, there will no degrade performance in the network. The reason is that while admitting the admission control decision in node A, the node J does not enters into the path. By examining the timestamp message, the node predicts the updated information of hello messages.

3.3 Admission Control based Algorithms

To initiate the route discovery with multi-hop networks, initially the source node broadcast the route request message with the bandwidth requirement and from the destination IP in neighborhood table it determines end-to-end hop number.

3.3.1 Admission Control Algorithm for Source node

Step 1: Initiate the route discovery with bandwidth requirement and destination IP and initially assume the hop count as zero.
Step 2: checks the destination IP is in first neighborhood table.
Step 3: if the IP is included in the table with hop count=0,then check if the available bandwidth is greater than required bandwidth, then broadcast RREQ with hopcount+1,else discard the RREQ packet.
Step 4: checks the destination IP is in second neighborhood table.
Step 5: if the IP is included in the table and if available bandwidth is greater than two times of required bandwidth, broadcast RREQ with hopcount+1, else discard the RREQ packet.
Step 6: if the available bandwidth is three times greater than required bandwidth, broadcast RREQ with hopcount+1, else discard the RREQ packet

3.3.2 Admission Control Algorithm for Intermediate Node

Step 1: admit the admission control with bandwidth requirement and destination IP; assume the hop count as zero.
Step 2: checks the destination IP is in first neighborhood table.
Step 3: if the IP is included in the table and the hop count is equal to one, then check if the available bandwidth is greater than two times of required bandwidth, then broadcast RREQ with hopcount+1,else discard the RREQ packet.
Step 4 : if the IP is included in the second neighborhood table and the hop count is equal to one, then check if the available bandwidth is greater than three times of required bandwidth, then broadcast RREQ with hopcount+1,else discard the RREQ packet.
Step 5 : if the IP is included in the first neighborhood table and the hop count is greater than one, then check if the available bandwidth is greater than three times of required bandwidth, then broadcast RREQ with hopcount+1,else discard the RREQ packet.
Step 6: if the available bandwidth is four times greater than required bandwidth, broadcast RREQ with hopcount+1, else discard the RREQ packet.

3.3.3 Admission Control Algorithm for Destination node

Step 1: admit the admission control with bandwidth requirement, destination IP, hop count.
Step 2: if hop count is equal to one, and check if available bandwidth at destination node is greater than bandwidth requirement, then update the information in the table, else discard it.
Step 3: if available bandwidth at destination node is greater than two times of bandwidth requirement, then update the information in the table, else discard the packet.

IV. SIMULATION ENVIRONMENT

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, the metrics used to measure the protocol's performance are the throughput, the number of admitted flows and routing overhead. Throughput is the number of useful bits per unit of time forwarded by the network from a certain source address to a certain destination node Fig.3 shows throughput vs. data rate of traffic flows. 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 raised due to admission control admitted in the session.

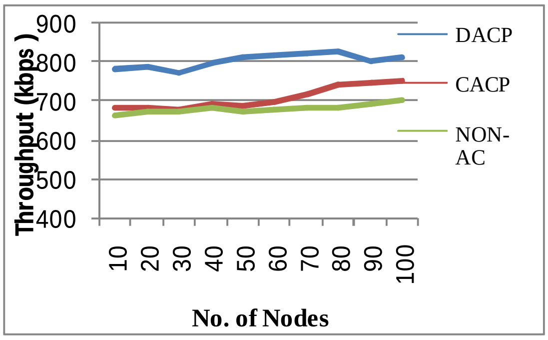

Fig. 3 Throughput (kbps) vs. No. of Nodes

Fig.4 shows the number of admitted flow per bandwidth requirement respectively. In these simulations, the non-admission control model is compared with CACP and DACP in the Dynamic environment. For CACP, 6-flows are admitted, whereas for ACBR and DACP, 8-flows are admitted. DACP achieves higher aggregated throughput than other models and DACP has less overhead compared to other admission control schemes. This is achieved because of reducing the routing traffic and the accurate measurement of local bandwidth requirement at every node.

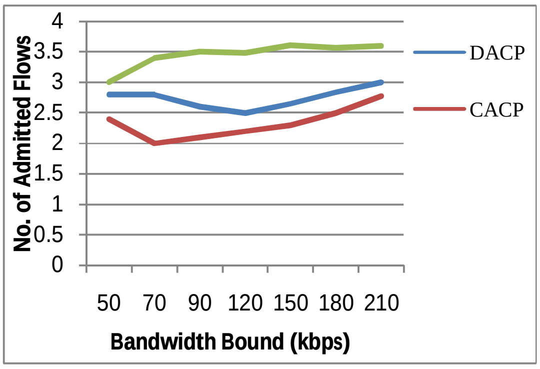

Fig. 4 No. of Admitted Flows vs. Bandwidth Bound

V. CONCLUSION

In this article, a distributed admission control scheme D-ACP is proposed, which guarantee the End-to-end bandwidth routing. In DACP, the admission control is followed in route discovery by broadcasting RREQ messages and algorithms proposed for source, intermediate and destination node makes the routing overhead to reduce significantly. The accurate estimation scheme for available resources of each node is introduced. From the Simulation results D-ACP significantly improves the end to-end QoS compared to the other scheme.

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