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Multipath Routing Protocol for Multimedia Applications in Ad-Hoc Wireless Networks

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Abstract— **A wireless ad-hoc network is a multihop wireless network which is collection of mobile/semi-mobile nodes with no pre-established infrastructure, forming a temporary network. So here the task becomes difficult topology of network changes dynamically. Here the Quality of Service (QoS) parameters is the Bandwidth, Jitter and Delay. The Routing protocol existing such as AODV, DSR and DSDV does not provide any guarantee to be used for multimedia application. As AODV protocol provides single path and is on-demand and it requires periodic updates of the adjacent neighbors. DSDV protocol provides single path and also needs periodic updates whenever there is change in routing table. DSR protocol is based on source routing which suffers from the scalability problem. So the main focus for development of this new protocol is to reduce the delay that incurred in the AODV and DSR routing protocol and to decrease the packet loss ratio that incurred in the DSDV routing protocol. This paper gives an overview of this new protocol and shows some experimental result.**

Keywords— MANET, AODV, DSR, DSDV

I. INTRODUCTION

An ad-hoc network has a dynamic topology, which is a consequence of node mobility. Nodes can changes its position quite frequently, which means that a routing protocol is needed which quickly adapts to the topological changes. The simulations show that we certainly need a modified protoco [1][5]l. Conventional protocol DSDV have a decrease in performance when mobility is high, so the new protocol can be developed from AODV which performs quite well.

This paper gives a general understanding of ad-hoc networks, explains few basic routing protocol and shows the analysis of the new modified protocol implemented in NS-2.

II. AD-HOC ROUTING PROTOCOLS

i. MANET

MANET is a group in IETF, which is working in the field of ad-hoc networks. Currently it has several routing protocols. Mobile Ad hoc Networks can be defined as "An autonomous system of mobile routers connected by wireless links [4]. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a stand-alone fashion, or may be connected to the larger Internet".

There are few assumptions made in the experiment conducted for the network [7]. They are:

- The nodes are the portable devices with the limited battery life. This feature can impose restriction on the computation and the communication (transmitting and receiving) at every node in the MANET.
- All the nodes have the equal capability of processing power, transmission range and the other features of the device.
- Connection between the nodes is not transitive.
- Nodes are identified by fixed ID's.
- Nodes are free to move in the network without any restriction and can leave or join the network at any time.
- The route availability defined in the thesis is limited to the range of transmission of all the nodes that comes in the path from source to destination.
- All the nodes trust each other by using predefined keys or because it is known that there are no malicious intruder nodes.
- Packets may be lost or corrupted during transmission on the wireless network.
- The routing protocol is tested with the assumption that the mobility is not very high.

ii. ROUTING PROTOCOLS FOR MULTIMEDIA APPLICATION

The paper is concentrated mainly on protocols for Multimedia applications. In a network consisting of mobile nodes, the connection between a source and destination may break down and has to be updated regularly [13]. Although, when a path fails, one could switch over to an alternative path; this may take an unacceptably long period of time, causing a temporary disruption in the multimedia signal. Instead of transporting a multimedia stream through a "single" communication pipe, the stream is split up into multiple sub-streams, each of which takes a separate route through the network [15]. At the destination all sub-streams received properly are merged in a clever way.

In this paper the network layer protocol for the transmission of multimedia data is focused more. The main idea is to provide continuous connection to the destination even when the path breaks. Continuous connection is provided by establishing multiple paths from source to destination, so that when one of the paths breaks than also other paths are available through which the data can be transmitted.

The routing commonly used are AODV, DSR and DSDV. These are described below

a. AODV

AODV (Ad Hoc On-demand Routing Protocol) uses the hop-by-hop routing. As shown in Figure below the node that wants to know a route to a given destination generates a ROUTE REQUEST. The route request is forwarded by intermediate nodes that also create a reverse route for itself from the destination [17]. When the request reaches a node with route to destination it generates a ROUTE REPLY containing the number of hops requires reaching destination.

All nodes that participate in forwarding this reply to the source node create a forward route to destination. This state created from each node from source to destination is a hop-by-hop state and not the entire route as is done in source routing.

The AODV routing algorithm is a source initiated [12], on demand routing algorithm Therefore a route is discovered only if and when a source wants to send data to a specific destination. Once the route is established between the source and the destination, it remains as long as it's needed for further communication.

