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A QUALITY OF SERVICE BASED AODV WITH QoS-AWARE ROUTING ALGORITHMS FOR MANETs

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ABSTRACT

One of the important challenging tasks in mobile Adhoc network is to provide a quality of service with delay and bandwidth restraint. To provide an end–to –end quality of service, the protocols should be used effectively and efficiently. In this paper, we proposed an new protocol AODV-D, which is an efficient local route repair mechanism for multi-hop Adhoc networks. The main objective of this paper is to enhance the network performance of AODV in case of frequent path breaks due to link failure. Simulations were carried out in ns-2 and the quantitative metrics like PDR, end-to end QoS and route life time were analyzed with existing AODV protocol

Keywords: Mobile Adhoc Network, Node Traversal Time (NTT), QoS metrics, AODV protocol

1. INTRODUCTION

A Mobile Adhoc Networks (MANETs) is a connection of self organized mobile nodes in which each node can communicate with each other node. One of the challenging tasks in MANET is to provide a QoS due to the lack of resources in the network and the frequent topology changes in the network. One of the main characteristics of the mobile node is to discover and maintain the route in the network. The Routing protocols used in Adhoc networks experiences link failure. Stability of the mobile ad-hoc network depends on mobility of node, packet transmission, and memory and power consumption. The mobility in mobile ad-hoc network and the shared nature of wireless medium, offers guaranteed Quality of Service (QoS), such as delay, jitter, throughput, bandwidth, Packet delivery ratio, Packet loss rate, etc. This paper proposes an efficient QoS-aware routing with end-to-end delay guarantee for multi-hop ad hoc networks.

2. LITERATURE REVIEW

Using on-demand routing protocol such as AODV (Perkins, Royar and Das, 1999) and DSR (Johnson, Hu and Maltz, 2007), there is no alternate path when the link session fails. Using proactive routing protocols, DSDV (Perkins and Bhagwat, 1994) the routing table maintains only single hop information, so there is a no alternate path in case of congestion. Using Ad-hoc on-demand QoS routing (Chen and Heinzelman, 2005) it provides an end-to-end QoS with delay and bandwidth constraints. Due to mobility in unsynchronized wireless environment, there is a chance of link broken. A stable QoS routing protocol is proposed (Shahram, Bita and Ali Mohammad, 2011) based on the route life time and hop count. Based on route selection algorithm with the Link Expiry Time (Suguna and subathra, 2011) there are degradation in frequent path changes and the authentication time will be more. Based on signal strength (Sharma and Nandi, 2010), a model is proposed with link and route stability based QoS Routing protocol. By using Admission Control in shadow-fading environments with QoS-Aware Routing protocol (Lajos and Rahim, 2011), the performance of the network is improved. The reliability of the network is increased by proactively maintaining the backup routes for active sessions.

3. PROPOSED WORK

3.1 QoS Algorithm based on delay estimation

A new route is selected based on the total path delay. To calculate a total path delay, the current delay [Murthy CSR, Manoj BS, 2004] at each node is to be calculated. For route maintenance, each node in the path piggybacks the delay information along with the packets to find the alternate path. Our proposed protocol includes the calculation of Node Traversal Time (NTT) or FORWARDING_DELAY, route discovery and route maintenance processes.

3.1.1 Calculation of the Node Traversal Time

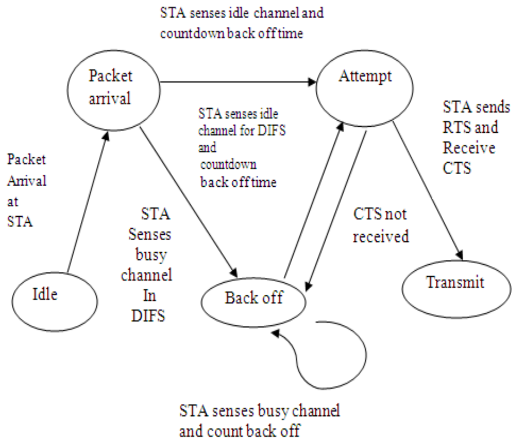

Fig 1 State transition diagram of a mobile node

Fig. 1 shows the simplified transition state Diagram, STAi (nodei) for packet transmission. The Traversal time of a mobile node, STA_i is calculated from equation (1)

$D_{delay} = P_{idle}$ (DIFS) X (DIFS + b + EA(i)) +(1-Pidle (DIFS)) X (DIFS + EB (i)) +T_{trans} ----- (1)

Where,

EA (i) = P_{idle} (slot) X (RTS +CTS+ 2SIFS) + (1-P_{idle} (slot)) X (RTS +2SIFS +EB (i)) and

EB (i) = [1/{Pidle(slot)XDIFS}] X [Pidle(DIFS) X (DIFS+b + RTS+2SIFS +Pidle(slot) X CTS) + (1-Pidle(DIFS)) X B]

From equation (1) the NODE TRAVERSAL TIME (NTT) for ith node is calculated. Here, we assume the propagation delay as negligible

