International Journal of Application or Innovation in Engineering & Management (IJAIEM)
Web Site: www.ijaiem.org Email: editor@ijaiem.org, editorijaiem@gmail.com
Volume 2, Issue 7, July 2013 ISSN 2319 - 4847

Green Networking in Practice: Performance evaluation of Routing Protocols for ad-hoc Networks based on Energy Consumption

Madhu Lakshmi[1], Ashwani Kumar[2], Nitin Arora[3]

[1&2]G. B. Pant Engineering College, Pauri
[3]Women Institute of Technology, Dehradun

Abstract

Ad hoc networks are characterized by multi-hop wireless connectivity, frequently changing network topology and the need for efficient dynamic routing protocols. A major issue with ad-hoc networks is energy consumption since nodes are usually mobile and battery-operated. In this paper we have mainly focused on energy consumption issues of routing protocols. We compare the Performance of three routing protocols for mobile ad hoc networks: Dynamic Source Routing (DSR), Ad Hoc On-Demand Distance Vector Routing (AODV) and Destination-Sequenced Distance-Vector Routing (DSDV) on the basis of energy consumption. The performances of protocols are analyzed in different network scales and based on the observation we make several recommendations.

Keywords: Ad-hoc networks, energy consumption, routing protocols, performance evaluation.

1. INTRODUCTION

Wireless networks are an emerging new technology that will allow users to access information and services electronically, regardless of their geographic position. Wireless networks can be classified in two types, Infrastructure Network and Infrastructure less (ad-hoc) Networks.

Infrastructure Network consists of a network with fixed and wired gateways. A mobile host communicates with a bridge in the Network or called base station within its communication radius. The mobile unit can move geographically while it is communicating. When it goes out of range of one base station, it connects with new base station and starts communicating through it.

A mobile ad-hoc network (MANET) [1] group has been formed within IETF. The goal of IETF is to support mobile ad-hoc networks with hundreds of routers and solve challenges. A mobile ad-hoc network (MANET) is a self-configuring infrastructure, with small network of mobile devices connected by wireless links. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. An ad-hoc network is a collection of mobile computers or mobile nodes that cooperate to forward packets for each other to extend the limited transmission range of each node's wireless network interface. Each node must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet. Active research work for mobile ad hoc networks is carrying on mainly in the fields of Medium Access Control (MAC), routing, resource management, power control, and security. Because of the importance of routing protocols in dynamic multi hop networks, a lot of mobile ad hoc network routing protocols have been proposed in the last few years. Table 1 shows some of the routing protocols for MANETs.

Table 1: Some Routing Protocols for MANETs

Pro-active Routing or table-driven Protocols	DSDV, FSR, OLSR
Reactive Routing or On-demand routing Protocols	AODV, DSR
Hybrid (Pro-Active/Reactive)	ZRP

In this work we compare the Performance of three routing protocols for mobile ad hoc networks: Dynamic Source Routing (DSR), Ad Hoc On-Demand Distance Vector Routing (AODV) and Destination-Sequenced Distance-Vector Routing (DSDV) on the basis of energy consumption. The performances of protocols are analyzed in different network scales and based on the observation we make several recommendations. The rest of this paper is organized as follows: in section 2 we discussed the various routing techniques. In section 3 the QualNet software and the metrics that are taken into consideration in the simulation and the results are presented. Conclusion and future work is given in section 4.

2. VARIOUS ROUTING PROTOCOLS

DSR: In DSR [2] protocol the agent checks every data packet for source-route information. The packets are then forwarded as per the routing information. In case it cannot find any routing information in the packet, it provides the source route if route is known and when the destination is not known it caches the packet and sends out route queries. The routing query is initially sent to all nearby nodes and is always triggered by a data packet which has no route information regarding its destination. Route-replies are sent back either through the destination node or by intermediate nodes if routing information to the destination is found.

