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Pro-Active Routing Protocols in MANETs: A Comparative Study with Hybrid Routing Protocols

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Abstract

Mobile ad hoc networks (MANETs) are one of the popular wireless networks for communication between various devices. From last few years, MANETs have gained huge popularity in wireless communication and researchers from all over the world used to work on different aspects of MANETs. MANET are infrastructure less networks system containing nodes having higher mobility like laptops and these interface without the need of infrastructure like routers and bridges. The various aspects like routing, synchronization, consumption of power, bandwidth consumption will be considered by the researchers. This paper deals with various pro-active routing protocols in MANETs and how each of these routing protocols are different from one another with in terms of applications and how they contribute to the topology of dynamic nature in ad hoc networks. The various protocols used for routing made it hard to find the protocol is best fit pertaining to various network conditions. The simulation analysis for routing protocols was done in NS2. This paper gives overview of various pro-active protocols for routing and it's comparison with hybrid routing protocols on the basis of various routing parameters.

Keywords: *Routing, Protocol, Pro-Active, Dynamic Topology, MANETs*

1. Introduction

The nodes in MANETs moves from one place to another, design of communication and networking protocols for these kinds of networks is one of the very challenging issues. Based on the technology, these networks are again divided into three generations. The 1st generation networks are called Packet Radio Networks which were developed in 1972. The 2nd generation networks aimed to modify the previous design for achieving reliability. Technologies like Bluetooth were developed under 3rd generation. MANETs have high demand in places where establishing the infra-structured networks was not applicable. As these networks are infrastructure less, they are used in various industrial, commercial applications, collaborative computing. Base stations are not required in ad hoc networks, whereas in cellular networks base stations are needed. The major important aspects of communication are designing the protocols for routing which maintain and establish

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routes and permit transfer of data among the devices [1]. Significant amount of work was completed in MANETs, and plenty of protocols for routing have designed from past few years. These ad hoc networks support the applications having huge demand such as video and audio processing. These applications need the network to provide Quality of Service (QoS) [2]. Few researchers are active in providing the QoS in MANETs and they have introduced so many Quality of Service protocols for routing. Few of them give QoS for path link as the prediction of the availability of the link will optimize the routing protocols service.

2. Literature Survey

The performance comparison of proactive and reactive protocols like DSDV and in ad hoc networks was done by *Deepak[1]*. While nodes having high mobility rate, the highest packet delivery ratio is achieved by AODV protocol with 85% efficiency whereas DSDV has very low packet delivery ratio but the performance of DSDV is comparatively better than AODV with more number of nodes. The average delay for DSDV is very less as it does not need to start route requests, but delay is more for AODV as it starts the route requests whenever needed.

For decreasing the traffic of the network as well as routing overhead, Cluster Based Routing Protocol (CBRP) was discussed by *Parvathi[2]*. In this protocol, one of the nodes will be elected as the cluster head and these cluster heads will communicate with other cluster heads with the help of gateway nodes. The packets for requesting the routes will be received by cluster heads and gateway nodes will receive the route reply packets.

By combining the horizontal as well as the vertical topology, the performance of routing protocols in MANET was simulated in ns2 by *santosh[3]* by taking various parameters like delay, packet delivery ratio, loss of packets. The DSDV protocol offers high packet delivery ratio, low end to end delay, less packet loss. DSDV is highly suitable for network having very less number of nodes.

For providing high security to MANETs, a new protocol called PLSV was proposed by *shim[4]* which provides security at the physical layer. This protocol combined the physical layer as well as the network layer for supporting secure transmission.

