A Comparative Study Of Different Ad-Hoc Routing Protocols Based On Qualitative Parameters

Tushar Saxena
M.Tech 1st Year
Dept. of Telecommunication Systems Engineering,
AITTM, Amity University, Noida, India

Nandini Deb
M.Tech 1st Year
Dept. of Telecommunication Systems Engineering
AITTM, Amity University, Noida, India

Abstract: **Mobile ad hoc networks (MANET) are self configuring, infrastructure less networks where the participating nodes are working as host as well as routers. Because of the absence of central infrastructure and mobility of nodes selection of a routing protocol has become a great issue. IETF MANET group has given certain qualitative parameters in order to select a protocol. These parameters define the inhibited characteristics of a protocol. Through this paper we are explaining different protocols and comparing them on these qualitative parameters.**
Index Terms: **MANETs, AODV, DSR, OLSR, ZRP**

I. INTRODUCTION

MANET stands for Mobile Ad hoc Network where nodes are mobile and no central infrastructure is present. Because of dynamic nature of network nodes, there is no fixed topology in the network and its changing continuously with time. Over the time MANET are becoming popular as they have got many important application like rescue operations, military combat operations, vehicular ad hoc networks etc., because of dynamic topologies, routing has become an important issue with this network and selection of appropriate routing protocol is thus more important. There are different protocols we are using in MANET and several research works has been done in the past regarding which one is good and which one is not. The IETF MANET group has given qualitative and quantitative parameters to select and judge the performance of these protocols [1]. In this survey we are comparing the mentioned protocols under the qualitative parameters as a part of the ongoing research work. The routing protocols are classified as proactive, reactive and hybrid protocols.

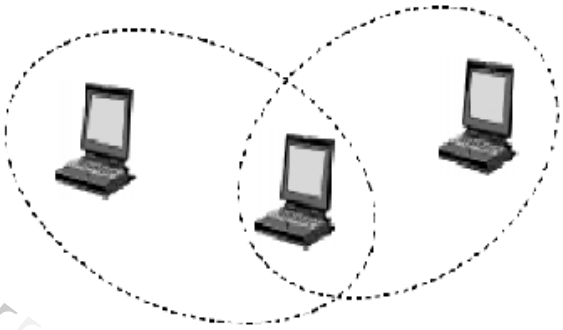

Figure1. Example of Ad-hoc Network [2]

II. PRO ACTIVE PROTOCOLS

These are also known as table driven protocol and actively determine the layout of the network. In this the nodes are constantly keep on exchanging network topology packets which presents the actual picture of the network at every single node. This make them ready with the route at any instant and it's their biggest advantage against the time critical traffic where the minimal delay is required. With the advantage this also brings certain disadvantages as well. When the nodes are mobile, there are many routes having very minute time to live and at a moment they are available and second moment they are gone. This increases the traffic overhead and reduces the throughput [3]. Also because of continuous exchange of network topology packets, these protocols also need much power as well. The pro-active protocol we are considering in this survey is OLSR protocol.

III. REACTIVE PROTOCOLS

The reactive protocols are designed with the goal to save the power which was excessively used earlier in pro active protocols. In this design of protocol it discovers the route on the fly. Whenever a node need to communicate with the other node, the sending node initiates a process called as route discover process in which it broadcast route request to its adjacent nodes and they will further continue and determine the route from the sending node to the destination. The premier advantages of Reactive protocols are that they are bandwidth efficient. As the routes are created on demand only, there is much traffic overhead unlike their pro active counterpart. The disadvantage with this technique is the delay. These protocols are not as good as pro active protocols for time critical information [4]. The different protocols were considering under this study are AODV, and DSR protocols

IV. HYBRID PROTOCOLS

There are some advantages and some disadvantages with both the classes of protocols and they work almost opposite to eh other. Hybrid protocols were invented to find the balance between the two. They use the characteristic of both. It divides the entire network in two zones [5]. Every node has its local zone where they use pro active routing and outside their zone, they use reactive routing. In this survey, we are presenting ZRP protocol.

