ISSN:2320-0790

COMPUSOFT
An International Journal of Advanced Computer Technology

Zone-based Proactive Source Routing Protocol for Ad-hoc Networks

Sangheethaa.S[1], Shyamily P V[2]
[1]Asst. Professor, Department of Electrical and Computer Engineering, School of Engineering and Technology, Dilla University, Dilla Ethiopia.
[2]Department of Computer Science,Vimal Jyothi Engineering College, Chemperi, Kannur

Abstract:- Ad-hoc networks has become a hot topic in the research world. Routing in ad-hoc networks has faced so many problems due to the peculiar nature of adhoc environments. In this paper a new routing protocol based on source routing and zone based routing is proposed. Proactive source routing protocol (PSR) is a method to reduce overhead in ad hoc networks by making use of BFSTs (Breadth First Spanning Trees). Zone routing protocol (ZRP) uses partition based routing. It uses source routing inside a zone and on-demand routing outside the zone. This paper proposes an approach which combines the advantages of both proactive and zone based routing protocols. The simulations are done in ns2 and the results show that the Z-PSR i.e. zone based proactive source routing protocol performs better compared to PSR.

Keywords: PSR, ZRP, ad hoc routing, Z-PSR, Breadth first spanning tree.

1. Introduction

Ad hoc networks [1] are temporary wireless networks normally formed at emergency situations where there are no centralized authorities like base station or access points. Ad hoc networks have special characteristics. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Ad Hoc networks are used for creating temporary networks. The main application areas of Ad-hoc networks are; Creation of instant infrastructure, Disaster relief, network connection to remote areas where installation of base station is not feasible. An ad hoc network consists of nodes which are free to move. The nodes may be anywhere, in airplane, ships, trucks, cars even on every people. Routing in such a type of network is challenging. This paper proposes a routing protocol which is lightweight, source routed, uses Breadth First Spanning Trees and is based on PSR[2] and ZRP[3]. This paper is organized in to following sections. The next section lists out some of the existing approaches from the literature. Section 3 deals with the design of the new protocol. Section 4 shows the simulation results. Section 5 finally concludes the paper.

2. Related Work

There are many routing protocols proposed for ad hoc networks. Each protocol has its own advantages, disadvantages, and its own environment / application where it can be used.

Routing protocols of ad hoc networks can be classified into three categories: 1. Table-driven Routing protocols, 2. On-Demand Routing Protocols and 3. Hybrid Routing

Protocols. Figure 1.1 shows the classification and example for each classification. Other than these types, there is a new type of classification based on geographical positioning system called as Geographical position assisted routing.

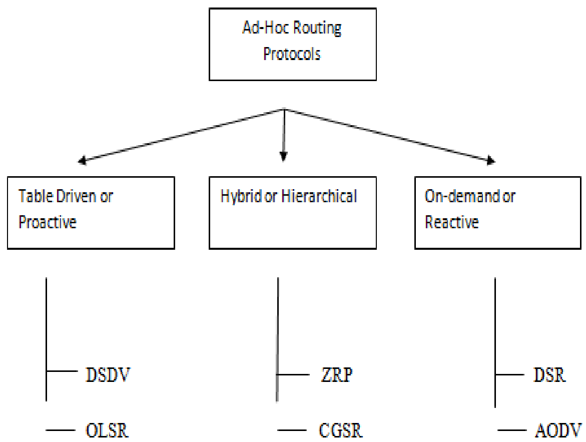

Figure 2.1 Classification of Ad-Hoc Routing Protocols

Table driven protocols are also called as proactive routing protocols. Proactive routing protocol maintains regular and up to date routing information about each node in the network by propagating route updation at fixed time intervals throughout the network, when there is a change in network topology. As the routing information is usually maintained in tables, these protocols are also called table-driven protocols. Examples of proactive routing protocols are Destination Sequenced Distance Vector (DSDV) [4], Optimized Link State Routing (OLSR)[5], Wireless Routing Protocol (WRP) [6].

On-demand routing protocols are also known as reactive routing protocol. In the ad-hoc networks where bandwidth resources are limited and topology frequently changes, it is not necessary to maintain routes to each node. Fast changing topology shortens effective time of routing and reduces utilization rate of routing information. Therefore, on-demand routing protocols came into being. On-demand routing protocols have two processes including Route Discovery and Route Maintenance. When the source node where there is no routing in the routing table needs to obtain the routing to destination node, the route discovery process will be activated. The node broadcasts routing request packets across the network by flooding. When a route request packet reaches the destination node, the destination node will send a route response packet to the source node. Thus, the two-way activated path will be set up between the source node and the destination node. As the topology changes, the route maintenance process are started when certain link on the activated path breaks. Examples includes Ad-hoc On-demand distance Vector protocol (AODV) [7], Dynamic Source Routing (DSR) [8], Admission Control enabled On-demand Routing (ACOR) [9] and Associativity Based Routing (ABR) [10].

