Performance Evaluation And QOS Analysis Of Routing Protocols In MANET

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Abstract

A Mobile Ad-Hoc Network (MANET) is a collection of wireless mobile nodes forming a temporary network without using any centralized access point, infrastructure, or centralized administration. Routing is a critical issue in MANET and hence the focus of this project along with the performance analysis of routing protocols. The scope of this project was to test routing performance of two different routing protocols (AODV and DSR) in variable network sizes and variable simulation times. We have used NS-2 Simulator from Scalable Networks to perform the simulations. This paper presents that which routing protocol performs better in which environment and scenarios of mobile ad- hoc networks.

1. Introduction

An ad hoc network is a wireless network, which do not have a centralized and fixed infrastructure. MANET is referred to as a wireless ad hoc network in which nodes are free to move arbitrarily and mobile nodes can transmit and receive the traffic. Also mobile nodes can act like routers by forwarding the neighbours traffic to the destination node as the routers are multi hop devices [1].

The topology of the network changes every time by getting in and out of the mobile nodes in the network. Hence, there is need of efficient routing protocols to allow nodes to communicate over multi-hop paths which consists of several links.

Compared to wired network, mobile network have unique characteristics. In mobile network node mobility may cause frequent change in network topology, which is rare in wired network. In contrast to the stable link capacity of wired network, wireless link capacity continuously varies because of the impacts from transmission power, receiver sensitivity, noise, fading and interference. Additionally, wireless mobile network have high error rate, power restrictions and bandwidth limitation [2].

Mobile ad hoc network routing protocols can be divided into proactive, reactive and hybrid [8] [10] [13]. A proactive routing protocol is also called "table driven" routing protocol. Using a proactive routing protocol, nodes in a mobile ad hoc network continuously evaluate routes to all reachable nodes and attempt to maintain consistent, up-to-date routing information [4]. Therefore, a source node can get a routing path immediately if it needs one. The Wireless Routing Protocol (WRP), the Destination Sequence Distance Vector (DSDV) and the Fisheye State Routing (FSR) are examples of proactive routing protocols. In proactive routing protocol, all nodes need to maintain a consistent view of the network topology. When a network topology changes, respective updates must be propagated throughout the network to notify the change. The Dynamic Source Routing (DSR) and Ad hoc on-demand Distance Vector routing (AODV) protocol are examples for reactive routing protocol. Hybrid routing protocols are proposed to combine the merits of both proactive and reactive routing protocols and overcome theirshortcomings [3]. The Zone Routing Protocol (ZRP) , Zone-based Hierarchical Link State routing (ZHLS) and Hybrid Ad hoc Routing Protocol (HARP) are examples of hybrid routing protocols for mobile ad hoc networks.

2. Ad-hoc On Demand Distance Vector Routing (AODV)

Ad-hoc on-demand distance vector (AODV) routing protocol is a reactive protocol even though it still uses characteristics of a proactive protocol. AODV uses the concept of route discovery and route maintenance of DSR and the concept of sequence number’s and sending of periodic beacon’s from DSDV [3]. AODV uses three types of control messages. They are Route Request (RREQ), Route Reply (RREP) and Route Error (RERR) messages [5]. When a route does not exist between two nodes i.e., when a route to new destination is required a node initiates the route discovery process. Route discovery involves flooding of RREQ messages to its neighbour to find the destination node [4] [6]. Route discovery process can also be initiated if the link has expired or broken. An intermediate node receiving the RREQ is required to first setup a reverse path to the source node. It uses sequence number and broadcast ID for loop free routing. When the destination receives a route RREQ, It responds with a RREP message containing the number of hops and latest destination sequence number. RREP is routed back to the source node using the reverse path and forward path to the destination is established. A time to live is associated with each reverse route entry. If no packets are sent over this route within the lifetime it will be removed from the routing table [10] [8] [9]. In route maintenance phase each node uses hello packets to check for the link. When a link failure is detected by a node it sends a route error (RRER) messages to its upstream neighbours on the current route. These error messages propagate to the source node. Intermediate nodes' receiving a RERR updates their routing table. The source node after receiving RERR starts the route discovery process again [10] [8] [9].

