PERFORMANCE EVALUATION OF GATEWAY DISCOVERY ROUTING PROTOCOLS IN MANETS

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ABSTRACT

In this paper we had used modified Ad-hoc On Demand routing protocol(AODV) called AODV + to integrate MANET with Internet using a stationary gateway. The communication between the mobile nodes in MANET and fixed node in internet pass through the gateways. Gateway bridge up MANET and Internets. Due to the dynamic nature of MANET, the changes in topology are very frequent and the task of routing the data turn out to be a challenging. We had evaluated the performance of the key protocols AODV+ and Destination-Sequenced Distance Vector *(DSDV) by simulating them in the wired cum wireless scenario and their performance has been compared on the basis of three performance metrics : packet delivery ratio, average end-to-end delay and average throughput.*

KEYWORDS:

MANET, gateway, AODV, AODV+, DSDV, end-to-end delay, packet delivery ratio, average throughput.

1. INTRODUCTION

Mobile Ad hoc Network is collection of wireless nodes connected together through a wireless link. It is mulit-hop wireless network having nodes free to move anywhere and able to organize themselves randomly. They are independent of any pre existing infrastructure and there is no central administration in MANETS. Nodes being mobile can leave and enter the network anytime, so the topology in MANET is highly dynamic because of frequent movement of nodes. Every node in MANET acts a host as well as a router to forward the data packets to other nodes. These traits formulate the MANET as self organised and self controlled network. With the advent of technology now days we have lots of wireless portable devices such as laptops, i-phones, PDAs etc are available with us that inclined the demand for anytime connectivity forming a temporary network. The mobile nodes in MANET have limited transmission range, so the total area of coverage is often limited.

The communication between the mobile stations is only within the ad hoc boundary. Due to lack of connectivity to the others network, the users in the MANET work as an isolated group. With the growth of internet which is widely used in almost every application of our daily life made the necessity of connectivity of MANET with internet to facilitate the users to the access to the global services. This will widen the total coverage area. There has been much research done on integration of MANET with Internet during last decade. Mobile IP concept was used to provide

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the connectivity of MANET with Internet but with time the interest in Mobile IP was declined and lead to approach not based on Mobile IP. So the focus was on internet gateway along with the supporting ad hoc routing protocols. Internet gateways act as a bridge between MANET and Internet and the main task involved is this is discovery of gateway by MANET for the transfer of data to wired network particularly internet. To accomplish this task gateways that understand not only the IP suite but also the MANET protocols stack [1] are required. In figure 1 the connectivity of MANET with wired network is shown. Gateway used will operate as a bridge between wired and wireless network. All the data exchange between two networks must go by through any of the gateways. With this the restriction of MANET of limited coverage area can be overcome and the total coverage area and the application domain can be widened.

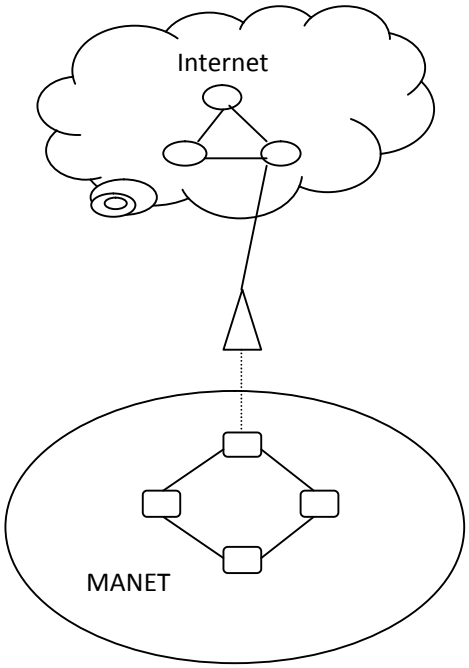

Figure 1: MANET Internet Integration

The routing in such tasks becomes a challenging task. The Internet Engineering Task Force (IETF) has projected a number of routing protocols for MANET such as Ad hoc On Demand Distance Vector (AODV), Dynamic source routing (DSR), Optimized Link state routing (OLSR) and Topology Based on Reverse Path Forwarding (TBRPF).