3.1.2 Route Discovery Process

To provide an end-to-end QoS, extensions are added to the default routing table structure of AODV in RREQ, RREP and RERR messages. A node which receives a RREQ messages, must agree to meet the service requirement to rebroadcast the RREQ. The RREQ includes Max_Delay parameter which specifies the maximum bound on the time delay from the source to the destination. Based on the delay demanded mechanism, the packet can be forwarded or dropped in RREQ which is discussed below in algorithms (fig 2)

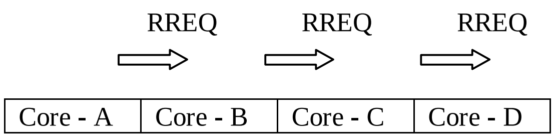

Fig. 2 RREQ forward or drop is based on the delay demanded

Fig 3 illustrates the packet is forwarded or dropped based on delay demanded

Source address	Destination address	Destination sequence no.	session ID	Hop count	Acc delay	Time out

Fig. 3 RREQ format for AODV-D

Source address	Destination address	Source sequence no.	Destination sequence no.	broadcast ID	session ID	Acc delay	Max delay

Fig. 4 RREP format for AODV-D

To enable the delay measurements in the RREQ and RREP, AODV provides an Accumulated Value extension field Acc_Delay which provides the cumulative value along the path from the beginning node to the currently processing node which is shown in the fig 4 and fig 5.Initially, assume the Acc_Delay to be zero and calculate the TRAVERSAL TIME, as per equation (1) which specifies the average time required to forward a data packet at every node.

3.1.3. Route Maintenance

By selecting the alternate paths incase of route failure, AODV-D tries to maintain the QoS delay constraint throughout the session. During data transmission, each mobile node informs the delay information to the data packets. Each packet header is time stamped when a packet reaches the mobile node successfully. Let A_i and D_i denote the arrival and successful transmission time of the ith packet respectively. After the ith packet's successful transmission at a node P, the estimated average total node delay qp includes contention, queuing and transmission delays at node p as per the following equation (2) [H. Song, V. Wong, and V. C. M. Leung, 2003]

$QPI = (1-\alpha)\ Q_P\ I-1 + \alpha(D_i-1-A_i-1)$ ----- (2)

Where i>1 and A_i-1 and D_i-1are arrival and departure time of the previous packet i-1.

To serve the QoS requirements, destination node monitors the route capacity for an entire session. If delay reaches the maximum limit, the destination node selects next better route from the buffered active route. When there is a link break, then AODV-D use Efficient local route repair mechanism, which is an unicast multi-hop local route repair protocol which recover the lost links and increase the network reliability, minimizing the control message overhead and delay taken to repair the route.

Each node in the network maintains a i) neighbourhood table, which records neighbourhood information, ii) a session ID table, which is used to record the current pair of source address, destination address and sessionID

iii) route buffer table, which is used to store alternate routes available to each session and iv) the route table, which is used to store information about routing for every session.

3.2. Efficient Two Hop Local Route Repair Mechanism

Local route repair is an important issue in routing protocol which is needed to minimize the flooding and to improve the performance of network. In case of link failure or route break, routes can be locally repaired by the node. Although the local repair mechanism works with a specified TTL to limit the repair range of RREQ, large number of the broadcast RREQ messages result in extensive control messages and obvious power consumption for transmitting these broadcast messages. In our Proposed Local route repair AODV is extended with an efficient multi- hop local route repair mechanism to minimizing the flooding.

In Fig. 5, Source node send the data packet through the path S->3->4->6->D. if there is a link breakage in node 4,it follows the concept of multi-hop local route repair approach which repair the broken link and maintains the information of neighbourhood nodes.

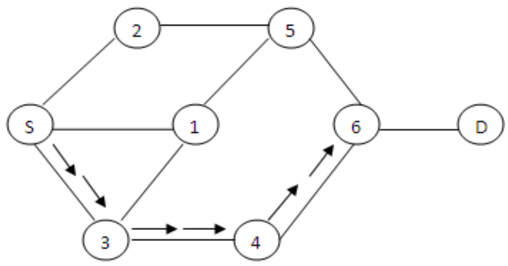

Fig 5 Existing path

After selecting the optimal substitute node from the extended routing table and the multi-hop neighbor table, a set of unicast-type repair messages are used instead of broadcasting. The unicast-type multi-hop repair approach consists of four unicast-types repair messages includes FREQ (Fixed Request), FREP (Fixed Reply), FERR (Fixed Error) and FUPDATE (Fixed Update) which functions are similar to AODV, respectively. The new path S->3->5->6->D is selected and transmission is done.

3.3 Pseudo code of Delay Estimation

The steps of the proposed delay estimation algorithm are:

Assume that the node A wants to send data packets to node D and no route is selected to transmit ,initiate a RREQ with Max_delay =x (Where x is the Max_delay in seconds and set Cum_delay = 0) and calculates node traversal time as per equation (1). If the calculated Difference between Max _delay and Cum_delay is greater than NTT then Update Cum_delay as Cum_delay = Cum_delay + NTT and Store Cum_delay in RREQ routing table or else discard the packet.

