Volume 4, Issue 11, November 2014 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

A Comparative Study of the Various Routing Protocols in Mobile Ad-Hoc Networks Using OPNET Simulator

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Abstract— Mobile Ad-hoc Networks (MANET) is type of Network which built up spontaneously whenever communicating devices come into range .due to high mobility of nodes link breakage occurs frequently, Nodes In a network service as host as well as a router . MANET does not have any fixed infrastructure and inanity of central management. In spite of all these features MANET utilize under various critical condition like rescue operation and disasters condition where easy and quick setup of communication is required. In this paper we are presenting comparative study of the various MANET routing protocols i.e. AODV, DSR, OLSR, ,GRP and TORA. In simulations analysis we are using OPNET modeler[9] and opting various performance parameter such as packet delivery ratio , throughput , end to end delay etc.

Keywords— Ad-hoc networks, MANET's, AODV, DSR, OLSR, GRP and TORA.

I. INTRODUCTION

Mobile Ad-hoc networks are made up of nodes which are mobile in nature, Their network topology is not fixed and change over time, so need to support dynamic routing protocol [1].The bandwidth is limited in case of Ad-hoc networks. Routing is a prominent operation of MANET because it decides how many nodes will transfer the packets to the intended destination via different nodes. MANET is rapidly deployable self configuring network. It can be standalone network or can be connected to internet also. Routing protocol in MANET classified into three broad categories namely proactive, reactive and hybrid. Proactive routing also termed as table driven protocols, maintains routing table at all the time, Each and every node in a network maintains routing table regarding all nodes under communication. Nodes collects routing information through network updates that can be changed over time .Reactive protocols that consists of nodes that build routing table whenever commutation needed. Hybrid routing protocol combines the features of both Reactive and Proactive routing protocols. The applications of MANET include Military scenarios, Sensor networks, Rescue operations, Students on campus, Free Internet connection sharing, Conferences etc.

II. CARACTERISTICS OF MANET

The following features highlight the characteristics of MANETs:

A. Dynamic topology

The topology of the MANETs is ever changing. Nodes continuously move from one location to other creates a dynamic configuration in the network.

B. Bandwidth constraints

The mobile nodes in MANET depend upon the radio transmission range which is comparatively lower than to the well established conventional computers and systems.

C. Energy operation

The nodes in MANET are battery driven for their operation. Hence it is an significant parameter to consider.

D. Limited security

There are many possible attacks like eavesdropping, spoofing and denial of service attacks (DOS) on MANETs . The physical security is lower in mobile operating environment.

E. Unpredictable links

Due the high mobility of the nodes in the network, the links are highly unpredictable by nature.

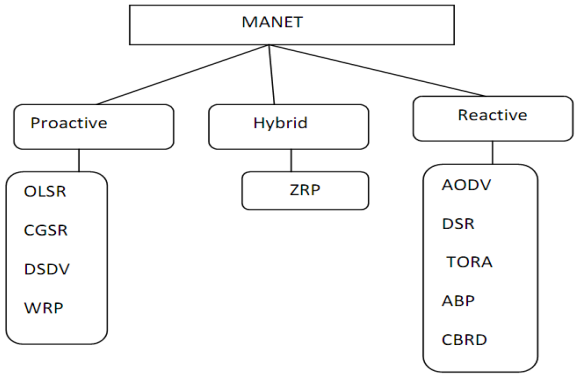

Fig 1: Classification of the Ad-hoc routing protocols

III. DESCRIPTION OF THE ROUTING PROTOCOLS

DSR (DYANAMIC SOURCE ROUTING): It is based on link state algorithm[2]. DSR is reactive routing protocol and it has less overhead in their routing. DSR routing Protocol is consists of two essential parts of route discovery and route maintenance. Source node maintains a replica of sent messages in its send buffer. Packets may be dropped if send buffer is full or the time out for route discovery happens. Whenever a destination node or the intermediate nodes having route to destination receives the route request message(RREQ), it generates route reply(RREP) to intended node.DSR is not applicable to large networks and packet Size grows with length of the route due to source routing.

AODV **(**AD-HOC ON DEMAND DISTANCE VECTOR**)**: It is a table driven, reactive routing protocol that collect routing information when communication started. Route discovery is done by Route Request (RREQ) messages Buy broadcasting it to network. The message through the network until it reaches to desired destination or a node knows fresh enough route to destination. Sequence numbers are used to guarantee loop free routing. The destination node uni-casts a Route Reply (RREP) back to the source node, Nodes that are transmitting a RREP message update their routing table.