2. MANET ROUTING PROTOCOLS

Protocols are categorised into three basic types reactive, proactive and hybrid protocols

2.1 PROACTIVE ROUTING PROTOCOLS

Proactive routing protocols are also known as table driven protocols. Routing information of the nodes is maintained in the tables. Each node in the proactive routing protocol has such tables

containing routing information so that the data packets could be transferred to the destination. Each row in the tables contains the information about the cost of the route to be followed and the next hop for reaching a node or a subnet. As each node has table entries, it is difficult to maintain tables for each node in a large network which can cause more overhead in the tables with a large number of table entries. That is why the proactive protocols are not recommended for the large networks. Examples of such schemes are the conventional routing schemes, Destination Sequenced Distance Vector (DSDV) [2].

2.2 REACTIVE ROUTING PROTOCOLS

In reactive routing protocols the routes are created as and when required. They are also known as on-demand routing protocols. In these protocols, whenever a source node wants to send the information to a destination, the route discovery mechanisms are invoked to find the path to the required destination. The routes are created on demand by flooding the network with Route Request packets. Example of reactive routing protocol is ad hoc on-demand distance vector routing (AODV) [3].

2.3 HYBRID ROUTING PROTOCOLS

A hybrid protocol combines the features of both the proactive and reactive routing protocols. An illustration of such a protocol is the Zone Routing Protocol (ZRP). In ZRP, topology is divided into zones and look for to utilize different routing protocols within and between the zones based on the weaknesses and strengths of these protocols.

2.4. WORKING PRINCIPLE OF AD HOC ON DEMAND DISTANCE VECTOR (AODV)

AODV is on demand reactive routing protocol in which routes are created as and when required. In this protocol, the route discovery mechanisms are invoked when a source node desires to send the data to a destination, to locate the path to the required destination. The routes are produced on demand by flooding the network with Route Request packets. It employs traditional routing table. It has only one entry per destination in the routing table and sequence number is used to verify the freshness of routing information and to prevent looping. The maintenance of time-based [3] states is an important feature of AODV which means that a routing entry which is not recently used is expired. Whenever there is link failure the neighbours are notified. To find the route source create a request message and broadcast it. This broadcast message propagates [2] through the network until it reaches an intermediate node that has recent route information about the destination or until it reaches the destination Its working is based on four control messages as follows:

- Route Request Message (RREQ)
- Route Reply Message (RREP)
- Route Error Message (RERR)
- HELLO Messages.

It performs two main functions:

2.4.1 ROUTE DISCOVERY

In MANET the mobile gateway controls Route Discovery by maintaining a MANET Node List (MNL). That further checks if the destination node is located within the local network or not. With this the delay in route discovery will decrease. For an unidentified destination the MANET

node will broadcast RREQ. After receiving RREQ Mobile gateway updates MANET node list with the source IP, after that it verify the destination in the MANET node list. The source node receives the reply from destination node in MANET or from intermediate node and no reply if the destination node is unreachable [4].

2.4.2 ROUTE MAINTENANCE

RERR packet is used for maintenance of routes. Whenever an active link fails the neighbourhood nodes are notified by route error message (RERR) on that contains the IP address of each destination that has become unreachable [1]

2.5. DESTINATION- SEQUENCED DISTANCE VECTOR (DSDV)

The Destination-Sequenced Distance Vector [8] is proactive table driven routing protocol which is based on based on Bellman- Ford routing algorithm. Each node in the network maintains routing table which contains all available destinations with associated next hop towards destination, metric and destination sequence number. Sequence number presents improvement of DSDV routing protocol compared to distance vector routing, and it is used to distinguish stale routes from fresh ones and avoid formation of route loops. [10].

The routing information is distributed between the nodes by transmitting full table infrequently and minor incremental updates more often. Regular updating of routing tables is necessary in DSDV, so it is much appropriate for small network as when the network is idle it consumes battery power and little bandwidth.

