

A comparative survey of routing protocols in mobile ad hoc networks

S.Senthilkumar¹ and B.Ananthampillai²¹Department of CSE, Anna University of Technology Tiruchirappalli, Pattukottai Campus, Tamil nadu, India²Mount Zion College of Engineering. & Tech. Lenavilaku, Tamil nadu, India.

ARTICLE INFO

Article history:

Received: 25 May 2011;

Received in revised form:

22 July 2011;

Accepted: 30 July 2011;

Keywords

MANETs,
CGSR,
ZRP.

ABSTRACT

A "Mobile Ad hoc Network" (MANET) is an independent system where mobile hosts are connected by wireless links without any of the preexisting administration. Each node acts as a host and sometimes as a router to forward packets to other nodes. So Routing protocol plays an important role in MANETs because it is designed with self-motivated topology, mobile host, distributed environment and limited battery power. In previous researches, a lot of routing protocols were developed for MANETs such as CGSR, DSR and ZRP. This paper evaluates these protocols by on their uniqueness, functionalities, pros and cons. This paper also emphasizes on enhancement of different protocol's performance.

© 2011 Elixir All rights reserved.

Introduction

Mobile Ad hoc networks (MANETs) are commonly known as an infrastructure less mobile network. In Mobile ad hoc network, wireless nodes communicate with each other using multi-hop link. Each node itself acts as a router for forwarding and receiving



Figure 1: Ad-hoc Network

packets to/from other nodes. Routing in mobile ad hoc networks has been a challenging task ever since the wireless networks came into existence. The major reason for this is the constant change in network topology because of *limited bandwidth, highly dynamic topology, link interference, limited range of links and limited physical security*. A number of protocols have been designed to accomplish this work. Some of them are CGSR, DSR and ZRP routing protocols which are explained in the forth coming chapters.

Adhoc Routing Protocols

Routing in Mobile Ad hoc Networks is different from conventional infrastructure networks. Routing in MANETS takes several issues together with dynamic topology, distributed environment, bandwidth and energy constrained. Based on how routing information is acquired and maintained by mobile nodes, MANET routing protocols is classified into Proactive, Reactive and Hybrid routing.

In Proactive routing protocols, every node maintains information about routes to all reachable nodes and also update the routing table information. So All nodes need to retain a consistent view of the network topology. The Proactive routing protocols are DSDV, CGSR, WRP and FSR.

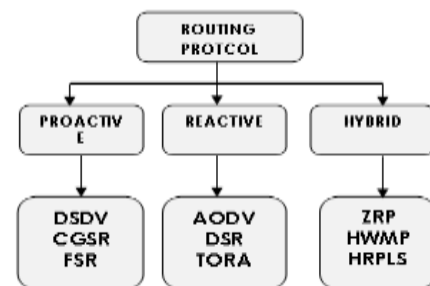


Figure 2: Categorization of MANET routing

Reactive routing protocols for mobile ad hoc networks are also known as "on-demand" routing protocols. In the reactive routing protocol, the routes are created as when needed. Once a route has been discovered, the route is maintained until the destination becomes inaccessible or the route is no longer required. Some of the Reactive routing protocols are DSR, AODV and TORA. In Hybrid routing protocols, to merge the advantages of both proactive and reactive routing protocols. Some of the Hybrid routing protocols are ZRP, HWMP and HRPLS. Hence this paper has proposed the outcome of the comparison of various table-driven, on-demand and hybrid routing protocols.

Cluster-Head Gateway Switch Routing Protocol (Cgsr)

Cluster-head gateway switch routing protocol (CGSR) is based on the hierarchical network topology. In this, it arranges nodes into cluster with coordination among members of each cluster assigned to a special node named cluster-head which is designated dynamically by applying Least Cluster Change (LCC) algorithm. The cluster-head is able to control a group of ad-hoc hosts and thus it is the in-charge for broadcasting within the cluster, forwarding messages and dynamic channel scheduling.

It also routes traffic from source node to destination node using a hierarchical cluster-head-to-gateway routing approach. The intersection between the communication range of two or more cluster-head is known as gateway node. The source node of first cluster transmits the packet to its cluster-head. From this

cluster-head, the packet is sent to the gateway node that connects this cluster-head and the next cluster-head along the route to the destination. The gateway sends it to that cluster-head and so on till the destination cluster-head is reached in this way. The destination cluster-head then transmits the packet to the destination.

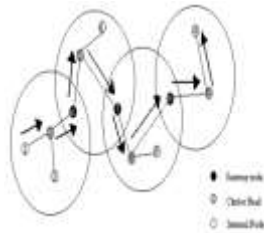


Figure 3: CGSR: routing from node 1 to node 12.

