Performance Analysis of various Routing Protocols in Mobile Ad-hoc Networks

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Abstract

Mobile Ad-hoc Networks are encouraged in future technological activates to link various objects. Routing in MANET become a challenging task. In the past decade many routing protocols are proposed, still there is a vacuum for research. Hence in this paper the performance of five most used routing protocol are compared. The routing protocols consider in this comparative analysis are Dynamic Source Routing (DSR), Destination Sequenced Distance Vector (DSDV), On-demand Distance Vector (AODV), Zone Routing Protocol (ZRP), and Temporally Ordered Routing Algorithm (TORA). In order to analysis the performance of these protocol, which are implemented with same configuration and performed for same a common objective. Then the performance such as sent packets, received packets, packet delivery ratio, throughput, average end to end delay, packets dropped, sending jitter and receiving jitter are analyzed.

Keywords: On-demand Distance Vector (AODV), Dynamic Source Routing (DSR), Destination Sequenced Distance Vector (DSDV), Zone Routing Protocol (ZRP), Temporally Ordered Routing Algorithm (TORA).

INTRODUCTION

Wireless Ad-hoc Networks (WANET) are used in any application, and it is a most used decentralized wireless network [1]. In this kind of networking configured without physical connection between its nodes. In centralized systems, there is a permanent base station and the nodes may be mobile. These nodes are mostly communicating with base station, while it is in its range. In a De-centralized network, all the nodes are connected are dynamically and arbitrarily. In these type of networks, every node can act as a router. This type of wireless networks also referred as mobile Ad-hoc network [2].

A. Table-Driven Routing Protocols

In this type of routing protocol, the network nodes maintain a table to record routing information. Nodes update the table whenever there is a change in the network. In routing tables are kept at each node and are occasionally updated. The routing of data is done on the origin of these tables.

Advantages:

i) Since the paths are existing between all the destination nodes in the network, so the delay to set up the path is low.

ii) The adapted wireless ad-hoc network, employed an incremental update method to number the existing wired network protocols. So all the existing wired protocols can easily implement in wireless networks.

Disadvantage:

i) Due to huge reply packets while answering caused the control overhead, it become a noticeable drawback in this type of protocol [7].

B. On-Demand Based Routing Protocols

The on-demand routing protocols, as a particular type of routing strategy. In with the routes are initiated based on its needs. In an ideal condition, the nodes in the network never maintain the routing data. The route enabled till its need, and it is a slow technique in routing. In this type of routing, the route is discovered after receiving route request packets [9] [11].

Advantages of AODV:

i) The routing load can be reduced, because the paths are created only when it required.

ii) Delay to setup connection is low.

Disadvantages of AODV:

i) While network change, it needs to start a new sequence number.

ii) Bandwidth problem may arise due to the frequent update of its routing table.

iii) It has the massive volume of control messages. [5]

C. Hybrid Routing Protocols

The advantages in the reactive and proactive routing is combined in this type of protocols. The initial routs are established from the proactively prospected routes. Then the service is provided based on the demand of activated nodes and via the reactive flooding.

Advantages:

i) Required to flood network with messages of updates of tables periodically is eliminated.

ii) This protocol is one of the best suitable technique for the densely packed arrays of nodes.

Disadvantages:
i) Each node in the network should require a structure. The structure describes the height of node and link status.

ii) Occurs routing loops due to the network topology change.

iii) All the nodes in the network should keep on concentrating the adjacent node to detect topology change.

Fig 1. Classification of various routing protocols

RELATED WORK

C. Siva Ram Murthy and B.S. Manoj [2] provides the fundamentals of Wireless Communications. It discusses the cellular and Ad-hoc networks in depth and also provides insights to their applications.

Fasee Ullah, Muhammad Amin and Hamidul Ghaffar [3] simulated AODV as well as DSDV for sensor networks. The sensor network was created to monitor the environmental and physical conditions and pass the data to the sink. Here the nodes were kept static. The system is implemented using ns2, and the performance of the AODV and AMODV protocol were compared.

Echchaachoui, Adel, et al. [4] discussed mobile Ad-hoc Networks (MANET). They implemented AODV and AMODV for a MANET scenario over the range of fifty to two hundred number of nodes. A comparison was conducted by Gayatree Rana et al. [5] where they analyzed five protocols, namely PAAODV, AOMDV, DSDV, DSR, and AODV in MANET and number of nodes ranging from ten to fifty. The comparison has been made to analyse the performance of the above protocols when different parameters in a simulation are varied.