3. GATEWAY DISCOVERY IN MANETS

Gateway Discovery is necessary for the mobile nodes in MANET to connect with Internet Gateway. Gateway discovery is of three types based on the registration process initiation.

3.1 PROACTIVE METHOD

In proactive approach the gateway itself initiates the gateway discovery process by broadcasting gateway advertisement message (GWADV). The nodes inside the range of the gateway accept the advertisement and generate a new route entry or renew the existing route entry in their routing table for the gateway.

3.2 REACTIVE METHOD

In reactive approach the mobile node starts looking for a gateway by broadcasting RREQ message to the IP address of group of gateways using ALL_MANET_GW_MULTICAST address. [*IETF MANET,2010}* . this message is received and replied only by the gateways. The intermediate nodes need not to reply to this message on receiving such message they just rebroadcast them. On receiving RREQ message gateways reply unicastly the source node.[1]

3.3 HYBRID METHOD

This approach is combination of both proactive and reactive approach. The gateway send GWADV messages to the nodes inside the transmission range and the nodes away from the gateway range reactively discovers the gateway by broadcasting the RREQ message.

4. INTERNET CONNECTIVITY

For the connectivity of MANET with Internet we require to modify the routing protocol. The modified AODV protocol is used called AODV+. In traditional AODV the mobile nodes initiates the route discovery process by broadcasting a RREQ message with its own IP address as the Originator IP Address field and the Destination IP address of the Internet host. When an intermediate mobile node receives a RREQ, it looks for its routing table for a route on the way to the destination, i.e., the Internet host. If there is no route, the intermediate node basically updates its routing table and rebroadcasts the RREQ message.

If a route is found, according to the AODV operation rules the intermediate station would send a RREP back to the originator of the RREQ. The source would believe that the destination is a mobile node that can be accomplished via the intermediate station. It is significant for the source node to know that the destination is an Internet host and not a mobile node because these are occasionally processed in a different way.[1][6]

AODV +

In AODV+, above problem has been solved by preventing the intermediate station to send a RREP back to the originator of the RREQ. If the destination is an Internet host instead, the intermediate station updates its routing table and rebroadcasts the received RREQ message. To determine whether the destination is an Internet host, an intermediate station consults its routing table. If the next hop address of the destination is a default route, the destination is an Internet host; otherwise, it is a mobile station or a gateway. [6]

4. SIMULATION

To evaluate the performance of two MANET routing protocols AODV+ and DSDV simulation is carried out in wired-cum-wireless scenario in NS2.33 with Linux platform.

4.1 SIMULATION SCENARIO

We had used rectangular area of 600m X 500m for simulation. We preferred rectangular area over square area to enable make sure longer routes are used among nodes. The simulation was carried using 10 mobile nodes, 2 wired nodes or hosts, 1 gateway, 1 source and was run for 60 seconds. The source starts sending data and chooses one of the hosts as destination randomly. And we had evaluated it by varying the node speed. The figure 3 shows the screenshot of simulation scenario in which green nodes marked with rings are the mobile nodes and red node is a gateway where as two blue nodes are host. In our integrated scenario we are using hierarchical routing to provide packet routing between two networks.

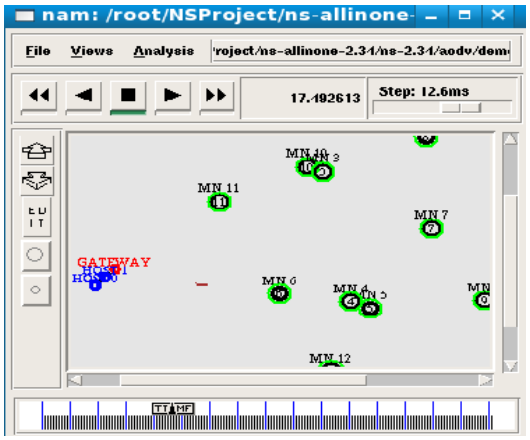

Figure 2 : Simulation Window of AODV+

In our simulation the mobile nodes moves randomly as we had chosen "random waypoint "model. We created movement pattern using setdest command by varying the node speed to five different values ranging from 0 to25 m/s. Various simulation parameters are shown in table 1.