3. Pro-Active Routing Protocols

The flat routing protocols were classified as proactive and reactive protocols. The very common thing in these protocols is that every node which participates in routing plays behaves in a similar way. The link state determines the Proactive routing and distance-vector determines the Reactive routing. The pro-active routing protocols are driven by tables and they operate similar to networks of wired type and contain a map of the network in updated form, and this routing protocol evaluates the routes in a continuous manner and tries to find new routes [6]. When sender node desires a path to receiver node, a packet will be sent for route discovery, if path is present previously so no excess delay caused because of the process of discovery of routes. As the information needs updates in this way, it will need a lot of bandwidth and battery power which is not available in MANETs. OLSR, OSPF and some other Conventional Routing Schemes like DVR and LSR will fall in pro-active routing protocols.

a) Destination-Sequenced Distance Vector (DSDV)

One of the proactive protocols for routing in MANET is DSDV. In this protocol, the Packets are routed among the nodes by utilizing the routing tables which are stored in every node [4]. The table which contains information about routing of each node contains all the destinations, nodes of the different hop and required number of hops to for reaching.

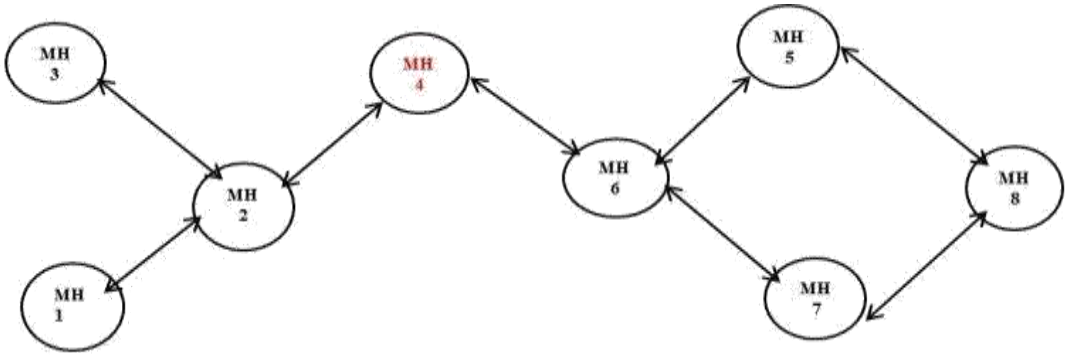

Figure 2. Figure Showing DSDV Routing Protocol with 8 Mobile Hosts

Thus Destination Sequence Distance Vector acts as the pro-active protocol. The advertisements of route will be sent either by broadcast routing or multicast routing. An example of DSDV protocol for routing is shown in the Figure 2.

Table 1. Table Showing the Routing Information and Sequence Numbers of DSDV Routing Protocol with Destination Mobile Hosts

Destination	Next Hop	Metric	Sequence Number
Mobile Host-1	Mobile Host-2	2	S406_MH4
Mobile Host-2	Mobile Host-2	1	S128_MH1
Mobile Host-3	Mobile Host-2	2	S564_MH2
Mobile Host-4	Mobile Host-6	0	S710_MH3
Mobile Host-5	Mobile Host-6	2	S392_MH5
Mobile Host-6	Mobile Host-6	1	S076_MH6
Mobile Host-7	Mobile Host-6	2	S128_MH7
Mobile Host-8	Mobile Host-6	3	S050_MH8

Every table of a node contains sequence number created by the nodes of the destination. In AODV, the sequence number was utilized for avoiding the loops in the route and these sequence numbers will give information about the freshness of routes. In order to keep the routing tables consistency in a topology which is varying dynamically, every node transmits the updates periodically along with updates transmission when significant amount of new information is available in the network. To decrease the information transmitted by these advertisements, some special packets are created [14]. An example of DSDV routing protocol with sequence number information and mobile hosts is as shown in table 1. One packet carries the information of routing which is readily available which is also called as “full dump". Another packet contains the changed data. Full dumps will be transmitted less frequently when there is no mobility of hosts. If the movements of the nodes are very high and incremental size approximates NPDU size, at this time, the dump of full value can be scheduled. When a mobile host fetches updated information about routing, this information will be compared with the information which is readily available

from the previous packets of routing information. A route which is having most updated sequence number will be used and the routes having the sequence numbers of older values will be removed. If the route contains the sequence number which is the same as the already pre-existed route will be selected if it contains a best measurement like having fewer hops [9]. If the path to the next hop of that route was damaged, different route which is available in next hop will be assigned immediately as an undefined metric and sequence number of new value. These changes will be broadcasted very quickly in the packet having the routing information.