V. A COMPREHENSIVE STUDY OF OLSR, AODV, DSR & ZRP.

A. OLSR-A PROACTIVE ROUTING PROTOCOL

Optimized Link state routing protocol developed for MANETs is a table driven proactive link-state routing protocol which uses HELLO and topology control(TC) messages to find and then give out link state information throughout the MANET. This topology information is used by individual nodes to compute next hop destinations to other nodes in the network using shortest hop forwarding packets. It permanently stores and updates its routing table. All nodes in network do not broadcast route packets, only Multipoint Relay (MPR) nodes broadcast them. Each node in the network keeps a list of MPR nodes. Nodes residing in the network send HELLO messages (these messages contain all the neighbor information) to their neighbors using OLSR which computes the link status and determines the MPR selector [7]. A node chooses least number of MPR

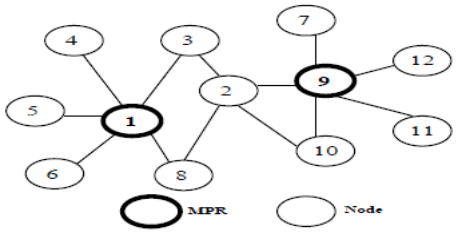

Figure2. MPR broadcast in OLSR [6]

Nodes, when symmetric connections (2 way interchange) are established. It broadcasts TC messages with link status information at predetermined TC interval. OLSR gives optimal routes in terms of number of hops and is suitable for large, dense networks.

B. AODV- A REACTIVE ROUTING PROTOCOL

AODV is developed in Nokia Research Centre of University of California, Santa Barabara and University of Cincinnati jointly by C. Perkins and S.das. it is an On demand and distance vector routing protocol which means that a route is established by AODV only when required[8]. It is a table driven protocol which basically works with 3 types of messages: Route Request (RREQ), Route Reply(RREP) and Route Errors(RRERs).

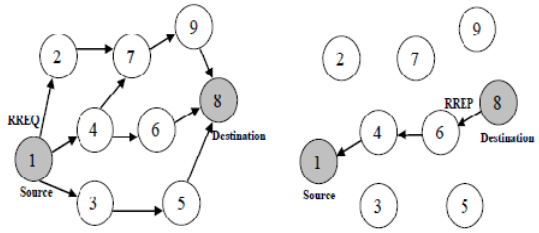

Figure3. Route setup in AODV [6]

When a node requires a route to another node, it broadcasts its RREQ messages to its neighborhood and the nodes receiving this RREQ will broadcasts to their neighbors and the process keeps going on until it reaches the destination node. Every RREQ packet has a time to live and if there is no reply in that period then a retransmission occurs. When RREP reaches the destination node or the node having a valid path to the destination, it sends a unicast message RREP. RREP are unicast because every node broadcasting a RREQ caches a route back to the

originator. Nodes monitor the link status of the route. If any route has been missing or breaks, the RRER message is use to inform other nodes regarding the loss of link [9]. To enable this mechanism, each node contains the list of its precursors. Node having the IP address of its neighbors which are expecting the next hop.

C. DSR-A REACTIVE ROUTING PROTOCOL

DSR when compared to other reactive protocols like AODV and DSDV has better performance in terms of mobility, packet dropping rate (PDR), delay, throughput and less network load. Like AODV, DSR is also an on demand routing protocol. DSR has two mechanisms: Route Discovery: It regularly updates its route cache for easier routes available. If found, the packet is directed by the node to that route. When a node wants to send a message to a specific destination, it broadcasts the repeat request (RREQ) packet in the network. The neighbor nodes on receiving this RREQ add their own address to it and again re-broadcast it to the network. Each node keeps its route cache maintained with memory of discovered route. The node will examine its route cache for desired destination before re-broadcasting RREQ. Thus memory overhead is reduced to a great level by maintaining Route Cache at every node. If a node is found with a roué cache containing the route to the destination, it will not rebroadcast RREQ to whole network, instead it will forward RREQ only to destination node. Destination Route in return will send a RREP packet to sender having the complete route information. Route Maintenance: Two types of messages are used for route maintenance: Route Error (RERR) and Acknowledgement (ACK) [10]. If message is successfully delivered to the destination, it sends an ACK to the sender. If there is any problem, source receives a RERR packet to reinitiate a new route discovery, thus deleting the last routing entries.

D. ZRP-A HYBRID ROUTING PROTOCOL

Zone Routing Protocol (ZRP) is a distributed, hybrid routing protocol developed by Haas, Z.J., Pearlman, M.R. and Samar, P. in 2003.This protocol uses the approach of both proactive protocol and reactive protocols. ZRP consists of 3 main parts: Intrazone Routing protocol (IARP), Interzone Routing Protocol (IERP) and bordercast routing protocol (BRP). The IARP is responsible for finding any available route within the node's internal zone. IARP is the proactive approach used for ZRP and a route from source to destination within the internal zone is always available [11]. IERP is the reactive part of the ZRP which works on to find the route outside the node's internal zone.