Parameter	**Value**
Topology size	600 m X 500 m
Number of Mobile nodes	10
Number of Wired Nodes	2
Number of gateways	1
Number of sources	1
Transmission Range	250 m
Simulation time	60 s
Speed	5,10,15,20,25 m/s
Packet size	512 bytes
Mobility model	Random way point

Table 1. Simulation Parameters

4.2 PERFORMANCE METRICS

For comparison we have chosen three performance metrics:
The Packet Delivery Ratio: It is defined as the ratio of number of packets received to the total number of packet generated.

The Average end-to-end delay: It's defined as time taken by a packet to reach from source to destination that is the time the packet is received minus the time it was generated at source.
The Average Throughput: It is defined as average number of packets successfully delivered per unit time i.e the average number of bits delivered per second.

4.3 Result And Discussion

In this section the performance of AODV+ has been compared with that of DSDV based on three performance metrics: Packet delivery ratio, average end-to-end delay and average throughput by varying the speed of nodes.

4.3.1 Packet Delivery Ratio Vs Speed

It is observed that the packet delivery ratio of both the protocols decreases as the speed of nodes increases as shown in the figure 3. This is mainly because with the increase in the mobility of the nodes, more link failures occurred which leads to the increase in packet drop rate. AODV+ performs better than DSDV because of efficient gateway discovery in AODV+ but in case of DSDV gateway discovery becomes complex with the increase in the mobility of nodes.

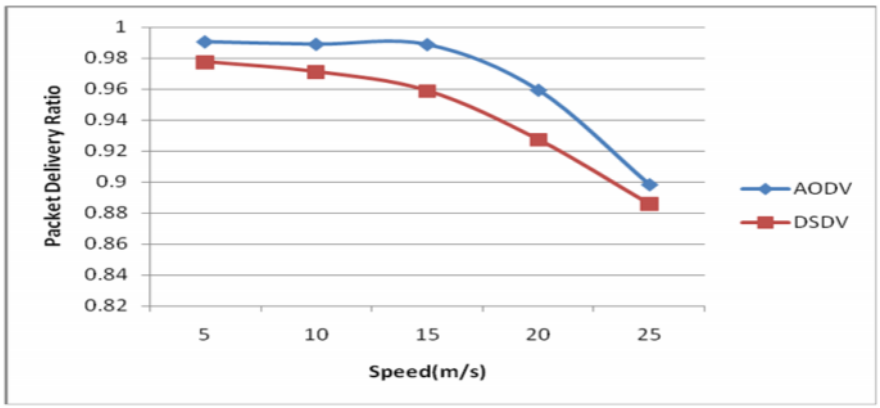

Figure:3 Graph for Packet Delivery Ratio Vs speed of nodes

4.3.2 Average Throughput Vs Speed

From the graph shown in figure 4, it is analyzed that the average throughput of both the protocols decreases as mobility of nodes increases. The performance of AODV + is better than DSDV because as the next hop is found in AODV + it immediately transfer the bits to the destination while in case of DSDV, more time is spent in updating the routes in the routing table.