OLSR (OPTIMIZED LINK STATE ROUTING): it is a proactive, link-state routing protocol that establish best route by determining various factors like delay, link load and bandwidth etc. In OLSR [5] periodic message has been broadcast over the network for route determination. Link-state routes are much stable, reliable and accurate in determining best route and more complex than hop count mechanism. Multipoint relays are used for Route calculations and provide facilitates to flooding of control message in the network to form the route from a source node to any destination in the network. The OLSR protocol has capability to work independently from other protocols. Furthermore OLSR contains essential elements such as neighbor sensing mechanism used for flooding of control traffic in network; it is a determination method of how to select diffuse-sufficient topological information in the network in order to prove optimal route selection in MANET.
TORA (Temporary Ordered Routing Algorithm): it is a efficient, highly adaptive and scalable distributed routing protocol based on the concept of link reversal. TORA [5] is proposed for the dynamic mobile network, multi-hop wireless networks. It is a source-initiated table driven routing protocol. TORA finds multiple routes between source node and destination node for frequent communication. The main feature of TORA is that the control messages can be localized to a small set of nodes when there is rapid topological change in network. To fulfill that task nodes maintain routing information about neighbor nodes. OLSR utilize three control messages:

- Route Creation.
- Route Maintenance.
- Route Erasure.

GRP (GATEWAY ROUTING PROTOCOL): it is a Distance vector routing protocol represent routes as function of distance and direction vectors, the distance factor is represented as hop count and direction is represented by link interface. Bellman- Ford algorithm is used for the path calculation where router takes the position of the vertices and the links For each node in a network. a specific distance vector table is maintained for all the router connected in the network. The distance vector is a pair of destination ID, shortest distance nodes present in network. every node broadcasts a distance vector to its neighbor and provide information about the available shortest routes within network . Each router depends on its adjacent for collecting the routing information. All routers are equally responsible for exchanging the distance vector in network. When a router in the network receives the advertisement from neighbor regarding lowest cost for particular path, it followed by add this information to the routing table storage. In distance vector routing protocol routers doesn't know the information about entire path. The router only knows the information about the direction and the interface where the packet will be forwarded.

IV. LITERATURE SURVEY

Tariq A et.al (2013) [3] have studied various routing protocols AODV, DSR, DSDV, RAODV, AOMDV, and TORA and evaluate their performance. NS- 2.34 is used to evaluate the relative performance of the routing protocols varying network traffic load and pause time. Reza Malekian et.al (2013) [4] have reviewed two routing protocols in mobile ad hoc

networks i.e., AODV and OLSR and then compare them in terms of performance. This concludes that the OLSR enhances the end-to-end delay at least 22% in comparison with AODV. B.A.S Roopa Devi et.al(2013)[5]have studied the features of ad hoc routing protocols such as OLSR, AODV and TORA based on the various performance metrics like packet delivery ratio, routing overload and end–to–end delay by increasing number of nodes in the network. Thriveni H.B et.al (2013) [6] have studied and analyzed the impact of variations in node velocity and node density combined with the choice of routing protocol, on network performance. P.Kuppusamy et.al(2011)[7] have showed the characteristics of ad-hoc routing protocols AODV, TORA and OLSR based on the performance parameters like routing overload, end–to–end delay, packet delivery ratio(PDR). Puneet Dadral et.al (2012)[8] evaluate the performance of MANET reactive routing protocols namely DSR ,AODV and TORA.

V. SIMULATION AND RESULTS

In this paper simulation is carried out by using OPNET Modeler 14.5. The comparative study show differences in performance between considered routing protocols, Simulation is carried on 30 nodes for FTP application. total simulation time is taken as 10 minutes. the traffic is VOIP mode, the data transmission rate is 11 Mbps and random way point mobility pattern has been used .Random waypoint is most widely accepted mobility model in MANET ,wherea node can choosee their destination randomly . The performance of the simulated results is analysed under different performance metrics such as throughput, delay, data dropped, network load and delay of Given network depicts in figure ffigures 3,4,5,6and ,7.

A. Throughput

The Throughput for different priority levels shows how well the QoS schemes can provide service differentiation between the various priorities. The Throughput of all nodes shows the utilization of the wireless medium. It is clearly mentioned (Figure 3) in given scenario throughput of OLSR is higher followed by AODV and TORA

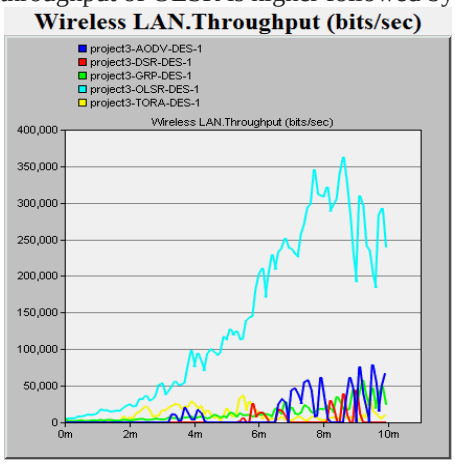

Fig 3: Throughput comparisons (bits/sec)

B. Media Access Delay

We measure media access delay (Figure 3) as the time from when the data reaches the MAC layer until it is successfully transmitted out on the wireless medium. it is visible that media access delay of AODV is minimum among all followed by OLSR and TORA.