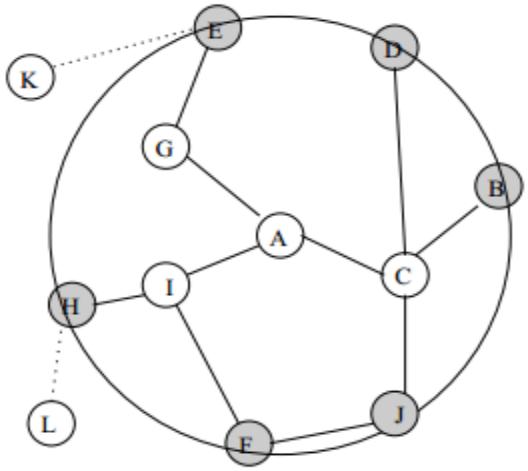

Figure4. Intrazone and interzone in ZRP [12]

IARP Protocol in ZRP is used to communicate with its interior node within a node's range. This protocol is set to behave pro actively as the nodes closer to a sending node, have much larger impact of the mobility regarding its topology. So in-order to have proper and fastest route for intrazone, this field is kept Proactive. These nodes update the routing information by local route optimization through the removal of redundant routes and shortening of routes when a route with less number of hop is found. It is also known as ``limited scope pro-active routing protocol' '[13]. IERP works outside this local domain of a node. It takes the advantage of known local routes and establishes a communication with the nodes of other zones. Border cast routing protocol (BRP) reduces the redundant queries and maximizes the efficiency by directing the route requests initiated by IERP to the peripheral nodes. It uses IARP and creates a bordercast tree [14]. BRP is not acting as a routing protocol but as a packet delivery service and also keeps a track of which node's query has been delivered so that it can be updated on the border cast tree.

VI. QUALITATIVE PARAMETERS

A. Security

MANETs are exposed to different type of attacks as there is no security at network and link level. They can easily be attacked by snooping attacks, packet retransmissions attacks, manipulate packet headers and redirect routing messages. A routing protocol is always desired to possess some security or support some security measures so that there vulnerabilities can be addressed [14].

B. Loop Freedom

Mostly protocols calculate their routing information through bellman ford's algorithm. In the environment like MANET the bandwidth constraint is very high. There should be no looping around a certain node while calculating or maintaining a routing table. As the network has high probability of collision, a protocol thus avoids the looping of packets to save time and bandwidth both [15].

C. Unidirectional Link Support

Many algorithms are designed to work with bidirectional links and they do not work properly with unidirectional links. At times required numbers of duplex links are available and hence unidirectional links has got limited value but the time when the pair of unidirectional links available to connect the two MANET regions which may look like bi directional link, there the ability to use them is valuable[16].

D. Sleep

MANET has got a limited power source for their operations and they usually work with little batteries. A protocol should be able to operate when some of the nodes are inactive and not taking part in sending and receiving for arbitrary time periods in order to conserve their energy. A protocol should work in such conditions without affecting its performance [17].

E. Multicasting

While transmitting the real time data link multimedia data, it is necessary to multicast the data through different nodes and a protocol used in MANETs should possess this property according to the requirement of the network.

F. Routing Scheme

It indicates the scheme of routing whether the protocols works on flat routing or hierarchical routing [18].

G. Routing Metric

Routing Metric provides the path defining how the nodes are connected to each other and sending or receiving the packets [19].

VII. COMPARISION

The various qualitative parameters are compared below in the table.

Parameters	OLSR	AODV	DSR	ZRP
Loop Free	Yes	Yes	Yes	Yes
Security	No	No	No	No
Unidirectional Link Support	Yes	No	Yes	Yes
Sleep Mode	Yes	No	No	Partially
Multicasting	No	Yes	No	Partially
Routing Scheme	Flat	Flat	Flat	Flat and Hierarchical
Routing Metric	Shortest Distance	Shortest Path	Shortest Path	Shortest Path locally
Nodes with Special Task	Yes	No	No	No

Table1. Comparison Chart

VIII. CONCLUSION

The different protocols are studied and they are compared according to the qualitative parameters mentioned above. There are certain characteristics available with some protocols and they have some advantages and disadvantages. The use of a protocol may vary from application to application of MANETs but in most of the scenarios. Hybrid approach (ZRP) is better as it also provides some sense of limited sleep mode working when it uses OLSR as its IARP. The comparison of their performance characteristic involves comparison with quantitative approach which is left with the scope of further research and evaluation.