3. Dynamic Source Routing (DSR)

The key feature of DSR is source routing [7] [9] [11]. The source or the sender knows the complete hop-by-hop route to the destination. These routes are stored in route cache. It uses a route discovery process to dynamically determine the unknown route. It does not use periodic hello message unlike AODV. RREQ and RRER message is used to discover the route similar to AODV. Source node broadcast the RREQ message and the receiving neighbour node adds its address to source address and rebroadcast the RREQ message if it does not have the information for destination node. If route to the destination node is known they send a route reply packet to the source node. Every node also maintains a cache where the route information is stored [11]. The advantage of DSR is that it can store multiple routes in their route cache [12]. If any link on a source route is broken, a node that identifies the break and sends a route error (RERR) packet to the source node. On receiving the RERR packet, the source node updates its route information by removing the link from its cache. A new discovery process will be started to find the viable route [5].

4. Performance Metrics

There are various performance metrics that can be used to evaluate the performance of ad-hoc routing protocol. This metrics play a significant role while comparing two different protocols or ad-hoc routing protocols in terms of speed, number of packets sent, area, density, pause time etc. Few performance metrics are briefly discussed below.

4.1. Packet Delivery Ratio

It is the number of packet received by the destination out of all the generated packets by the source.

4.2. Average end-to-end Delay

It is the average delay time incurred when data packets are sent from the source to the destination.

4.3. Throughput

It is the average rate of successful packet delivery per unit time.

5. Simulation Result and Analysis

5.1. Simulation Environment

The simulation is carried out using Ns-2 i.e. ns-allinone-2.34 on Ubuntu operating system on Pentium –IV, 2.0GHz/RAM-1GB/HDD-1.

5.2. Traffic Model

Continuous bit rate (CBR) traffic sources are used. The source-destination pairs are spread randomly over the network.

5.3. Mobility Model

The mobility model used is Random waypoint mobility model because it models the random movement of the mobile nodes.

5.4. Scenarios

For all the simulations, the number of traffic sources was fixed at 10, the maximum speed of the nodes was set to 20m/s and the simulation time was varied as 10s, 15s, and 20s.

We have used three scenarios to compare AODV and DSR, some parameters with a specific value are considered are shown below:

Scenario 1:

Table 1: Scenario 1 for implementation of AODV and DSR

Parameter	Value
Number of nodes	10
Simulation Time	10 Sec
Pause Time	5ms

Environment Size	800X800
Transmission Range	250m
Traffic Size	CBR (Constant Bit Rate)
Packet Size	512 bytes
Packet Rate	5 packets/s
Maximum Speed	20m/s
Queue Length	50
Simulator	ns-2.29
Mobility Model	Random Waypoint
Antenna Type	Omni directional

Scenario 2:

Table 2: Scenario 2 for implementation of AODV and DSR

Parameter	Value
Number of nodes	10
Simulation Time	15 Sec
Pause Time	5ms
Environment Size	800X800
Transmission Range	250m
Traffic Size	CBR (Constant Bit Rate)
Packet Size	512 bytes
Packet Rate	5 packets/s
Maximum Speed	20m/s
Queue Length	50
Simulator	ns-2.29
Mobility Model	Random Waypoint
Antenna Type	Omni directional

Scenario 3:

Table 3: Scenario 3 for implementation of AODV and DSR

Parameter	Value
Number of nodes	10
Simulation Time	20 Sec
Pause Time	5ms
Environment Size	800X800
Transmission Range	250m
Traffic Size	CBR (Constant Bit Rate)
Packet Size	512 bytes
Packet Rate	5 packets/s
Maximum Speed	20m/s
Queue Length	50
Simulator	ns-2.29
Mobility Model	Random Waypoint
Antenna Type	Omni directional