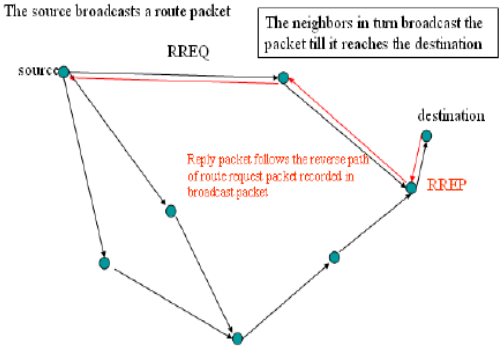

Figure 1 AODV Routing Protocol

b. DSDV

In DSDV (Destination Source Distance Vector) routing protocol routing messages are exchanged between neighboring mobile nodes (i.e. mobile nodes that are within range of one another). DSDV is a proactive or table driven routing protocol. That is the protocol maintains a correct route to any node in the network. The DSDV routing algorithm is based on the idea of the classical Bellman-Ford Routing [14], with some major improvements to make it suitable for wireless schemes and specifically solve the count-to-infinity problem.

The main idea for the routing table updates is based on the time at which the routing information is to be sent to the other nodes. In this protocol the information is disseminated based on the time at which the routing table was updated since previous update. The protocol uses a sequence number for each routing table entry to distinguish stale routing information from new routing information, and thus avoids looping. The nodes communicate with each other to update their routing tables.

The update is both time-driven and event-driven. That is, the nodes periodically transmit their routing tables to their neighbors. A node also transmits its routing table if a significant change has occurred in its table since the last update was sent. Any routing updates may be triggered or routine. Updates are triggered in case routing information from one of the neighbors forces a change in the routing table. The received routing information is also broadcasted by the nodes after adding one hop count more to the already hop count number.

c. DSR

The Dynamic Source Routing protocol (DSR) is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration. The protocol is composed of the two mechanisms of Route Discovery and Route Maintenance, which work together to allow nodes to discover and maintain source routes to arbitrary destinations in the ad hoc network [14].

As shown in Figure below the use of source routing allows packet routing to be trivially loop-free, avoids the need for up-to-date routing information in the intermediate nodes through which packets are forwarded, and allows nodes forwarding or overhearing packets to cache the routing information in them for their own future use [11]. All aspects of the protocol operate entirely on-demand, allowing the routing packet overhead of DSR to scale automatically to only that needed to react to changes in the routes currently in use.

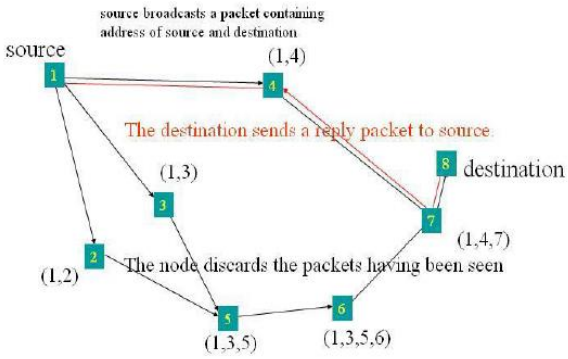

Figure 2 DSR routing Protocols

d. RESULTS

With the studies of these routing protocols and looking at the advantages and the disadvantages a new routing protocol for multimedia application is to be designed. As the DSR lacks in scalability, and the AODV with the control packets dissemination into the network, a new Multipath routing using the AODV approach for the routing table update mechanism along with route discovery and maintaining the continuous path from source to destination.

For the network experiment network scenario was considered.