IX. REFERENCES

[1] S. Corson and J. Macker, "*Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations*", RFC 2501, January 1999.

[2] Tony Larsen, Nicklas headman "*Routing protocols in wireless ad-hoc networks*" Master's thesis, Switchlab Ericsson, 1998.

[3] E.M. Royer, C-K. Toh, "*A Review of Current Routing Protocols for Ad-Hoc Mobile Wireless Networks*", IEEE Personal Communications Magazine, April 1999, pp. 46-55.

[4] L.M. Feeney: "*A Taxonomy for Routing Protocols in Mobile Ad Hoc Networks*", SICS Technical Report T99/07, October 1999.

[5] G.Vijaya Kumar, Y.Vasudeva Reddyr, Dr.M.Nagendra "*Current Research Work on Routing Protocols for MANET: A Literature Survey*" International Journal on Computer Science and Engineering Vol. 02, No. 03, 2010, pg 706-713.

[6] P.Kuppusamy, Dr.K.Thirunavukkarasu, Dr.B.Kalaavathi, "*A Study and Comparison of OLSR, AODV and TORA Routing Protocols in Ad Hoc Networks*", 2011 IEEE.

[7] T. Clausen and P. Jacquet, "*Optimized Link State Routing Protocol (OLSR)*", RFC 3626, October 2003.

[8] Rendong Bai and Mukesh Singhal "*DOA: DSR over AODV Routing for Mobile Ad Hoc Networks*" IEEE Transactions on Mobile Computing, vol. 5, no. 10, october 2006, pg 1403-1416.

[9] Geetha Jayakumar and Gopinath Ganapathy, "*Performance comparison of Mobile Ad-hoc Network Routing Protocol*," International Journal of Computer Science and Network Security (JJCSNS 2007), vol. VII, no.I I, pp. 77-84, November 2007.

[10] Z. Chang, G. Gaydadjiev, and S. Vassiliadis, "*Routing protocols for mobile ad hoc networks: Current development and evaluation,*" 2005.

[11] Zygmunt J. Haas, Marc R. Pearlman,Prince Samar, " *The Zone Routing Protocol (ZRP) for Ad Hoc Networks*," draft-ietf-manetzone-zrp-04.txt, July 2002.

[12] Jan Schaumann "*Analysis of the Zone Routing Protocol*", December 8, 2002.

[13] Zygmunt J. Haas, Marc R. Pearlman,Prince Samar, "*The Intrazone Routing Protocol (IARP) for Ad Hoc Networks*," draftietf-manet-zone- iarp-01.txt, June 2001.

[14] Zygmunt J. Haas, Marc R. Pearlman,Prince Samar, "*The Interzone Routing Protocol (IERP) for Ad Hoc Networks*," draftietf-manet-zone- ierp 02.txt July 2002.

[15] Patil V.P. "*Qualitative and Quantitative Performance Evaluation of Adhoc on Demannd Routing Protocol in Manet*" IOSR Journal of Electronics and Communication Engineering, Volume 2, Issue 5 (Sep-Oct 2012), PP 34-42.

[16] George Adam, Vaggelis Kapoulas, Christos Bouras, Georgios Kioumourtzis "*Performance Evaluation of Routing Protocols for multimedia transmission over Mobile Ad hoc Networks*", 4th Joint *IFIP* Wireless and Mobile Networking Conference, IEEE 2011.

[17] Hrituparna Paul , Dr. Prodipto Das "*Performance Evaluation of MANET Routing Protocols*", International Journal of Computer Science Issues, Vol. 9, Issue 4, No 2, July 2012, pg 449-556.

[18] Parma Nand, Dr. S.C. Sharma "*Comparative study and Performance Analysis of FSR, ZRP and AODV Routing Protocols for MANET*" International Journal of Computer Applications, 2011, pg 13-19.

[19] Suresh Kumar and Jogendra Kumar "*Comparative Analysis of Proactive and reactive Routing protocols in Mobile Ad-Hoc Networks (MANET)*" Journal of Information and Operations Management, Volume 3, Issue 1, 2012, pp-92-95.