Performance Analysis of AODV, DYMO and Bellman Routing Protocols in Mobile Ad-Hoc Network

SEEMA RAHUL
Department of ECE, Radha Govind Group of Institutions, Meerut
seema_3485@yahoo.com

SANJAY KUMAR MAURYA
Department of ECE, GCRG Group of Institutions, Lucknow
sanjay.skm97@gmail.com

YASHI RAJVANSHI
Department of ECE, Vidya College of Engineering, Meerut
yashiec@gmail.com

SANDIP VIJAY
Head, Department of ECE/AEI, Dehradun Institute of Technology, Dehradun
vijaysandip@gmail.com

Abstract

One of the major challenges in wireless ad hoc network is the design of robust routing protocols. The routing protocols are designed basically to established correct and efficient paths between source and destination. In the recent years several routing protocols have been proposed in literature and many of them studied through extensive simulation at different network characteristics. This paper present performance comparison of four mobile ad-hoc network routing protocols i.e. Ad-hoc On Demand Distance Vector (AODV), (DYMO), Bellman using Qualnet 5.0.2 The performance analysis is based on different network metrics such as End-to-End delay(s), Average Jitter(s), Total packet received and Throughput

Key Words - AODV, DYMO, BELLMAN MANET, QUALNET**.**

1.Introduction

A Mobile Ad-Hoc Network (MANET) consists of self governing mobile nodes communicating in a decentralized manner. The goal of routing protocol is to determine paths with reduced overhead and also faster reconfiguration when a broken link is identified [5]. Every node has the responsibility to determine the best route to its destination. A lot of research study is performed on various routing protocols but this paper presents a comparison of AODV, DYMO, BELLMAN operating based on scope and zones. The performance analysis is based on different network metrics such as End-to-End delay(s), Average Jitter(s), Total packet received and Throughput.

2. Ad-hoc routing protocols

2.1Types of Routing Protocol

Mobile ad hoc network does not have any fixed infrastructure. In ad hoc network node move arbitrarily so topology changes in ad hoc network is rapid and unpredictable therefore routing is very important in ad hoc network. Routing protocols can be classified in three parts. (i) Table driven (Proactive) routing protocols (ii) Reactive routing protocols (iii) Hybrid routing protocols.

2.2 Proactive (Table driven) routing protocol

In table driven routing protocols, every nodes maintains the network topology information in the form of routing tables by periodically exchanging routing information. Routing information is generally flooded in the whole network. Whenever a node requires a path to a destination, it runs an appropriate path-finding algorithm on the topology information it maintains.

2.3 Reactive (On demand) routing protocol

Protocols that fall under this category do not maintain the network topology information. They obtain the necessary path when it is required, by using a connection establishment process. Hence these protocols do not exchange routing information periodically.

2.4 Hybrid routing protocol

Protocols belonging to this category combine the best features of the above two categories. Nodes within a certain distances from the node concerned, or within a particular geographical region, are said to be within the routing zone of the given node. For routing within this zone, a table-driven approach is used. For nodes that are located beyond this zone, an on-demand approach is used.

3.1 The protocols studied here are:

3.1.1 AODV

AODV adopts a very different mechanism to maintain routing information. It uses traditional routing tables, one entry per destination. This is in contrast to DSR, which can maintain multiple route cache entries for each destination. AODV uses sequence numbers maintained at each destination to determine freshness of routing information and to prevent routing loops. All routing packets carry these sequence numbers. An important feature of AODV is the maintenance of timer-based states in each node, regarding utilization of individual routing table entries. A routing table entry is expired if not used recently. A set of predecessor nodes is maintained for each routing table entry, indicating the set of neighboring nodes which use that entry to route data packets. These nodes are notified with RERR packets when the next-hop link breaks. In contrast to DSR, RERR packets in AODV are intended to inform all sources using a link when a failure occurs.

Advantages:

- Routes are established on demand and destination sequence numbers are used to find the latest route to the destination.
- Lower delay for connection setup.