S. Vanthana and Dr V.Sinithu Janita Prakash [6] compares reactive, proactive and hybrid protocols in this paper. They discuss different types of Ad-hoc networks namely Vehicular Adhoc Network (VANET), Smart Phone Ad-hoc Networks (SPAN) and Mobile Ad- hoc Network (MANET). Here, more than one routing tables are maintained to recorded the overall topology of the network using the proactive routing protocol. Reactive routing protocols follow a route determination procedure.

RESULT ANALYSIS

A. Sent Packets

The performance of the five most used routing protocol based on its sent packets is compared. The number of nodes in the network varied from 10 to 50. At a lower number of the node, the DSDV sent the least packets, and while increasing the number of nodes, the ZRP sent the lowest packets. Thus the ZRP become the lowest performing protocol than the other four protocol. The performance chat based on the sent packet is given in fig. 2.

B. Received Packets

Figure 2. Graph - Sent packets v/s Number of Nodes

Figure 3. Packets received by each protocol and number of nodes
The performance chart based on the received packet is shown in fig 3. The overall performance based on a received packet of AODV is better than the other techniques, and the ZRP gives the lower performance.

C. Packet Delivery Ratio

![Graph – Packet Delivery Ratio vs Number of Nodes](image1)

**Figure 4.** Graph – Packet Delivery Ratio vs Number of Nodes

The packet delivery ratio of the four routing protocol of MANET is given in fig 4. The figure shows that the performance of DSDV is varied based on the number of nodes in the network. Moreover, the DSR provided a stable delivery ratio, comparing to the other four routing protocols.

D. Throughput

![Graph – Throughput vs Number of Nodes](image2)

**Figure 5.** Graph – Throughput vs Number of Nodes

The throughput of the four routing protocol is evaluated and is plotted in fig 5. The throughput of DSDV is maximum at the total number of nodes considered in the network is 10, and it gets reduced while increasing the number of nodes in the network. The overall performance of AODV is better based on it throughput comparing to the other techniques.

E. End to End delay

![Graph – Average End to End Delay vs Number of Nodes](image3)

**Figure 6.** Graph – Average End to End Delay vs Number of Nodes

The end to end delay observed from the various routing techniques is plotted in fig. 6. The DSDV technique provided better performance than the other techniques based on its average end to end delay.

F. Packets dropped

![Graph – Packets Dropped vs Number of Nodes](image4)

**Figure 7.** Graph – Packets Dropped vs Number of Nodes
The total number of packets dropped is given in fig 7. The total packets dropped by the ZRP in routing is lower than the other technique. Thus this technique can be a suitable option for the routing in MANET at lowest packet loss.

G. Jitter Sending

![Figure 8. Graph – Sending Jitter v/s Number of Nodes](image)

The sending jitter value of various routing techniques for MANET is graphically illustrated in the fig. 8. The DSDV has a high jitter at low nodes, but least jitter at more number of nodes. Hence, if there are an unusually high number of nodes, DSDV can be used, but for constant low jitter, ZRP should be preferred.

H. Jitter Receiving

![Figure 9. Graph – Receiving Jitter v/s Number of Nodes](image)

When the number of nodes is 10, AODV has the lowest jitter as compared with the rest of the protocols. But while increasing the number of nodes, the jitter of DSDV also increases. The jitter of ZRP is high when the number of nodes is less, but as the number of nodes increases the jitter of ZRP decreases gradually. DSDV has a high jitter at low nodes, but least jitter at more number of nodes. Hence, if there are an unusually high number of nodes, DSDV can be used, but for constant low jitter, ZRP should be preferred.

CONCLUSION

The routing in MANET become a challenging task. Hence many techniques were proposed in the literature. However, the performance obtained by the existing techniques are not up to the mask. Hence there is a research gap to propose a novel routing strategy for MANET. However, before proposing a new technique, it is essential to understand the complete knowledge about the operation and performance of the well-known existing techniques. Hence in this paper five most used routing strategies such as ZRP, TORA, DSR, DSDV, and AODV are described, and its performance is analyzed. The performance of these techniques depends on the number of nodes in the network. However, ZRP, DSDV and AODV are the suggested techniques to modify or enhance in the future study.

REFERENCES