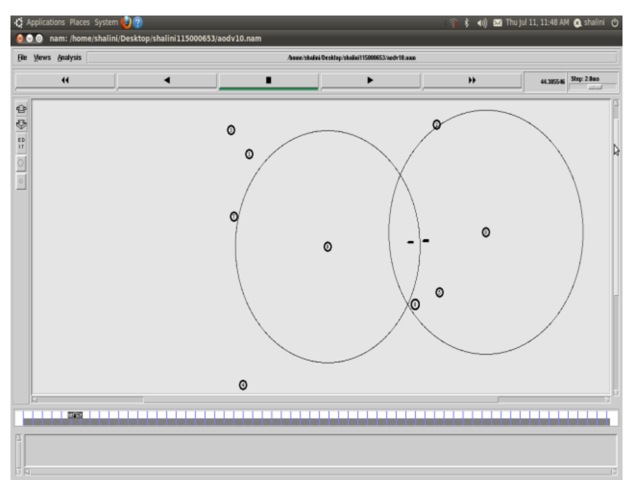

Figure 1: A screenshot of 10 nodes AODV NAM-Network Animator

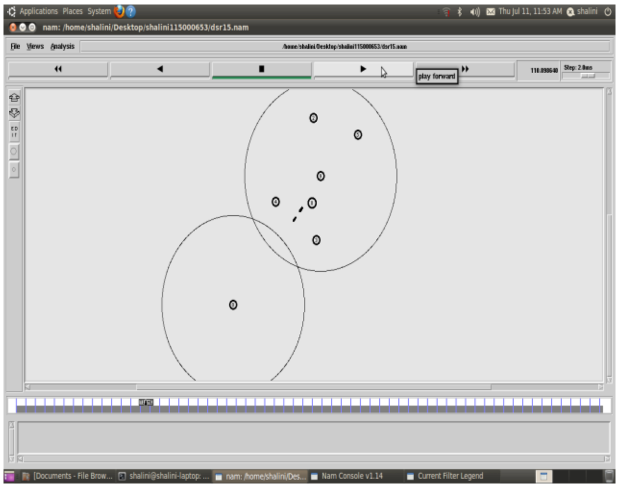

Figure 2: A screenshot of 10 nodes DSR NAM-Network Animator

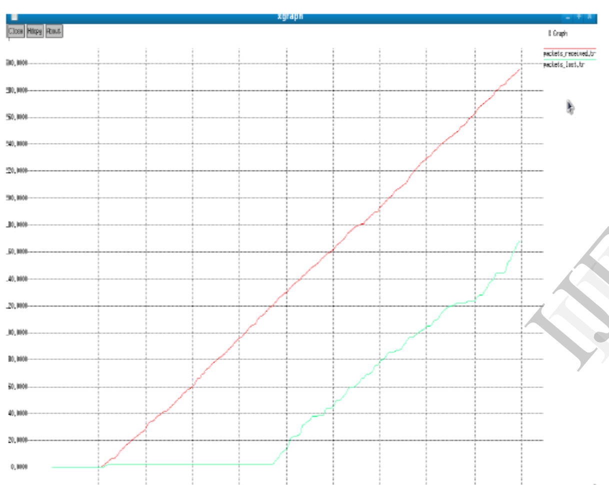

Figure 3: X graph for AODV (10 seconds)

The Figure 3 shows the X graph of AODV for simulation time of 10 seconds. By the figure we see that as the simulation starts the packet receive and packet loss is initially zero, because initially there is no CBR connection and nodes taking their right places. As the CBR connections establish between the nodes, the number of packets received increases but no packet loss is there, it means, all generated packets are being received by the nodes. But the packet loss increases substantially as the simulation time increases. Finally the packet received is more than the packet loss.

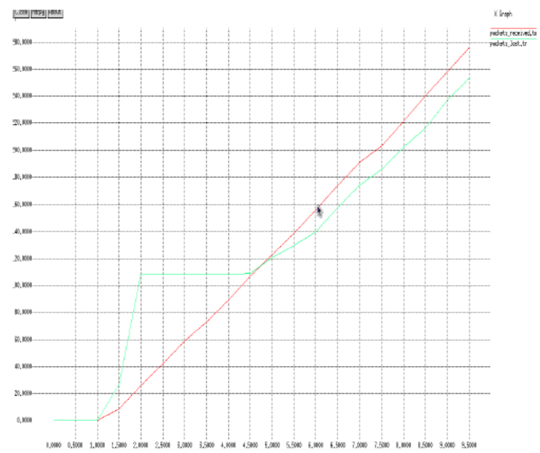

Figure 4: X graph for DSR (10 seconds)

The Figure 4 shows the X graph of DSR for simulation time of 10 seconds. By the figure we see that as the simulation starts the packet receive and packet loss is initially zero, because initially there is no CBR connection and nodes taking their right places. As the CBR connections establish between the nodes, the number of packet lost increases very much as compared to packet received. It shows that mostly generated packets are being dropped by the nodes. But the packet loss decreases substantially as the simulation time increases, and number of packet received also increases substantially as the simulation time increases.

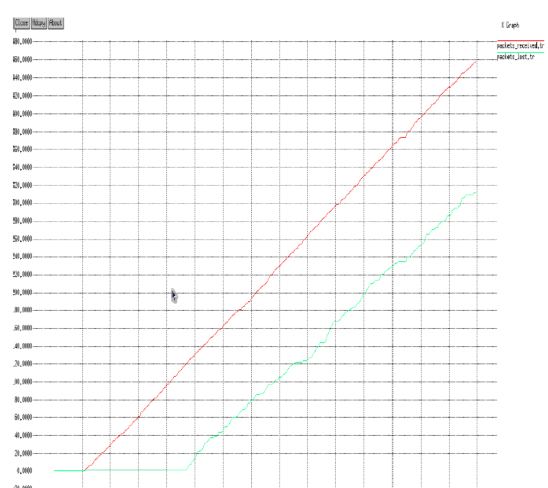

Figure 5: X graph for AODV (15 seconds)

The Figure 5 shows the X graph of AODV for simulation time of 15 seconds. The number of packet received increases with the simulation time; it means that the generated packets are being received at a good ratio by the node. But the simulation time increases the packet loss substantially.