Disadvantage:

- AODV doesn't allow handling unidirectional links.
- Multiple Route Reply packets in response to a single Route Request packet can lead to heavy control overhead.
- Periodic beaconing leads to unnecessary bandwidth consumption

3.1.2 DYMO

The Dynamic MANET On demand (DYMO) is a reactive or on demand, multihop, unicast routing protocol that not update route information periodically. The DYMO is a small memory stores routing information and generated Control Packets when a node receives the data packet from route path. The basic operations of Dynamic MANET On demand source router generates Route Request (RREQ) messages and floods them for Destination routers for whom it doesn't have route information. Intermediate nodes store a route to the originating router by adding it into its routing table during this dissemination Process. The target node after receiving the RREQ responds by sending Route Reply (RREP) Message. RREP is sent by unicast technique towards the source. An intermediate node that receives the RREP creates a route to the target and so finally it reaches to originator. Then Routes have been established between source and destination in both directions .The DYMO nodes monitors link over which traffic is flowing in order to cope up with dynamic network topology. A Route Error (RERR) message is generated when a node receives a data packet for the destination for which route is not known or the route is broken. Is RERR notifies other nodes about the link failure. The source node reinitiate route discovery quickly as it receives this RERR .Hello messages are used by all nodes to maintain routes to its neighbor nodes The sequence numbers are used in DYMO to make it loop free. These sequence numbers are used by nodes to determine the order of route discovery messages and so avoid propagating stale route information.

3.1.3 BELLMAN

Bellman-Ford Routing Algorithm, also known as Ford-Fulkerson Algorithm, is used as an algorithm by distance vector routing protocols such as RIP, BGP, ISO IDRP, NOVELL IPX. Routers that use this algorithm have to maintain the distance tables (which is a one-dimension array - "a vector"), which tell the distances and shortest path to sending packets to each node in the network. The information in the distance table is always updated by exchanging information with the neighboring nodes. The number of data in the table equals to that of all nodes in networks (excluded itself). The columns of table represent the directly attached neighbors whereas the rows represent all destinations in the network. Each data contains the path for sending packets to each destination in the network and distance/or time to transmit on that path (we call this as "cost"). The measurements in this algorithm are the number of hops, latency, the number of outgoing packets, etc.

Advantages and disadvantages

The main disadvantages of the Bellman–Ford algorithm in this setting are as follows:

- It does not scale well.

- Changes in network topology are not reflected quickly since updates are spread node-by-node.
- Count to infinity (if link or node failures render a node unreachable from some set of other nodes, those nodes may spend forever gradually increasing their estimates of the distance to it, and in the meantime there may be routing loops).

4. Simulation Parameters

The following five performance metrics were used to compare AODV, DYMO and Bellman protocols.

Throughput:

Throughput is defined as total number of packets received by the destination. It is a measure of effectiveness of a routing protocol (Reddy and Reddy 2006). Throughput is determined as the ratio of the total data received to required propagation time. The throughput (messages/second) is the total number of delivered data packets divided by the total duration of simulation time (Al-Maashri and Ould-Khaoua, 2006).

Packet Delivery Ratio:

Packet delivery ratio is calculated by dividing the number of packets received by the destination through the number of packets originated by source.

Average End-to-End Delay:

Average end-to-end delay is the average time it takes a data packet to reach to destination in seconds. It is calculated by subtracting “time at which first packet was transmitted by source” from “time at which first data packet arrived to destination.

Jitter:

Jitter is the variation in the time between packets arriving, caused by network congestion, and route changes.

5. Simulation Setup

To evaluate and compare the effectiveness of these routing protocols in a Mobile Ad-Hoc network, we performed extensive simulations in QualNet5.0.2 each simulation is carried out under a constant mobility. The simulation parameters are listed in Table 1.

