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Caching of Routes in AODV for MANET

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Abstract: Mobile Ad hoc networks (MANET) have multi-hop wireless connectivity and they are categorised on the basis of route finding and maintenance. MANET has frequently changing topology and need dynamic routing protocol. Comparative studies between on demand or reactive routing protocols like AODV and DSR (the two best known and used routing protocols) shows that performance of AODV, DSR etc. are varies i.e. performance of AODV is better in high mobility environment and performance of DSR is better in high routing MAC load case. This is the cause of route caching in DSR as in high mobility; it has to modernize the route as soon as the node moves from the network. In this paper, we have cached the route in AODV without manipulating its basic structure to enhance the throughput, packet delivery ratio (PDR), energy etc. We have made a comparison between the traditional AODV and proposed AODV. We have shown the performance graph in performance result section.

Keywords: AODV, DSR, MANET, QoS.

1. INTRODUCTION

MANETs are local area network (LAN), built of your own accord as nodes connect. Due to absence of base station which coordinates the message flow among nodes, the individual nodes forward data packet to each other and from each other. In Latin, ad hoc literally stands "for this," which means "for this particular purpose" and moreover, by extension, no preparation or impromptu.

Mobile Ad-Hoc Networks (MANETs) consists of a set of mobile nodes which are not bounded in any infrastructure. MANET nodes can communicate with other nodes and can move without restriction. This free mobility and effortless deployment features of MANETs make them extremely popular and well suitable for emergencies, natural disaster and military operations. Routing protocols AODV, DSDV, DSR, OLSR etc. are used in MANET based on the network requirement. AODV and DSR are the well popular protocols used in mobile ad-hoc networks. DSR is best for low mobility networks as it caches the route for alternate transmission and in high mobility its route caching mechanism becomes unmanageable. Thus in high mobility environment AODV achieve better performance since it does not cache routes and used the best path from source node to destination node for transmission.

2. DESCRIPTION OF AODV

The Ad hoc On-Demand Distance Vector (AODV) routing algorithm enables multihop, dynamic, self-starting routing among participating nodes desired to establish or maintain an mobile ad hoc network. Mobile nodes in AODV obtain routes rapidly for new destination, and do not maintain inactive routes to destinations. AODV allows mobile devices to reply on a broken link and modification in topology with suitable manner. The AODV procedure is loop free and avoids the problem "counting to infinity" Bellman-Ford problem propose quick convergence when topology changes in Ad Hoc network (typically, when a node shifts in the network). When links from source node to destination node breaks, AODV protocol send notification to all the affected nodes to invalidate that route for future communication. AODV uses RREQs, RREPs, and RERRs which defines route request, route replies and route error messages for any transmission.

These messages are received using UDP (User Datagram Protocol), and normal IP (Internet Protocol) header processing applies. When node wants to communicate, the route requesting node’s IP address is used as originator IP address and is used in the data packets. For broadcasting, broadcasting address (255.255.255.255) is used in the data packets. This declares that these messages are not forwarded blindly. Though, AODV procedure does have need of certain messages (e.g., RERR, RREQ) to be broadcasted widely throughout the network. The range of broadcasting of these messages is specified by the time to live (TTL) in the IP header.

3. PROPOSED WORK

In proposed system we have added a cache in each node to store in node information and latest sequence number carried by the RREQ packet. The RREQ message carries the information of node address and latest sequence number. When this RREQ message arrives at next node the node copies the entire path starting source to previous node and adds its address and sequence number and forwards this towards next node until it reaches destination.

The advantage of this system can be analysed if there is any route failure in the AODV transmission, Source node follow the cached route for continuous data transmission.

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3.1. SIMULATION MODEL

We use a detailed simulation model based on ns-2. The changes mentioned above are made in the code of AODV which is available ns-2.34 and performance of the new routing protocol is compared with AODV under various scenarios.