b) Wireless Routing Protocol (WRP):

WRP is one of the class of the algorithms for exploring the best path; these algorithms can be defined as the shortest path algorithms in a distributed manner which evaluates the paths with the help of information like length and shortest path of second-to-last hop to each destination. Wireless Routing Protocol decreases the number of ways of occurrence of temporary routing loop [6]. To achieve efficient routing, each node contain four requirements which are in the form of tables which gives information about distance, routing, cost of link and the list containing retransmission of message. Wireless Routing Protocol utilizes the update of periodic message transmissions to the nearest node neighbors. Acknowledgments should be sent by the nodes in the updated message response list. For keeping the connection, the nodes which are presented in the list of response must transmit a Hello message of idle type, if no change is observed from the last update. A node will take decision for updating the table for routing or not after getting message which contains update from a neighboring node; every time a node search for the best link utilizing newly available information. Once, after getting a best link by the node, it will resend that message to original nodes to update the routing tables. After getting acknowledgment, the Message Re-transmission List was updated by original nodes [2]. In this way, every time the routing information consistency will be checked by each node, which ensure removing the routing loops and always makes an efforts to achieve the optimized solution for network routing.

c) Cluster Gateway Switch Routing Protocol (CGSR):

CGSR will consider a wireless network of having mobile nature in clustered form apart from network of flat type. In order to obtain the network structure into separate network structure but should be in groups which are interrelated to each other, the heads of the cluster will be elected by using the algorithm [7]. By making different clusters, CGSR will get a mechanism of processing in a distributed form in network. The dis-advantage of CGSR protocol was that continuous change of selecting the cluster head will degrade the node resources and it will significantly degrade the performance of routing. An example of CGSR protocol is as shown in Figure 3.

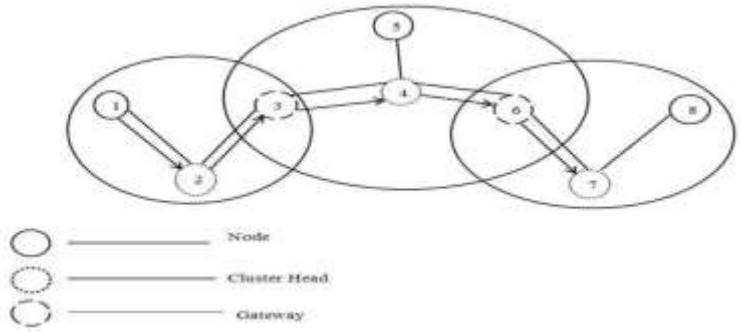

Figure 3. Figure showing CGSR Routing Protocol with Nodes, Cluster Heads and Gateways which are Connected in the Network

CGSR uses protocol of DSDV as the basic scheme of routing. So, therefore it will be having the equal amount of routing overhead as that Destination Sequence Distance Vector. It changes the Destination Sequence Distance Vector by utilizing the approach of hierarchical routing for forwarding data from nodes of source to nodes of destination [12]. Nodes which are located closer to heads of the cluster are called Gateway nodes. If the node desires to send the packet, initially, the data packet was sent to head of cluster node, after that data packet will be sent from the head of the cluster node to node of gateway and then to another head of cluster node, and this process will continue upon reaching the head of the cluster of the node of destination. This data packet will be transmitted from cluster head to node of destination.

d) Source-Tree Adaptive Routing (STAR):

The STAR routing protocol mainly based on algorithm of link state. In STAR protocol, the links or the most selected paths which are connecting the destinations will be maintained by the router of the source tree. The analysis of various pro-active protocols was done by performing simulation in NS2 and the comparison of table-driven protocols of routing on various specifications is shown in Table 2.