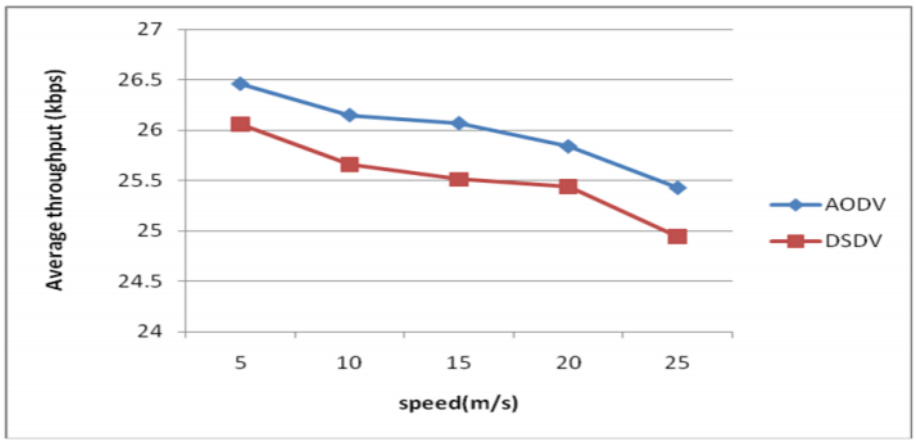

Figure 4: Graph for Average throughput Vs speed of nodes

4.3.3 AVERAGE END-TO –END DELAY VS SPEED

It is clear from the graph shown in figure 5 that the Average end-to end delay increases in both AODV+ and DSDV gradually as the speed increases. This happens because the route determination becomes a challenging task as the mobility increases. It becomes difficult for the nodes to find out the next hop address and which leads to delay in delivering a packet at destination. Here DSDV performs better than AODV+ because AODV+ being a reactive routing protocol creates routes on demand which leads to delay as compared to the table driven proactive routing protocol DSDV which has an updated routing table.

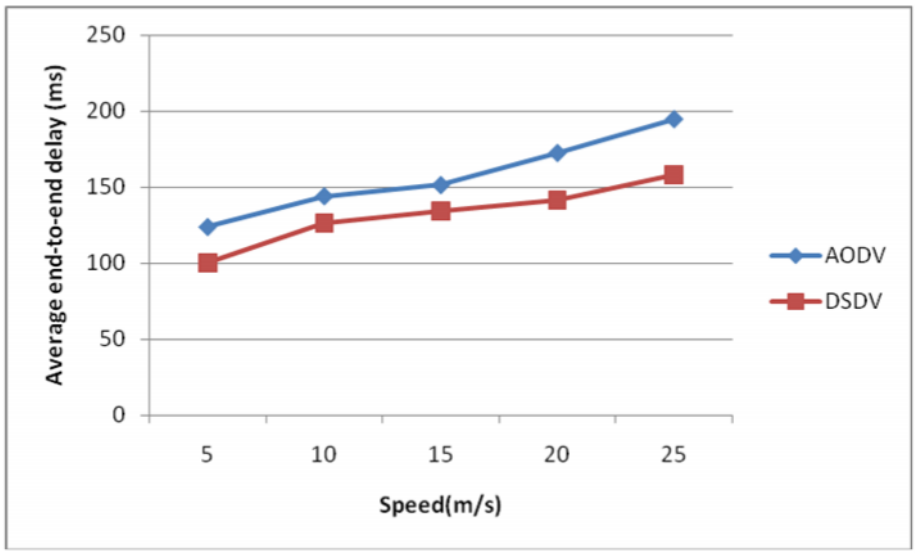

Figure 5: Graph for Average end-to-end Delay Vs speed of nodes

5. CONCLUSION

In this paper we had considered the connectivity of Internet with MANET using stationary gateway. We compared two key protocols AODV+ a reactive and DSDV a proactive routing protocol in wired-cum-wireless scenario in other words we can say in integrated MANET Internet network by varying the node speed. The AODV + showed better performance in different mobility scenario as compared to DSDV in terms of packet delivery ratio and average throughput. Average end-to-end delay is more delay in AODV+. But overall AODV + outperformed in maintaining the connection. The proactive routing protocol DSDV performance is quite good but is not appropriate in large network.

REFERENCES

[1] Hossam el-Moshrify,M.A Mangoud and M.rizk," Gateway Discovery in Ad hoc On-Demand Distance Vector (AODV) Routing for Internet Connectivity", 24th National Radio science conference(NRSC 2007).

[2] S. A. Ade& P.A.Tijare "Performance Comparison of AODV, DSDV, OLSR and DSR", International Journal of Information Technology and Knowledge Management July-December 2010.

[3] Mohammed Bouhorma, H. Bentaouit and A.Boudhir, "Performance Comparison of Ad-hoc Routing Protocols AODV and DSR ", 2009 IEEE.

[4] Lu Bo; Yu Bin; Sun Bin "Adaptive Discovery of Internet Gateways in Mobile Ad Hoc Networks"Sept 2009.