Now, each node must maintain a "cluster member table" whose responsibility is to store the information of its cluster-head and each mobile node in the network. Each mobile node in the network transmits its cluster member table information periodically using Destination Sequenced Distance Vector (DSDV) algorithm. After receiving information table from the neighbors, the nodes update their cluster member table. Other than the cluster member table, each node must also maintain a routing table which is used to lookup the next hop in order to reach the destination. On receiving a packet, a node will check its cluster member table and routing table to determine the nearest cluster-head along the route to the destination. Next, the node will check its routing table to determine the next hop used to reach the selected cluster-head. Then it transmits the packet to this node. The main advantage of CGSR is better bandwidth utilization is achieved between source and destination. But gateway node needs more resources and cluster-head consumes more power.

Dynamic source routing protocol (dsr)

The Dynamic Source Routing (DSR) is reactive, source routing protocol which could be able to control a topology without using periodic table-update messages like table-driven routing protocols. It is intended especially for making use of multi-hop ad hoc networks for mobile nodes. It allows the network to be completely self-organizing and self-configuring without the aid of existing infrastructure or administration. The DSR protocol is a collection of two main mechanisms of "Route Discovery" and "Route Maintenance" for finding and maintaining routes from source to different destinations in the mobile ad hoc network. To discover an optimal path from source to destination using "Route Discovery" Process. "Route Maintenance" ensures the best possible path i.e. loop-free according to the changes in network conditions, even when there is high mobility from source to destination among nodes.

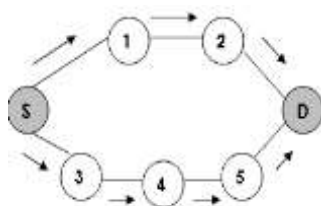


Figure 4: The Route Request (RREQ) packets flooding in DSR

In figure 4, source node S sends to transmit a packet to destination D. It first checks with its route cache for an optimal

route to D. If the required route information is found, the source node S includes the routing information inside the data packet before sending it. Otherwise, the source node S starts a route discovery operation by broadcasting route request (RREQ) packets. A route request (RREQ) packet contains addresses of both the source and the destination and a unique number to identify the request.

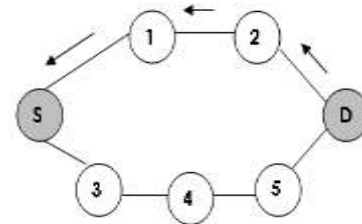
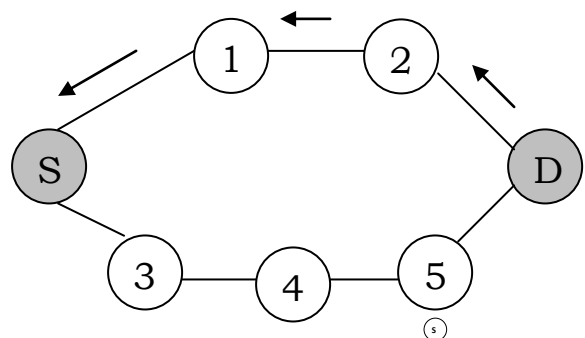


Figure 5: The forwarding of Route Reply (RREP) packet in DSR

Receiving a route request (RREQ) packet, a node checks its route cache. If the node doesn't have routing information for the requested destination, it appends its own address to the route record field of the route request packet. Then, the request packet is forwarded to its neighbors. To control the communication overhead of route request packets, a node processes route request packets that both it has not seen before and its address is not presented in the route record field. If the route request packet reaches the destination or an intermediate node has routing information to the destination, a route reply packet (RREP) is generated. When the route reply (RREP) packet is generated by the destination, it comprises addresses of nodes that have been traversed by the route request packet. Otherwise, the route reply packet comprises the addresses of nodes the route request packet has traversed concatenated with the route in the intermediate node's route cache. In DSR, when the data link layer detects a link disconnection, a ROUTE_ERROR packet is sent backward to the source. After receiving the ROUTE_ERROR packet, the source node initiates another route discovery operation. Additionally, all routes containing the broken link should be removed from the route caches of the immediate nodes when the ROUTE_ERROR packet is transmitted to the source. In DSR, control overhead has reduced by using of route cache. But traffic overhead has increased by containing complete routing information into each data packet, which degrades its routing performance.