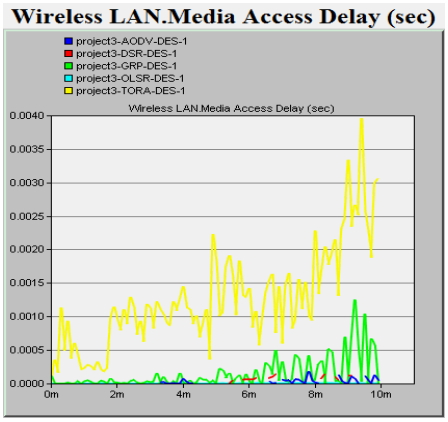

Fig 4: Media access Delay (second)

C. Data Dropped

Data Dropped define as unavailability of access to medium of communication. This factor greatly affects the reliability of WLAN. During the simulation duration of 10 minute (Figure 5) data dropped of TORA is maximum followed by GRP. AODV, DSR and OLSR are not showing any data packet dropped during simulation span.

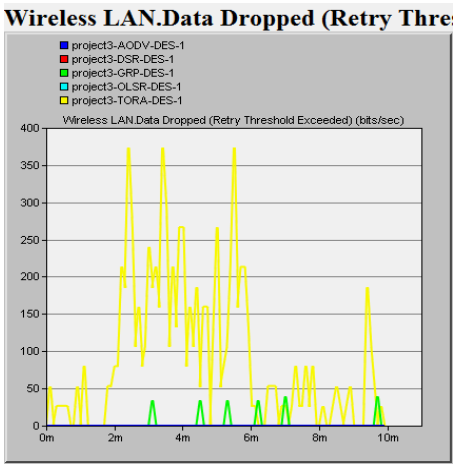

Fig 5: Data Dropped (bits/sec)

D. Network Load

The comparative study of MANET routing protocol with reference to network load in given scenario is shown in Figure 6. Based on wireless LAN load, Networks load represents the total load bit/sec submitted to wireless LAN layer, when there is more traffic entering into the network, it is difficult for the network nodes to handle all this traffic in order to increase the performance of network. Figure 5 shows that, network load of OLSR is higher among All followed by TORA, AODV,GRP then DSR.

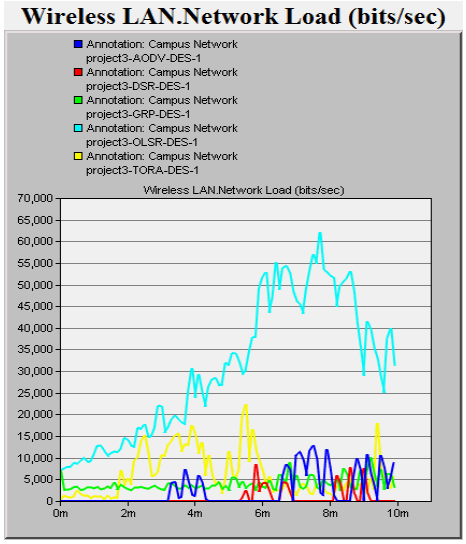

Fig 6: Network Load(bits/sec)

E. LAN Delay

The LAN delay of network with references to 30 node for given scenario is shown in figure 7. By analyzing th graph we found that delay of AODV is minimum followed by TORA,GRP and TORA. it is observed that continuous delay is shown by TORA and GRP .

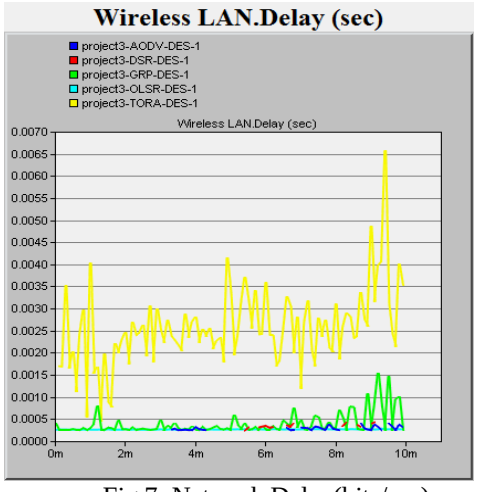

Fig 7: Network Delay(bits/sec)

VI. CONCLUSIONS

In this paper, the performance of the five prominent MANET Routing protocols termed as GRP,OLSR,TORA, AODV and DSR was analyzed using OPNET Simulator. We have done comprehensive simulation study on Throughput, Media Access Delay, Data Dropped ,Network load and wireless LAN Delay. Media Access Delay of AODV is minimum among all followed by OLSR and TORA. OLSR performs best among all in terms of load handling and throughput of network.GRP performs best in terms of delay and routing overhead. TORA is the worst choice when we consider any performance parameters . In summary, we can say that OLSR is best as compared to GRP and TORA in all traffic volumes since it has maximum throughput

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