Hybrid routing protocols is the combination of both proactive and reactive routing protocols. For e.g. Temporary Ordered Routing Algorithm (TORA) [11], Zone routing Protocol (ZRP) and OrderOne Routing Protocol (OOPR) [12] are hybrid routing protocols. Proactive and reactive algorithms are used to route packets. The route is established with proactive routes and uses reactive flooding for new mobile nodes. Hybrid routing protocols are referred to as hierarchical routing protocols in some texts. Hierarchical routing protocol divides the networks into clusters. Each cluster has a cluster head. Cluster head maintains information about other clusters. Other nodes maintain information about their own clusters. Collection of clusters is known as super cluster. These types of protocols are having advantages of both table driven and on-demand routing protocols.

ZRP uses table driven approach inside the zone and on-demand approach outside the zone. A zone is created based on radius. If radius =1, a node needs to maintain table of routes to reach one hop neighbors alone. This is called its zone. Outside the zone communication is done by requesting route from other nodes. If radius =2, a node needs to maintain routes to reach all its two hop neighbors. So table driven routing for two hop neighbors and outside the zone, on-demand routing protocol should be used.

PSR is the base for the new protocol designed in this paper. So PSR's details are explained here in detail. PSR provides every node with a breadth-first spanning tree (BFST) of the entire network rooted at itself. Each node periodically broadcasts the tree structure it has built from the information from its neighbors. Due to its proactive nature, the update operation of PSR is iterative and distributed among all nodes in the network. At the beginning, node v is only aware of the existence of itself; therefore, there is only a single node in its BFST, which is root node v . By exchanging the BFSTs with the neighbors, it is able to construct a BFST within n each subsequent iteration, nodes exchange their spanning trees with their neighbors. From the perspective of node v toward the end of each operation interval, it has received a set of routing messages from its neighbors packaging the BFSTs. Node v incorporates the most recent information from each neighbor to update its own BFST. It then broadcasts this tree to its neighbors at the end of the period. Formally, v has received the BFSTs from some of its neighbors. Including those from whom v has received updates in recent previous iterations, node v has a BFST, which is denoted Tu , cached for each neighbor $u \in N(v)$, where N(v) represents neighbors of node v. Node v constructs a union graph, by suing equation 1.

$$G v = S v \cup u \in N(v)(T u - v) \quad (1)$$

Here, the authors uses T –x to denote the operation of removing the subtree of T rooted at node x.

3. Protocol design

The new routing protocol proposed in this paper is named as Z-PSR. We are combining the advantages of both PSR and ZRP hence the name.

Basic problems of PSR are discussed below.

In a denser network, the overhead involved in maintaining the BFST to reach every node in the network will become high in case of PSR. The time taken to search for a route from the set of BFSTs is also high. Even though PSR is reducing the overhead in terms of communication bytes, it fails to reduce the computational overhead and memory overhead incurred by each node in finding out the route. This results in high energy consumption.

The objectives of the new routing protocol are as follows

1. Develop a routing protocol which minimizes the computation overhead in searching for a route.
2. The protocol should reduce the memory occupied by each BFST.
3. The protocol should find route to the destination with minimum delay.
4. The minimize energy consumption compared to the existing PSR protocol.

In order to meet the objectives, the following steps are taken.

1. Each node will maintain a BFST of its one hop or two hop neighbors only, as opposed to PSR where every node needs to maintain BFST to reach every other node in the network.
2. Whether to maintain one hop or two hop neighbors BFST is decided based on parameter radius. If radius = 1, maintain BFST to reach one hop neighbors. If radius =2 , maintain BFST to reach two

hop neighbors and so on. (Simulations in this paper has used radius 2)

3. When a node needs to send data to its one hop or two hop neighbors, it will use BFSTs maintained at that node. When it needs to send data to other nodes, (other than one/ two hop neighbors), it needs to send data to one of the two hop neighbor which will have BFST to reach the destination.
4. Which two hop neighbor will have the BFST to reach the destination? This is the challenge in this protocol. A node will be receiving BFSTs from all the nodes, but it need not store them. Periodically update messages also sent by the neighboring nodes. So when a node needs to transmit data to a node which is not its one/two hop neighbor, it has to check the update from neighbors to check if it has a path to the destination. The BFST messages will be transmitted as a broadcast. So the protocol is actually following the concept of Link state vector algorithm, which says pass information about neighbors to all the nodes in the network.
5. Thus only when needed, the node will accept and process the broadcast messages carrying BFST of other nodes.
6. This reduces computation overhead and memory overhead maintaining the communication overhead at same level as PSR.