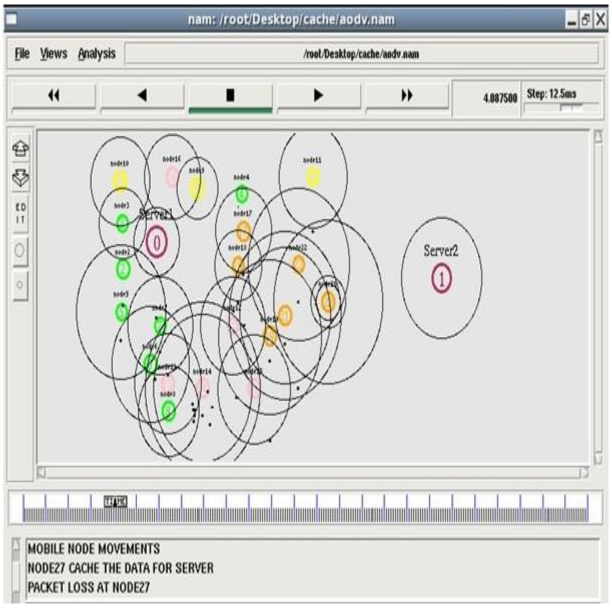

Fig 3.1. System Simulation Layout

We used traffic and mobility models similar to those used in using ns-2. Traffic sources are continuous bit rate (CBR) for a major component of the simulation though we have analyzed the effect of caching on TCP traffic as well. The source to destination pairs is spread at random in the network.

We have used only 512 byte (common data packet) data packets. The total number of source to destination pairs and data packet transmission rate in every pair is varied to modify the offered load. The proposed model uses random waypoint model in a rectangular area. Two field having configurations: "500 m x 500 m field with 50 nodes" and "1000 m x 1000 m field with 100 nodes" are used. Here, all packets start their journey from moving source to moving destination. The mobile terminals move through a randomly chosen speed (uniformly distributed between 0 to 20 m/s). Once one destination is achieved, other different random destinations are targeted with a pause. We differ pause time, that influence the comparative speeds of mobiles nodes. Simulations are run for 500 simulated seconds for 50 and 100 nodes. Each data represent average of minimum three runs with identical traffic models, but altered randomly produced mobility scenarios. Similar mobility and caching scenarios are applied across protocols.

4. PERFORMANCE METRICS

In this proposed system, we consider the following performance metrics in our proposed system.

4.1 PACKET DELIVERY RATIO

PDR is described as the ratio of received data packets at the destination node to the data packet send by the source node. Data packets at the source are generated by CBR. A interrelated metric, received throughput (in kb per second) at destination has been evaluated in the case of analysis of TCP.

4.2 AVERAGE END-TO-END DELAY

This metric indicate all possible delay during buffering, route discovery, queuing, transmission, retransmission, propagation and transfer times.

4.3 NORMALIZED MAC LOAD

The number of ARP (Address Resolution Protocol) and control packets (RTS, CTS, ACK) transmitted by MAC for each and every delivered packet. It considers routing overhead and MAC control overhead.

4.4 ENERGY CONSUMPTION

Since mobile nodes comprise limited energy, it is considerable factor for the network to use as low as it need. This is the whole energy used in the AODV protocol from route discovery till route destroy. This energy is divided into two categories:

- **Active Communication Energy:** This is the energy used in route discovery, route maintenance and data transmission.

- **Inactive Communication Energy:** Although nodes in AODV do not participate in data transmission as it uses best path for data transmission but energy of inactive nodes also used as they are the component of the network.

4.5 THROUGHPUT

System throughput also called aggregate throughput is data transmission rate in unit time between two nodes in network. Throughput is essentially identical to network bandwidth consumption: it is measured mathematically through the queuing theory, when loads in the packets per unit time is denoted as the arrival rate (λ), and the throughput, in packets per time unit, is denoted as the departure rate (μ).

5. PERFORMANCE RESULT

5.1 PACKET DELIVERY RATIO (PDR)

For analysing the performance of network for any protocol it is required to calculate the PDR of network.

PDR Calculation

Formula for calculating the PDR (packet delivery ratio) is given below.

$$\text{Packet Delivery Ratio} = \frac{\text{Total packets received by destination node}}{\text{Total packet generated by CBR at source node.}} * 100$$

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Fig 5.1 Packet Delivery Ratio of Proposed System vs. Existing System

From above figure 5.3, we can see that our proposed system is better than existing system.

5.2 THROUGHPUT

Throughput is total amount of data that a network computer can transmits form source node to destination node in a unit time period. In common words throughput measure is the number of jobs finished in unit time.