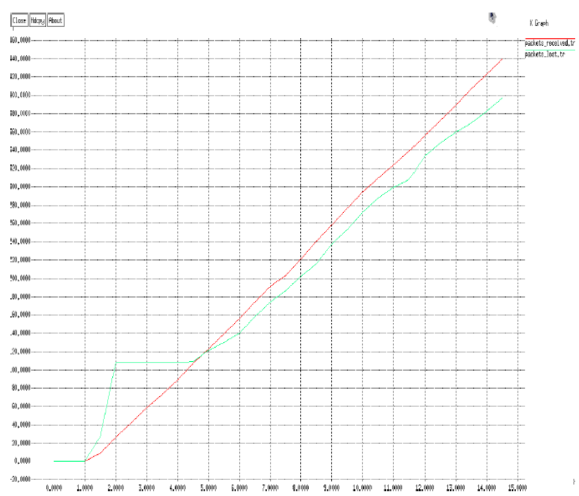

Figure 6: X graph for DSR (15 seconds)

The Figure 6 shows the X graph of DSR for simulation time of 15 seconds. It shows that initially there is very high packet loss but the number of packet received increases with the simulation time; it means that the generated packets are being received at a good ratio by the nodes, since the packet loss decreases substantially with the increasing simulation time.

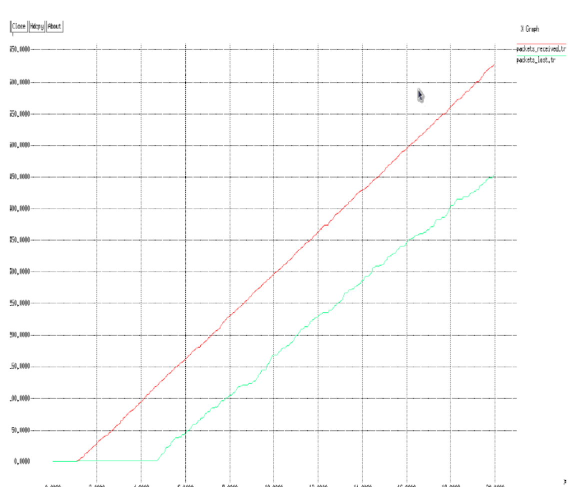

Figure 7: X graph for AODV (20 seconds)

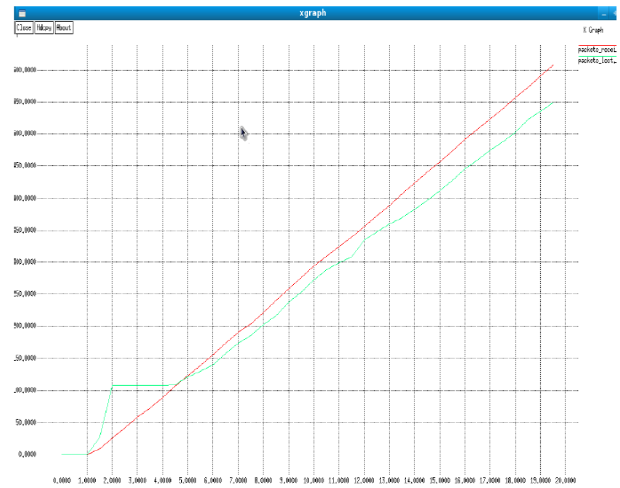

Figure 8: X graph for DSR (20 seconds)

The above graphs shows the same behaviour of AODV and DSR for packet receiving and packet loss, initially in AODV no packet loss and in DSR very high packet loss. But as the simulation time increases the number of packet loss decreases and the number of packet received increases.

6. Conclusion

It is observed that the packet loss is very less in case of AODV, initially but it increases substantially on the simulation time increases. In case of DSR simulation the packet loss is very high initially but it decreases substantially as the simulation time increases. So, we can conclude that if the MANET has to be setup for a small amount of time then AODV should be preferred due to low initial packet loss over DSR because for a small amount of time initial packet loss is very high. If we need to use the MANET for a longer duration then both the protocols can be used, because after some time both the protocols have same ratio of packet delivery. But, AODV has very high packet receiving ratio in comparison to DSR.

7. References

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