Table 2. Table Showing the Comparison of Table-Driven or Pro-Active Routing protocols based on Various Parameters

Parameters	**DSDV**	**CGSR**	**WRP**
Complexity of Time	F(d)	F(d)	F(h)
Complexity of Communication	F(x=N)	F(x=N)	F(x=N)
Philosophy of Routing	Flat type of Routing	Hierarchical Routing	Flat type of Routing
Loop free routes	Loop free routes exist	Loop free routes exist	Loop free routes exist, but not instantaneously
Multicast Capability	Does not exist	Does not exist	Does not exist
Required number of routing tables	Two routing tables are required	Two routing tables are required	Four routing tables are required
Frequency of transmitting the updates	Transmit the updates periodically and whenever needed	Transmit the updates periodically	Transmit the updates periodically and whenever needed
Sequence Numbers Utilization	Utilizes the sequence numbers	Utilizes the sequence numbers	Utilizes the sequence numbers
“Hello ” Messages Utilization	Utilizes “Hello” Messages	Not utilizes “Hello” Messages	Utilizes “Hello” Messages
Existence of critical nodes	Critical nodes does not exist	Critical nodes exist (Cluster head)	Critical nodes does not exist
Metrics of Routing	Shortest Path	Shortest Path	Shortest Path

N=Number of nodes presented in the network

d=Diameter of the network

h=Height of Routing tree

x=Number of nodes which are affected due to network topology change

This protocol will significantly decrease value of overhead of routingof the network by utilizing the approach of overhead of routing of least value in order to the information

regarding routing [2]. It supports the approach of optimum routing if required. This kind of approach will eliminate the procedure of updating the routes periodically which was existed in algorithm of Link State. Updates of the Link state will be exchanged during the occurrence of certain events.

So, the scalability of STAR is good in case of large networks as this protocol considerably decreased the consumption of the bandwidth for routing updates as well as it reduced the latency by utilizing the routes which are predetermined [6]. In case of large and heavy mobile ad hoc networks, this protocol will be having large overheads of memory and processing, as it is required for every node to keep a graph of partial topology of the network. The frequency of changing of this partial topology is high as the neighboring nodes are reporting the various source trees. The following table shows the classification of Table-Driven Routing protocols based on various parameters.

3) Hybrid Routing Protocols

These protocols have advantages of Pro-Active and Reactive routing, by using the Pro-Active routing protocol locally and using Reactive routing protocol inter-locally. This is partially based assuming that in mobile ad hoc networks majority of communication took place among the nodes which are very close to each other and changes in network topology is very significant if it happens in the node's transmission range [16]. If there is a failure of the link or the disappearance of the nodes on other side of network, it will affect only local and neighboring nodes, but nodes on other side of network will not be affected.

a) Zone Routing Protocol (ZRP)

Zone Routing Protocol was compatible for different types of MANETs; this protocol is fit for those networks having large span and different patterns of mobility [17]. In ZRP, each node actively maintains routes in a local region, called as routing zone. The Zone routing protocol with nodes, cluster head and gateways is shown in figure 4. The creation of routing will be done using the mechanism of query-reply. For establishing distinguish network zones, initially a node have to be familiar with it's neighbors. A neighbor can be defined as a node having direct communication with that node, and the transmission range of one hop. The information of discovering the neighbor can be utilized as basic factor for Intra-zone Routing Protocol (IARP).

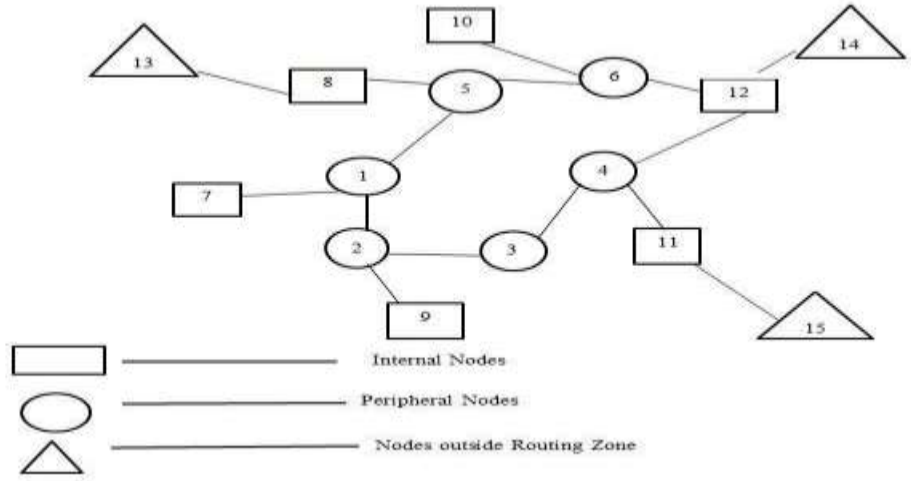

Figure 4. Figure showing Zone Routing Protocol with Nodes, Cluster Head and Gateways