Zone Routing Protocol (Zrp)

The Zone Routing Protocol (ZRP) is a hybrid routing protocol for mobile ad hoc networks. The hybrid protocols are proposed to reduce the control overhead of proactive routing approaches and decrease the latency caused by route search operations in reactive routing approaches. The Zone Routing Protocol (ZRP) aims to deal with the problems by combining the



best properties of both approaches. The key concept is to use a proactive routing scheme within a limited zone in the r-hop neighborhood of every node, and use reactive routing scheme for nodes beyond this zone. An *Intra-zone routing protocol (IARP)* is used in the zone where particular node employs proactive routing whereas *inter-zone routing protocol (IERP)* is used outside the zone. The routing zone of a given nodes is a subset of the network, within which all nodes are reachable within less than or equal to the zone radius hops. The IERP is responsible for finding paths to the nodes which are not within the routing zone. When a node *S* wants to send data to node *D*, it checks whether node *D* is within its zone. If yes packet is delivered directly using IARP. If not then it broadcasts (uses unicast to deliver the packet directly to border nodes) the RREQ packet to its peripherals nodes. If any peripheral nodes find *D* in its zone, it sends RREP packet; otherwise the node re broadcasts the RREQ packet to the peripherals nodes. This procedure is repeated until node *D* is located. In ZRP, less control overhead as in a proactive or reactive protocol. But short latency for finding new routes in ZRP. The Comparison study of Proactive, Reactive and Hybrid protocols is summarized in Table 1.

Conclusion

This Survey attempts to evaluate table driven, on-demand and hybrid routing protocols and exposes their characteristics and trade-offs.

The field of ad-hoc mobile networks is rapidly growing and dynamic changing and while it is not clear that any particular algorithm or class of algorithm is the best for all environment, each protocol has definite advantages and disadvantages, and is well suited for certain situations.

Abbreviations

d: Network diameter;

B: The average gateway nodes of a Zone or cluster-head;

N: Number of nodes in the Network;

M: The average no. of nodes in a Zone or cluster

D: The number of maximum desired destination

References

- [1]Vijaya I, Mishra P.B, Dash A.R, Rath A.K," Influence of routing Protocols in Performance of wireless adhoc Network", International Conference on Emerging Application of Information Technology 2011.
- [2]Bai, R, Singhal, M.," DOA: DSR over AODV Routing for Mobile Ad Hoc Networks", IEEE transactions on Mobile computing,Page(s):1403 –1416, 2006.
- [3]Haider Raza, Poonam Nandal and Silky Makker," Selection of Cluster- head using PSO in CGSR Protocol", IEEE international conference on Method and Models in Computer Science (ICM2CS),Page(s): 91-94,2010.
- [4]Elizabeth M. Royer, Santa Barbara Chai-Keong Toh," A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks", IEEE Personal Communications, Page(s): 46 – 55, April 1999.
- [5]Brent Ishibashi, Raouf Boutaba," Topology and mobility Considerations in mobile ad hoc networks", Elsevier,Page(s) :762- 776, 2004.
- [6]V.Ramesh, Dr.P.Subbaiah, N.KoteswarRao, N.Subhashini, Narayana. D ,"Performance Comparison and Analysis of Preemptive-DSR and TORA", International Journal of Ad hoc, Sensor & Ubiquitous Computing (IJASUC) Vol.1, No.4, December 2010.
- [7]Samad Baseer, Muhammad. Ibrahim Channa, Kazi Ahmed," A Review of Routing Protocols of Heterogeneous Networks Routing Protocols of Heterogeneous Networks", IJCA Special Issue on "Mobile Ad-hoc Networks"MANETs, 2010.
- [8]Kapang Lego, 2pranav Kumar Singh, Dipankar Sutradhar," Comparative Study of Adhoc Routing Protocol AODV,DSR and DSDV in Mobile Adhoc NETWORK", Indian Journal of Computer Science and Engineering Vol. 1 No. 4 364-371.
- [9]C. Siva Ram Murthy, B. S. Manoj," Ad-Hoc Wireless Networks: Architectures and Protocols", Pearson Publication, 2004

Table 1: Comparison of CGSR, DSR and ZRP

Parameters	CGSR	DSR	ZRP
Network Organization	Flat	Flat	Hierarchical
Topology Dissemination	Periodical	On-Demand	Both
Route Latency	Always	Available	Both
Mobility Communication	Periodical	Route	Both
Loop Free	High	Low	Medium
Loop Free	Yes	Yes	yes
Multicast Capability	No	No	No
Update destination	Neighbors and cluster heads	Source	Neighbors
Update Period	Periodically	Event Driven	Periodically& Event Driven
Hello Messages Requirements	No	No	Yes
Route Metric	Shortest Path	Shortest Path	Shortest Path
Storage Complexity	O(2N)	O(d)	O(M+B+D)
Communication Complexity	O(N)	O(2N)	O(M)/O(2B*D)
Time Complexity	O(d)	O(2d)	O(M)/O(2d)