Whereas for destination node,

i)If it receives the RREQ message ,buffer it and if buffer time expires (NTTX NETWORK_DIAMETER) then select a route with minimal traversal time and unicast the RREP in the backward direction.

ii) If it receives the RERR message then select a fresh route from buffer.

Where as in source node
i) If it does not receive RREP message within WAIT_TIME then restart route discovery with new session Id.
ii) If it receives a fresh RREP with same session Id then transmit through new route

3.4 Pseudo code of Route Maintenance

When there is a link break, perform the multi-hop local route repair approach and update the routing table or else send RERR message to source and invalidate the associated route entry.

4. SIMULATION SETUP

Simulations were carried out in NS-2 with the simulation parameters given in Table 1 below.

TABLE 1 Simulation Parameters

Parameter	Value
Topology	1000mX 1000 m
No of Nodes	50
Mobility Model	Random way point
CBR sending rate (Packets/sec)	8 m/s
Pause Time	0
Transmission range	250 meters
Propagation model, Antenna type	Two-ray ground reflection, omni directional
Simulation Time	900s
Packet Size	512 bytes
Data Traffic	CBR
MAC Layer	IEEE 802.11 DCF
No of Flows	10

4.1 Packet Delivery Ratio (PDR)

Fig 6.shows the packet delivery ratio against the node mobility speed. In this experiment, we were varying the mobility speed from 10 km/h to 100 km/h. It is observed that the packet delivery ratio decreases when there is an increase in mobility speed because of the probability of link failure. As a result, AODV-D has highest packet delivery which maintains the stability compared to existing AODV protocols

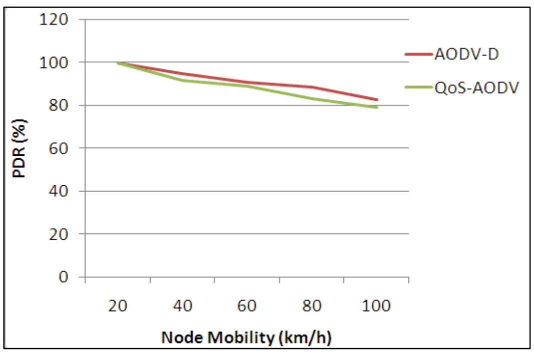

Fig 6 Packet Delivery Ratio vs. Node Mobility Speed (km/h)

4.2 Ends-to-End Delay

Fig.7 shows the average End-to-End delay of data packets vs. node mobility speed (km/h). f the mobility of node increases, the end-to-end delay also tends to increase because of dynamic environment between source, destination and path breaks. As a result AODV-D has shortest end-to-end delay and route failure is reduced compared with QoS-AODV and AODV

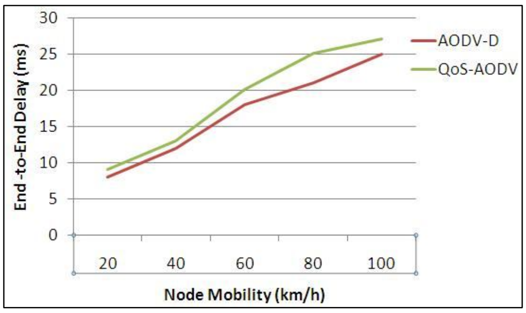

Fig.7 End-to-End delay (ms) vs. Node Mobility Speed (km/h)

4.3 Route life time

Fig. 8 shows the Route Life Time vs. node mobility speed (km/h). If the mobility of the node increases, as a result the route life time also decreases due to path breaks. By considering the signal stability and boundary level, the route life time increases better than QS-AODV and AODV

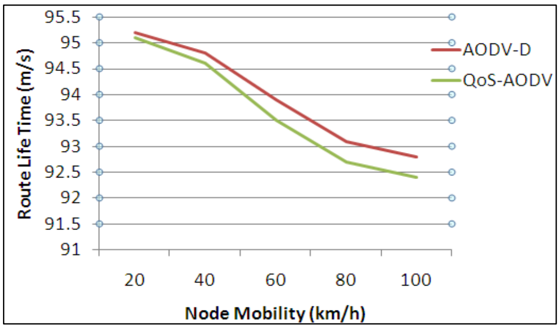

Fig.8 Route Life time (m/s) vs. Node Mobility Speed (km/h)

5. CONCLUSION

QoS routing in Mobile Ad hoc network is one of the challenging task in multimedia applications. Many researches is going on to solve this issue which includes mobility, limited bandwidth and power consumption, and broadcast characteristic of radio transmission. We proposed an local route repair mechanism for multi-hop networks using AODV protocol for mobile Adhoc networks which satisfies QoS parameters like End-to-End delay, PDR and Route Life Time constraints. It is observed that by using the delay estimation for QoS routing algorithm AODV-D achieves the QoS parameters compared to QoS-AODV protocol.

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