Table 1: Simulation Parameters:

PARAMETER	VALUE
Data Rate	1,2,11 Mbps
Buffer Size	150000
Antenna	Steerable
Terrain Range	1500mx1500m
Traffic Type	CBR
No. of nodes	50
Channel Type	Wireless channel
Protocols	AODV, DYMO, BELLMAN

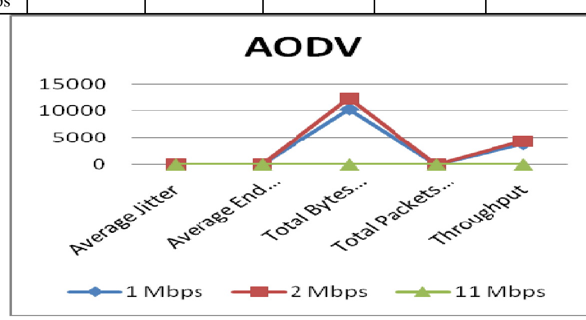
Results and Discussion

AODV

On comparing the performance metrics for AODV for various data rates we come to know that the average jitter is minimum for 11Mbps & no results obtained for 2 Mbps. Average end to end delay is minimum for 2 mbps while no observations obtained for 11 Mbps. When talking for Total bytes received, total packets received & throughput were higher than 1 Mbps. So overall performance shows that AODV gives better performance at a data rate 2 Mbps than other.

Data Rate	Average Jitter	Average End to End delay	Total Bytes Received	Total Packets Received	Throughput
1 Mbps	0.0219704	0.073618611	10240	20	3782
2 Mbps	NIL	0.0299	12288	24	4343
11 Mbps	0.0126307	NIL	NIL	NIL	NIL

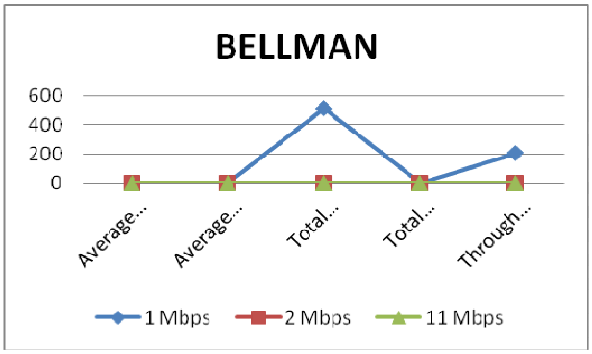
Data Rate	Average Jitter	Average End to End delay	Total Bytes Received	Total Packets Received	Throughput
1 Mbps	0.185366	0.397351	8192	16	3749
2 Mbps	0.236542	0.320592	6656	13	3502
11 Mbps	0.171025	1.95231	3584	0	0



BELLMAN

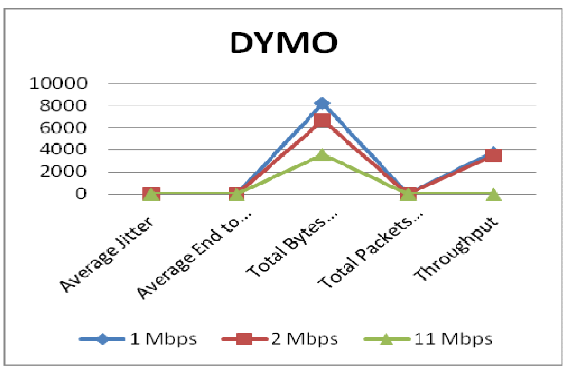
For Bellman- Ford protocol no observations were obtained for 2 Mbps & 11 Mbps, so it can be used at a data rate of 1 Mbps.

Data Rate	Average Jitter	Average End to End delay	Total Bytes Received	Total Packets Received	Throughput
1 Mbps	0	.392595	512	1	208
2 Mbps	NIL	NIL	NIL	NIL	NIL
11 Mbps	NIL	NIL	NIL	NIL	NIL



DYMO

Throughput, Total bytes received, Total packets received should be higher for better performance, and here these parameters are higher at a data rate of 1 Mbps. And average end to end delay and average jitter should be minimum here it is minimum for 1 Mbps. So DYMO routing protocol can be used at a data rate for 1 Mbps for efficient performance.



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