[5] "The Network Simulator: Contributed Code". www.isi.edu/nsnam/ns/ns-contributed.html

[6] Ali Hamidian, Ulf Körner and Anders Nilsson, Performance of Internet Access Solutions in Mobile Ad Hoc Networks, Dagstuhl-Workshop ".

[7] M. Bernard. "Gateway Detection and Selection for Wireless Multihop Internet Access". Olching, Germany, Master's thesis, May 2002.

[8] C. E. Perkins and P. Begat, "Highly Dynamic Destination- Sequenced Distance-Vector Routing (DSDV) for Mobile Computers," Proceedings of the ACM SIGCOMM'94 Conference on communications Architectures, Protocols,and Applications, London, United Kingdom, August 1994, pp. 234-244.

[9] EIT,Ali Hamidian, Research www.eit.lth.se

[10] Sabina Barakovi, Jasmina Barakovi,"Comparative Performance Evaluation of Mobile Ad hoc Routing Protocols" MIPRO 2010, May 24-28, 2010, Opatija, Croatia.

[11] S.Tamilarasan and P.A.Abdul saleem, "Performance Analysis and Comparison of Different Routing Protocols in MANET", IJCSNS International Journal of Computer Science and Network Security, VOL.11 No.6, June 2011.

[12] Kapil Suchdeo, Durgesh Kumar Mishra" Comparison of On-Demand Routing Protocols", 2010 Fourth Asia International Conference on Mathematical/Analytical Modelling and Computer Simulation.

[13] Shima Mohseni, Rosilah Hassan, Ahmed Patel, and Rozilawati Razali "Comparative Review Study of Reactive and Proactive Routing Protocols in MANETs", 4th IEEE International Conference on Digital Ecosystems and Technologies (IEEE DEST 2010).

[14] Internet Engineering Task Force, MANET working group charter. Available from: IETF MANET group Character Sector , Jan. 2010.

[15] LU Bo,YU Bin,SUN Bin ,"Adaptive Discovery of Internet Gateways in Mobile Ad Hoc Networks" 2009 5th international conference.

[16] Shahid Md. Asif Iqbal, Md. Humayun Kabir,"An Improved Internet Gateway Discovery and Selection cheme in Mobile Ad Hoc Network", 6th International Conference on Electrical and Computer Engineering ICECE 2010, 18-20 December 2010, Dhaka, Bangladesh.

[17] Prashant Ratanchandani and Robin Kravets,"A Hybrid Approach to Internet Connectivity for Mobile Ad Hoc Networks ", 2003 IEEE.

[18] A. J. Yuste, A. Triviño, F.D. Trujillo, E. Casilari, "Improved Scheme for Adaptive Gateway Discovery in Hybrid MANET", 2010 IEEE 30th International Conference on Distributed Computing Systems Workshops.
[19] Wang Ningning Cao Yewen ,"An Improved AODV Protocol with Lower Route Cost and Smaller Delay – PWAODV", 2011 Fourth International Conference on Intelligent Computation Technology and Automation.
[20] G. Karthiga, J.Benitha Christinal, Jeban Chandir Moses "Performance Analysis of Various Ad-Hoc Routing Protocols in Multicast Environment", IJCST Vol. 2, Iss ue 1, March 2011.
[21] Md. Arafatur Rahman and Farhat Anwar, "A Simulation Based Performance Comparison of Routing Protocol on Mobile Ad-hoc Network (Proactive, Reactive and Hybrid)", International Conference on Computer and Communication Engineering (ICCCE 2010), 11-13 May 2010, Kuala Lumpur, Malaysia.
[22] Asma Tuteja, Rajneesh Gujral, Sunil Thalia" Comparative Performance Analysis of DSDV, AODV and DSR Routing Protocols in MANET using NS2", 2010 International Conference on Advances in Computer Engineering.
[23] Yi Fu"t, Kwang-Mien Chan, Kean-Soon Tan and Boon-Sain YeO" Multi-Metric Gateway Discovery for MANET" 2006 IEEE