DSDV: In DSDV [4] protocol messages are exchanged between nearby mobile nodes (i.e. mobile nodes that are within range of one another). Routing updates may be triggered or routine. Updates are caused when routing information from one of the neighbors forces a change in the routing table. If there is a packet which the route to its destination is unknown it is cached while routing queries are sent out. The packets are cached until route-replies are received from the destination. The buffer has a size and time limit for caching packets beyond which packets are dropped. All packets which have destination to the mobile node are routed directly by the address dmux (dmux port hands the packets to the respective destination agents) to its port dmux. In the event that a target is not found (which happens when the destination of the packet is not the mobile node itself), the packets are forwarded to the default target which is the routing agent. The routing agent designates the next hop for the packet and sends it down to the link layer.

AODV: AODV protocol [3] is a mixture of both DSR and DSDV protocols. It keeps the basic route-discovery and route-maintenance of DSR and uses the hop-by-hop routing sequence numbers and beacons of DSDV. When a node needs to know a route to a specific destination it creates a ROUTE REQUEST. Next the route request is forwarded by intermediate nodes which also create a reverse route for itself from the destination. When the request reaches a node with route to destination it creates again a ROUTE REPLY which contains the number of hops that are require to reach the destination. All nodes that participate in forwarding this reply to the source node create a forward route to destination. This route created from each node from source to destination is a hop-by-hop state and not the entire route as in source routing. One advantage of AODV is that AODV is loop-free due to the destination sequence numbers associated with routes. The algorithm avoids the Bellman-Ford "count to infinity" problem [5]. Therefore, it offers quick convergence when the ad hoc net-work topology changes which, typically, occurs when a node moves in the network [5]. Similar to DSR, poor scalability is disadvantage of AODV [6].

3. SIMULATION METRICS AND RESULTS

3.1. Scenario and Simulation Environment

The aim of these simulations is to compare the various routing protocols (DSR, DSDV and AODV) for its efficiency in terms of power. This has been done by calculation the energy with respect to different network size and taking the remaining battery power. QualNet 5.0.2 Simulation tool has been used in this study. The physical medium used is 802.11 PHY with a data rate of 2 Mbps. The MAC protocol used is the 802.11 MAC protocol, configured for MANET mode. The simulations are carried out for network densities of 10, 20 and 30 nodes respectively. The area considered for the above network densities are 500m x 300m for stationary nodes. Simulations are configured for the performance evaluation of different routing protocols with the metrics like packet delivery ratio, end to end delay and throughput. Figure 1 shows the node placement scenario for the 50 nodes. Initial energy of a node is 1000.0Joules and the mobility is 0 or 20 m/s. In all the cased, only two senders Constant Bit-rate (CBR) over User Datagram Protocol (UDP) and two receivers (null sink) have been used.

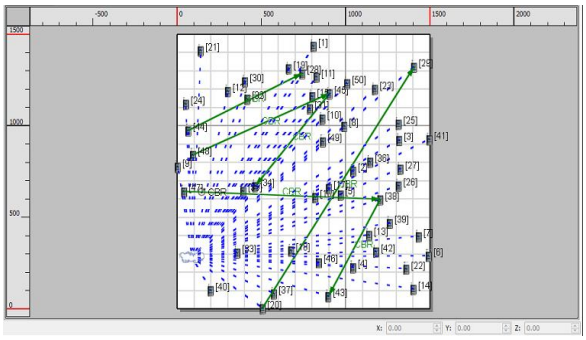

Figure 1. Node Placement Scenario

3.2 Performance Metrics Considered

Remaining Battery Power	The number of nodes in the network versus the average remaining battery power is considered to analyze the performance of the protocols in terms of power.
Consumed Power	The number of nodes in the network versus average consumed battery power is considered.

3.3 Results

3.3.1 Average Consumed Power versus the number of nodes

The figure 2 shows that the Routing Energy for all the three protocols is almost similar if the number of nodes are less (10, 20, 25) but there is a drastically change in the routing energy if we increased the number of nodes above 25. Energy consumption is the minimum for the DSR protocol followed by AODV and DSDV. If the numbers of nodes in the network are less, we can use any of the three protocols but for higher number of nodes the DSR protocol consumed less energy.