5. Simulation and Analysis

The simulation is done in ns2 [13] version 2.35. The simulation parameters used are shown in the Table 5.1.

The parameters used for comparison are

1. Memory overhead measured in terms of length of BFST to be maintained at each node.

2. PDR- packet delivery ration measured as the ratio of number of packets received to number of packets transmitted.

3. Energy level of nodes. The average energy spent by the nodes at the end of simulation. 4. End to end Time delay - Difference between the Time taken to transmit a packet from source to the time taken to reach a destination.

Table 5.1. Simulation parameters

S.No	Parameter	Values
01	Number of nodes	50
02	Speed of nodes	10 m/s
03	Simulation time	200 s
04	Initial Energy	200 joules
05	Type of traffic	TCP
06	Number of connections	1

Extensive simulation can be done by varying the simulation parameters. Number of nodes can be changed, or speed of nodes can be changed and various graphs can be taken. This paper shows the results for the parameters as set in table 5.1.

The figure 5.1 shows the graphical result of length of the BFST to be stored at each node. It is clear from the graph that Z-PSR needs to store only shorter length BFSTs compared to PSR. Figure 5.2 gives the Packet delivery ratio, both PSR and Z-PSR maintains a 99.9% delivery ratio.

The average remaining energy level of nodes is shown in figure 5.3. Z-PSR manages to maintain a higher average remaining energy compared to PSR. This is because, nodes in Z-PSR does not need to spend more time in searching the longer BFSTs. Figure 5.4 shows the end to end delay incurred in routing the packets. PSR is showing high delay because it has to search for routes in the longer BFSTs where as Z-PSR uses short length BFSTs.

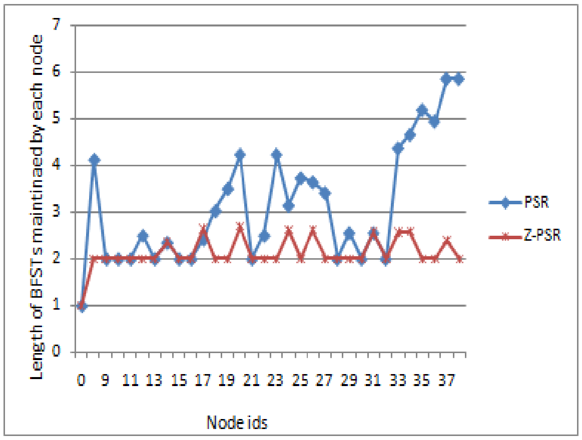

Figure 5.1. Length of BFST at each node

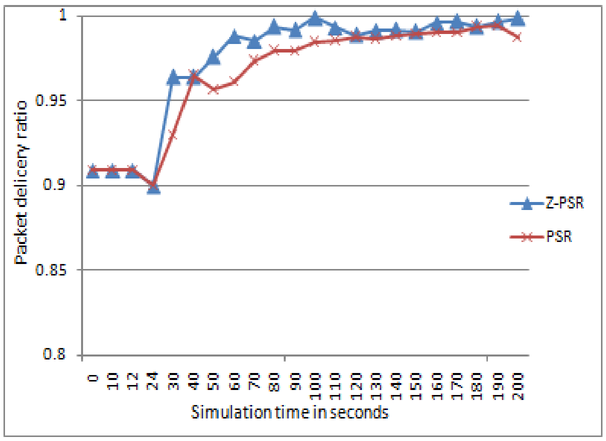

Figure 5.2 Packet Delivery ratio Vs. Simulation Time

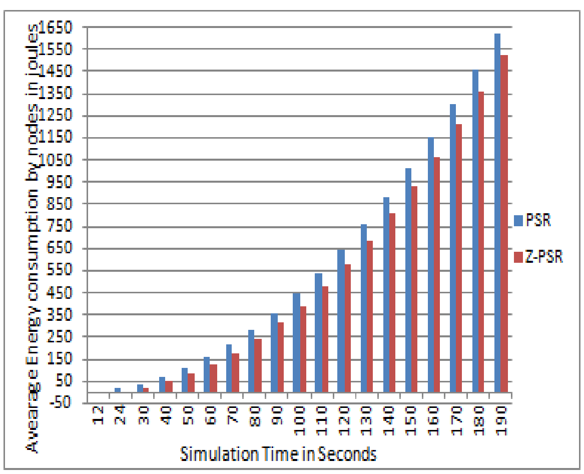

Figure 5.3 Average Energy consumed by nodes.