Delay for the three routing protocols

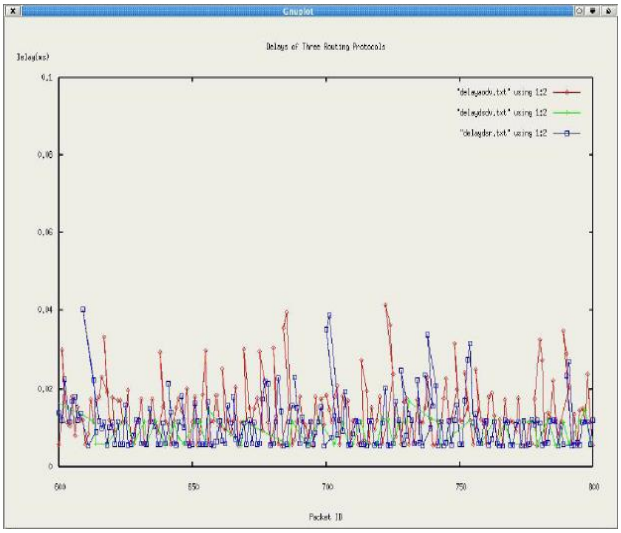

Figure 3 Delay of all AODV, DSDV and DSR routing protocols

Note: Red: AODV, Green: DSDV and Blue: DSR

From the results it can be concluded that the application whose packets loss ratio are more stringent to QoS than DSDV cannot be used. In that case either AODV or DSR can be used where packet loss is very less. In case if the application that are more stringent to delay for example conversation voice, where some of the packet loss doesn't make any difference than DSDV protocol can be used. From the conclusion it is required to have a new routing protocol that is having the packet loss ratio less than that of DSDV routing protocol and the Delay parameter to be less than that of AODV and DSR routing protocol.

The delay and the packet loss that is seen in these protocols is due to the control information disseminated into the network [4]. AODV and DSR routing protocols have less number of control information disseminated into the network and the DSDV has more number of control information. This control information has more priority at the intermediate node that acts as the routers so the data packets are dropped at these nodes [16]. In case of delay, the routing table of DSDV routing protocol is updated whenever there is change in routing table at any node. So the path for any node to reach the destination is the shortest.

III. PROTOCOL IMPLEMENTATION

The flow chart as shown in Figure shown the implementation of the protocol from the start when the data comes at the nodes and the node sends the request to the destination. The protocol shown above is implemented in NS-2, and its simulation is carried out.

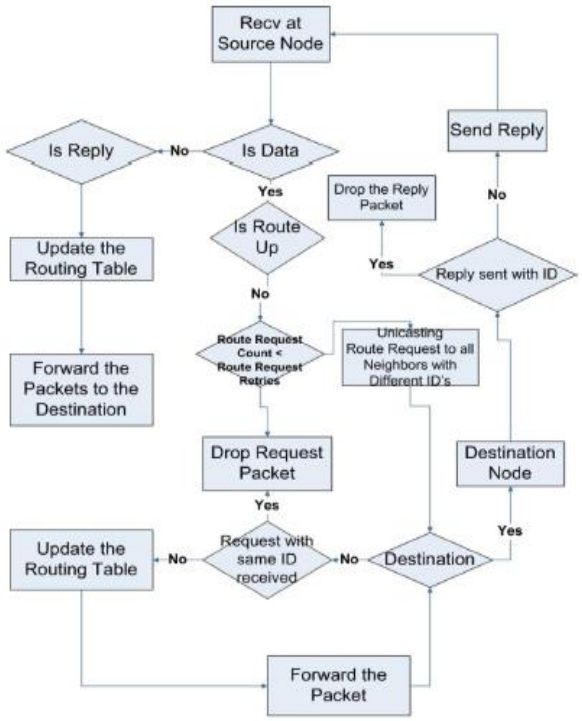

Figure 4 Flow of Implementation

The experiment was conducted and it shows the following results

Table 1: Comparison of different routing protocols with max mobility 10 m/s

Parameters	AODV	DSR	DSDV	Multipath Routing
No. of Nodes	30	30	30	30
Mobility Max	10	10	10	10
Packets Type	CBR	CBR	CBR	CBR
Efficiency (%)	93	92	94	100
Avg Delay(ms)	33.4912	9.8416	8.26218	25.7392
Min Delay(ms)	5.469	5.45034	5.44978	5.469
Max Delay(ms)	61.1047	399.78	20.3764	691.963

Table 2: Comparison of different routing protocols with max mobility 20 m/s

Parameters	AODV	DSR	DSDV	Multipath Routing
No. of Nodes	30	30	30	30
Mobility Max	20	20	20	20
Packets Type	CBR	CBR	CBR	CBR
Efficiency (%)	92.96	100	75.39	99.84
Avg Delay (ms)	15.5204	19.1148	11.8156	14.0406
Min Delay(ms)	11.2043	11.8337	11.1637	11.2035
Max Delay(ms)	61.1047	399.78	20.3764	691.963

Delay of Multipath routing protocol (the new implemented protocol) with maximum mobility 20m/s)