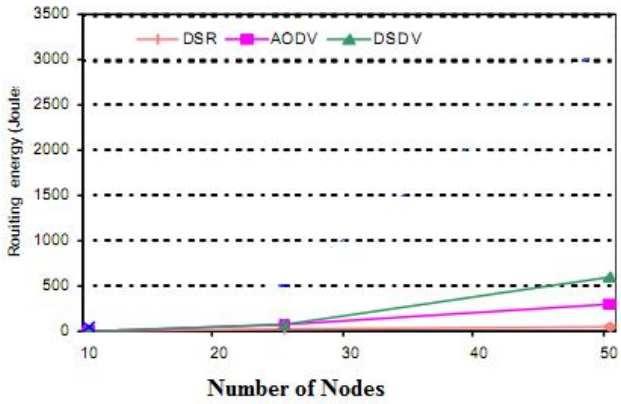

Figure 2: Routing Power Consumption comparison for the three protocols as a function of number of nodes.

4. CONCLUSION AND FUTURE WORK

This study has evaluated three ad-hoc routing protocols in different network environment taking into consideration node mobility. The results show that the energy consumption in small size networks did not reveal any significant differences. The performance of AODV, DSDV and DSR in small size networks was comparable. But in medium and large size networks, the AODV and DSR produced good results and the performance of DSR in terms of energy consumption is good.

References

[1.] C.Siva Rammurty and B.S.Manoj [2011],"Ad hoc wireless networks architectures and protocols".
[2.] D. Maltz, Y. Hu, The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks, Internet Draft, Available: http://www.ietf.org/internet-drafts/draft-ietf-manet-dsr-10.txt, July 2004.
[3.] C. Perkins and E. Royer, Ad Hoc On-demand Distance Vector (AODV) Routing, Internet Draft, MANET working group, draft-ietf-manet-aodv-05.txt, March 2000.
[4.] A. H. Abd Rahman, Z. A. Zukarnain, Performance Comparison of AODV, DSDV and I-DSDV Routing Protocols in Mobile Ad Hoc Networks, European Journal of Scientifc Research Vol. 31, No. 4, pp. 556-576 (June, 2009).
[5.] Z. J. Haas, M. R. Pearlman, and P. Samar, "The Interzone Routing Protocol (IERP) for Ad Hoc Networks," Internet Engineering Task Force (IETF) draft, July 2002. Available at http://www.ietf.org/internet-drafts/draft-ietf-manet-zone-ierp-02.txt.
[6.] I. D. Aron and S. K. S. Gupta, "On the scalability of on-demand routing protocols for mobile ad hoc networks: an analytical study," in Journal of Interconnection Networks, vol. 2, no. 1, pp. 5-29, 2001.

Author

Nitin Arora (nitinarora47@gmail.com) received B. Tech. (Computer Science & Engineering) from MNNIT Allahabad in 2008 and M. Tech. (Computer Science & Engineering) from Govind Ballabh Pant Engineering College, Pauri, Garhwal Uttarakhand in 2012. he is the member of IANEG (USA), ISOC (USA) and IACSIT (USA) and has published over several research papers in National and International journals/conferences in the field of Mobile Ad-Hoc Networks, Data Structures and Algorithms. He started his career as a Lecturer from Shobhit Institute of Engineering and Technology, Saharanpur and later on promoted as an Assistant Professor in the Department of Computer Science & Engineering at Women's Institute of Technology (WIT) Constituent college of Uttarakhand Technical University (UTU), Dehradun. He finished his M. Tech. from Govind Ballabh Pant Engineering College, Pauri, Garhwal, Uttarakhand in the field of Data Structures and Algorithms Design under Ministry of HRD, Government of India fellowship. Currently he is working as an Assistant Professor in the Department of Computer Science & Engineering at Women's Institute of Technology (WIT) Constituent college of Uttarakhand Technical University (UTU), Dehradun.