Instead of broadcasting blindly, ZRP utilizes mechanism of query control for decreasing the traffic of route query by routing the query messages from query source from zones of routing. A covered node can be defined as one which belongs to the node routing zone which have received a route query. While forwarding query packet, a node which determine if it came from its neighbor node or not.

If it is coming from the neighboring node, then it will mark the neighboring nodes which are known in its same zone as covered. The query will be forwarded until it reached the destination. The destination will send the reply message back through the reverse path as well as creating the route.

b) Sharp Hybrid Adaptive Routing Protocol (SHARP)

SHARP adapts both the reactive and proactive type of routing by the proactively shared dynamically varying information about routing. This protocol will describe the zones of proactive nature in the nodes vicinity. The radius of the node-specific zone will describe total number of nodes in zone having proactive nature [18]. The nodes which are within the radius of zone of particular node will become the node members of proactive zone. If a node does not existed within a proactive zone for the required destination, the mechanism of reactive routing (query-reply) will be utilized for making route to that node. The mechanism of proactive routing will be used in proactive zone. With respect to central node, nodes in proactive zone will maintain the routes proactively. The proactive zones will be created automatically in this protocol, if few destinations are addressed frequently. If the packets have been reached any of the nodes in the vicinity of the zone, the proactive zones will act as packet collectors, which will route the packets to the destination efficiently. The following Table 3 shows the comparison of Pro-active routing protocols with hybrid routing protocols on the basis of various performance parameters.

Table 3. Table showing classification of protocols for routing based on various parameters

Parameters	**Proactive Protocol**	**Hybrid Protocol**
Philosophy of Routing	Flat/Hierarchical Routing	Hierarchical Routing
Scheme of Routing	Table-Driven Routing	Combination of On-Demand and Table-driven Routing
Overhead of Routing	The value of Routing overhead is high	The value of Routing overhead is medium
Level of Scalability	The scalability is low	The scalability is high and suitable for large sized networks
Routing information availability	Routing information is available all the time and stored in routing tables	It exhibits the combination of both Proactive Routing and Reactive Routing
Getting periodic updates	Periodic updates are required whenever the topology of the network changes	Periodic updates are needed inside the zone
Capacity of Storage	Storage capacity is high due to the presence of routing tables	Storage capacity basically depends on the size of the zone.
Support of Mobility	Getting periodical updates	Combination of both Pro-active and Reactive Routing

4. Conclusion

The various pro-active routing protocols like Destination Sequence Distance Vector, Cluster Gateway Switch Routing Protocol, Wireless Routing Protocol and Source Tree Adaptive Routing protocol were compared and it was advantageous that loop free routes exist for DSDV and CGSR which was not applicable in case of WRP. One of the advantages of CGSR is the existence of cluster head. Hybrid routing protocols like Zone Routing Protocol and Sharp Hybrid Adaptive Routing Protocol are presented. A comparison is made for Pro-active routing protocols with hybrid routing protocols on the basis of various performance parameters and it showed that routing overhead, storage capacity is high for pro-active routing protocols and scalability is high for hybrid routing protocols.