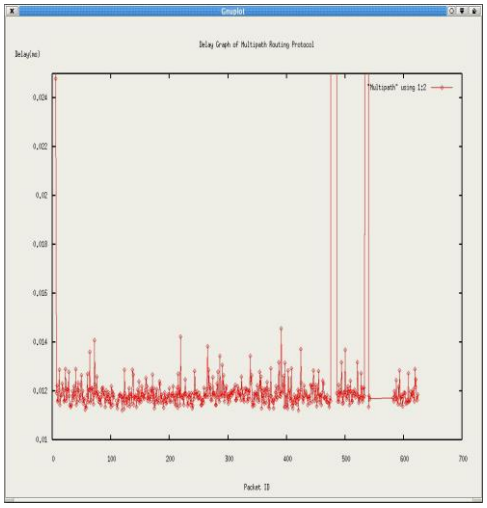

Figure 5 Delay of Multipath Routing Protocol

Delay of DSR Routing Protocol with maximum mobility 20m/s

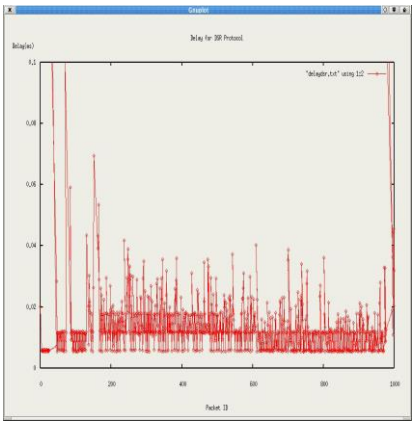

Figure 6 Delay of DSR

Delay of AODV Routing Protocol with maximum mobility 20m/s

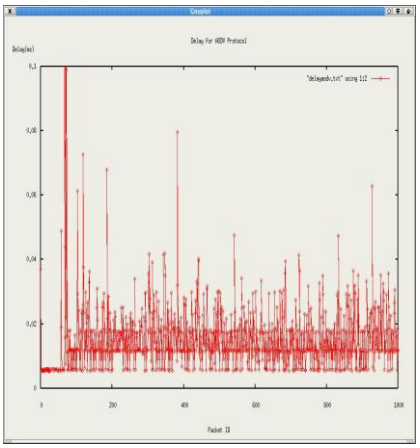

Figure 7 Delay of AODV

Delay of DSDV Routing Protocol with maximum mobility 20m/s

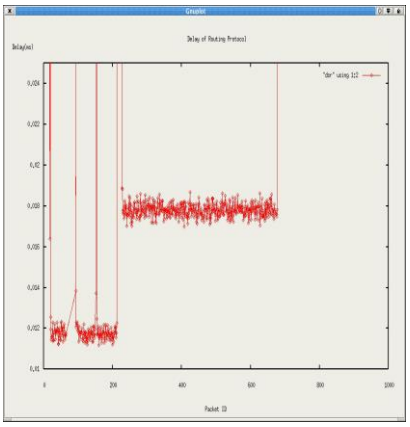

Figure 8 Delay of DSDV

IV. CONCLUSION

It can be clearly seen from the table 6.1 that the delay is less for DSDV than other protocols. This delay variation is so because the routing tables in DSDV protocol is updated as the topology changes. During the topology change the control information about the node is to be broadcasted. This broadcasting of the routing table is dependent on the timing interval of how frequent the routing table is updated. This updated information is to be transmitted to the other nodes in the network. So the packet loss is more due to the control packets processing at the intermediate nodes. As the routing tables are the updated regularly the source gets the best path to the destination. In case of DSR and AODV routing protocol the route for the packets from the source once established is updated only when there is path break. So even if the destination node is far away during the first packet transmission and comes to a single hop distance during the other packet transmission the path do not change as long as the path is active. This is the main reason for more delay in AODV and DSR routing protocol.

The other parameter is the packet loss in the AODV and DSR routing protocol, in this the control packets are transmitted on timely basis i.e. at fixed interval of time the control information is disseminated into the network. So due to less number of control packets the node which acts as the router handles the data packets. The new Multipath routing protocol searches for multiple paths to the destination. The maximum number of paths is limited to four paths because of control to dissemination of control packets in the network. This dissemination of control packets is increased with respect to the network size. So the delay difference in this protocol is due to restriction made on number of paths to destination. Also the control information transmitted is on timely basis as in case of AODV and DSDV routing protocol. In case of DSDV routing protocol, single path is available; this is the best one to reach the destination.

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