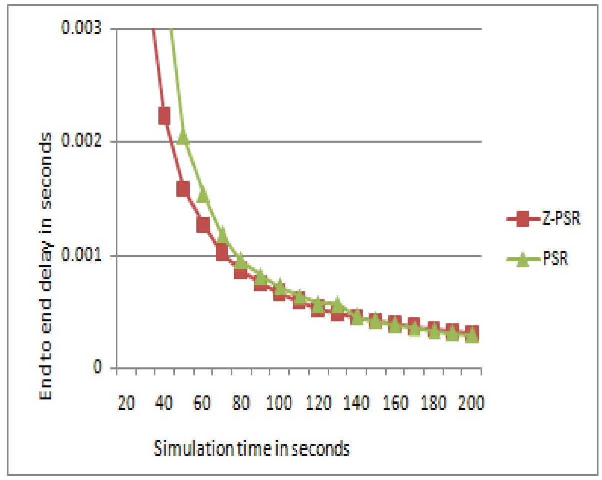

Figure 5.4 End to end delay Vs simulation time

6. Conclusion

Routing in ad hoc network is always a challenging one. This paper proposed a routing protocol based on two existing protocols ZRP and PSR. The simulations results show that the proposed protocol outperforms the existing PSR protocol which acts as a base for this new protocol. Simulations can be extended to change the number of nodes, node mobility etc. In future, extensive simulations will be done and graphs will be plotted in ns2 using xgraph tool.

References

1. http://en.wikipedia.org/wiki/Wireless_ad_hoc_network.
2. Zehua Wang, Cheng Li ; Yuanzhu Chen, "PSR: A lightweight Proactive Source Routing protocol for Mobile Ad Hoc Networks" in IEEE transactions on Vehicular Technology, Vol. 63, No. 2, February 2014.
3. Zone Routing Protocol available from online http://www.cs.mun.ca/~yzchen/papers/tvt2014.pdf
4. C. E. Perkins and P. Bhagwat, "Highly dynamic Destination-Sequenced

Distance-Vector Routing (DSDV) for mobile computers," Comput. Com mun. Rev., vol. 24, pp. 234–244, Oct. 1994
5. T. Clausen and P. Jacquet, "Optimized Link State Routing Protocol (OLSR)," RFC 3626, Oct. 2003. [Online]. Available: http://www.ietf.org/rfc/rfc3626.txt
6. S. Murthy and J. J. Garcia-Luna-Aceves, "An efficient routing protocol for wireless networks," Mobile Netw. Appl. , vol. 1, no. 2, pp. 183–197, Oct. 1996
7. C. E. Perkins and E. M. Royer, "Ad hoc On-Demand Distance Vector (AODV) routing," RFC 3561, Jul. 2003. [Online]. Available: http://www.ietf.org/rfc/rfc3561.txt
8. D. B. Johnson, Y.-C. Hu, and D. A. Maltz, "On The Dynamic Source Routing Protocol (DSR) for mobile ad hoc networks for IPv4," RFC 4728, Feb. 2007. [Online]. Available: http://www.ietf.org/rfc/rfc4728.txt
9. N. Kettaf et al. "Admission Control enables Routing Protocol -ACOR-" Internet draft, IETF, (draft-kettaf-manet-acor-00.txt), July 2006,
10. CHAI-KEONG TOH , "Associativity-Based Routing for Ad-Hoc Mobile NetworkS" University of Cambridge, Kluwer Academic Publishers. Pg. No. 103–139, 1997.
11. Vincent D. Park and M. Scott Corson. "Temporally Ordered Routing Algorithm (TORA) version 4: Functional specification". Internet Draft, draft-ietfmanet-TORA Spec 04.txt, July 2001
12. Order one routing protocol http://en.wikipedia.org/wiki/Order_One_Network_Protocol
13. Ns2- *www.isi.edu/nsnam/ns/*