Throughput Calculation

The formula for calculating throughput is given below

Transmission Time = File Size / Bandwidth (sec)

Throughput = File Size / Transmission Time (bps)

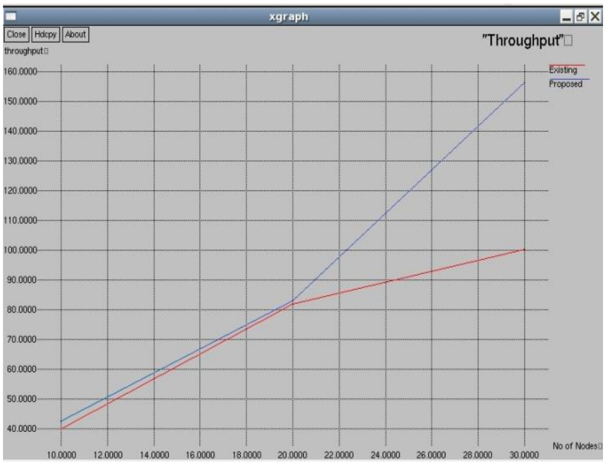

Fig 5.2 Throughput of Proposed System vs. Existing System

From above figure, we can analyse that the throughput of proposed system is better than the existing system.

5.3 ENERGY

Every mobile device has limited power as most of them operate through battery power. Thus it is necessary for the network to consume minimum energy as they require forming network and data transmission. The total energy consumed in proposed system and existing system is given below.

Energy Calculation

Set of nodes forming the network and involved in communication for packet delivery process losses some energy after each transmits and receive.

Suppose TP is the transmission Power of one packet, TT is the transmission Time of that packet, then, the total energy ET required during for one packet transmission will be below:

$$ET = TP * TT \quad \ldots\ldots\ldots\ldots\ldots\ldots 1$$

Therefore, Remaining Energy Enew of that node will be below,

$$Enew = Ecurr - ET \quad \ldots\ldots\ldots\ldots\ldots\ldots 2$$

Similarly, suppose RP is the reception Power of one packet, RT is the reception Time of one packet therefore, the sum of energy ER required during one packet reception will be below:

$$ER = RP * RT \quad \ldots\ldots\ldots\ldots\ldots\ldots 3$$

Therefore, Remaining Energy Enew of that node will be below,

$$Enew = Ecurr - ER \quad \ldots\ldots\ldots\ldots\ldots 4$$

With these calculations energy of the node at any interval of time can be calculated.

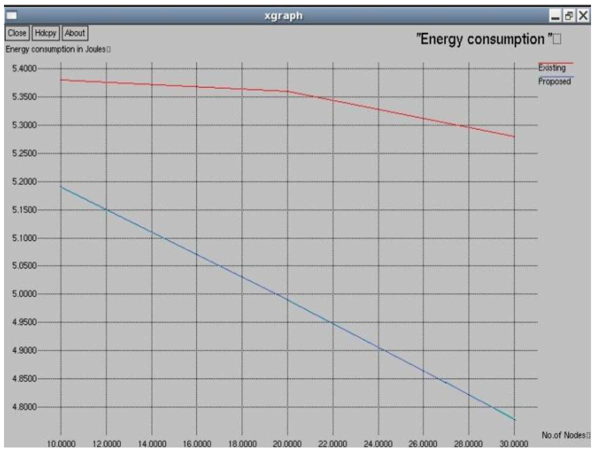

Fig 5.3 Energy Consumed In Proposed System Vs. Existing System

From the above figure it can be analysed that proposed AODV is much energy efficient than the existing AODV.

6. CONCLUSION

In this work, we first try to give introduction about the MANET, its characteristics and its application. In next section, we try to elaborate how our existing system works and we also cover the drawbacks of our existing system.

Then we elaborate our proposed model to overcome the problem that arises in our existing System.

We designed our proposed system model in the situation of route failure. We have cached path in the node cache for alternate route and this path works when node moves and route breaks and source does not need to rebroadcast RREQ message if route breaks. We have compared the AODV with the AODV proposed model for performance. We saw that the proposed model of AODV is improved over existing AODV.

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