References

[1] Deepak, Srivastava, Gupta, Performance comparison of Pro-active and Reactive Routing Protocols for MANET, IEEE International Conference.
[2] Parvathi, Comparative analysis of CBRP, AODV, DSDV Routing Protocols in Mobile Ad-hoc Networks, IEEE International Conference.
[3] Santosh, Performance simulation of MANET protocols with the combination of horizontal and vertical topology using NS2, IEEE International Conference
[4] Shim, A Physical Layer Security-based Routing Protocol in Mobile Ad-hoc Wireless Networks, IEEE International Conference
[5] A. SachinDnyandeoUbarhande, Performance Evolution of AODV and DSR Routing Protocols in MANET Using NS2, International Journal of Scientific & Engineering Research Volume 3, Issue 5, May-2012, ISSN 2229-5518.
[6] G.Vijaya Kumar , Y.VasudevaReddyr , 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, 706-713.
[7] Tarek Sheltami and Hussein Mouftah, Comparative study of on demand and Cluster Based Routing protocols in MANET, IEEE conference, pp. 291-295, 2003.
[8] Dr. Kamaljit I. Lakhtaria, Analyzing Reactive Routing Protocols in Mobile Ad Hoc Networks, Int. J. Advanced Networking and Applications Volume:03 Issue:06 Pages:1416-1421 (2012) ISSN : 0975-0290
[9] Johnson. D and Maltz. D. A, Dynamic source routing in ad hoc wireless Networks in Mobile Computing (Imielinski and H. Korth, eds.), Kluwere Academic Publishers, 199.
[10] Perkins CE, Royer EM, Chakeres ID (2003) Ad hoc On-Demand Distance Vector (AODV) Routing. IETF Draft, October, 2003, available at http://tools.ietf.org/html/draft-perkins- manet-aodvbis-00. Accessed 21.
[11] Toh C-K (1996) A Novel Distributed Routing Protocol to Support Ad- Hoc Mobile Computing.Proceedings of the 1996 IEEE 15thAnnualInternational Phoenix Conference on Computers and Communications: 480–486.
[12] Elizabeth M. Royer, A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks, University of California, Santa Barbara Chai-KeongToh, Georgia Institute of Technology, IEEE Personal Communications, pp. 46-55, April 1999.
[13] Krishna Gorantala ,Routing Protocols in Mobile Ad-hoc Networks, A Master' thesis in computer science, pp-1- 36, 2006.
[14] Perkins CE, Bhagwat P (1994) Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers. Proceedings of ACM SIGCOMM 1994:234–244.
[15] Cheng C, Riley R, Kumar SPR, Garcia-Luna-Aceves JJ (1989) A Loop Free Extended Bellman-Ford Routing Protocol Without Bouncing Effect. ACM SIGCOMM Computer Communications Review, Volume 19, Issue 4:224– 236.
[16] Humblet PA (1991) Another Adaptive Distributed Shortest-Path Algorithm. IEEE Transactions on Communications, Volume 39, Issue 6:995–1003.
[17] Rajagopalan B, Faiman M (1991) A Responsive Distributed Shortest- Path Routing Algorithm Within Autonomous Systems. Journal of Internetworking Research and Experiment, Volume 2, Issue 1:51–69
[18] Chiang C-C, Wu H-K, Liu W, Gerla M (1997) Routing in Clustered Multihop, Mobile Wireless Networks with Fading Channel. Proceedings of IEEE SICON: 197–211
[19] C K Toh, Ad Hoc Mobile Wireless Networks, Prentice Hall Publishers , 2002.
[20] Robinpreet Kaur &Mritunjay Kumar Rai, A Novel Review on Routing Protocols in MANETs, Undergraduate Academic Research Journal (UARJ), ISSN : 2278 – 1129, Volume-1, Issue-1, 2012.

[21] Ammar Odeh, EmanAbdelFattah and MuneerAlshowkan, Performance Evaluation Of AODV And DSR Routing Protocols In Manet Networks, International Journal of Distributed and Parallel Systems (IJDPS) Vol.3, No.4, July 2012.
[22] Mina Vajed Khiavi, ShahramJamali, SajjadJahanbakhshGudakahriz, Performance Comparison of AODV, DSDV, DSR and TORA Routing Protocols in MANETs, International Research Journal of Applied and Basic Sciences. Vol., 3 (7), 1429-1436, 2012 ISSN 2251-838X © 2012 Victor Quest Publications.

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