International Journal of Advances in Computer Networks and Its Security– IJCNS
Volume 4 : Issue 3 [ISSN 2250 – 3757]
Publication Date : 30 September, 2014

Investigations on Routing Protocols in Mobile Grid Environment

Dr.L.Nirmala Devi
Dept.of ECE, University College of Engineering,
Osmania University, Hyderabad, India
E-mail: nagiitkgp@yahoo.co.in

Abstract

Grid computing has recently migrated from traditional high performance and distributed computing to pervasive and utility computing based on the advanced capabilities of the wireless networks and the lightweight, thin devices. As a result the emergence of a new computing paradigm which evolved is the Mobile Grid. This paper presents the simulation results in order to choose the best routing protocol to give the highest performance. When implement the routing protocols in the target mobile grid application. The simulations comparing three ad hoc routing protocols named DSDV, DSR and AODV. The simulations have shown that the conventional routing protocols like DSR have a dramatic decrease in performance when mobility is high. However the AODV and DSDV are perform very well when mobility is high.

I. INTRODUCTION

One of the most critical things for understanding and realizing Mobile Grid computing is to have a consistent and accurate definition, or at least determination of what a Mobile Grid is. There are many attempts for the accurate definition of the Grid. However the various approaches that have been made to address in a high degree of accuracy the term Grid. Mobile Grid, in relevance to both Grid and Mobile Computing, is a full inheritor of Grid with the additional feature of supporting mobile users and resources in a seamless, transparent, secure and efficient way [3]. It has the ability to deploy underlying ad-hoc networks and provide a self-configuring Grid system of mobile resources (hosts and users) connected by wireless links and forming arbitrary and unpredictable.

Mobile Grid enables both the mobility of the users requesting access to a fixed Grid and the resources that are themselves part of the Grid. Both cases have their own limitations and constraints that should be handled. In the first case the devices of the mobile users act as interfaces to the Grid to monitor and manages the activities in 'anytime, anywhere' mode, while the Grid provides them with a high reliability, performance and cost-efficiency. Physical limitations of the mobile devices make necessary the adaptation of the services that Grid can provide to the users' mobile devices. In the second case of having mobile Grid resources, we should underline that the performances of current mobile devices are significantly increased. Laptops and PDAs can provide aggregated computational capability when gathered in hotspots, forming a Grid on site. This capability can have advantage the usage of Grid applications even in places where this would be imaginary.

The objective of this paper is to study the Mobile Ad-hoc Network (MANET) routing protocol in grid environment. It is to make the comparison between AODV, DSDV and DSR routing protocols, using the performance metric such as packet delivery fraction, average-end to end delay and packet loss. This paper also carry out the analysis and discuss which protocol the is best between AODV, DSR and DSDV in mobility that implement in grid environment.

II. AD HOC ON DEMAND DISTANCE VECTOR (AODV)

The Adhoc On Demand Distance Vector (AODV) routing algorithm is a routing protocol designed for ad-hoc mobile networks [1] [7]. AODV is capable of both unicast and multicast routing [15]. It is an on demand algorithm, meaning that it builds routes between nodes only as desired by source nodes. It maintains these routes as long as they are needed by the sources. Additionally, AODV forms trees which connect multicast group members. The trees are composed of the group members and the nodes needed to connect the members. AODV uses sequence numbers to ensure the freshness of routes. It is loop-free, self-starting, and scales to large numbers of mobile nodes [6].AODV builds routes using a route request / route reply query cycle. When a source node desires a route to a destination for which it does not already have a route, it broadcasts a route request (RREQ) packet across the network. Nodes receiving this packet update their information for the source node and set up backwards pointers to the source node in the route tables. In addition to the source node's IP address, current sequence number, and broadcast ID, the RREQ also contains the most recent sequence number for the destination of which the source node is aware. A node receiving the RREQ may send a route reply (RREP) if it is either the destination or if it has a route to the destination with corresponding sequence number greater than or equal to that contained in the RREQ. If this is the case, it unicasts a RREP back to the source. Otherwise, it rebroadcasts the RREQ. Nodes keep track of the RREQ's source IP address and broadcast ID [6]. If they receive a RREQ which they have already processed, they discard the RREQ and do not forward it.As the RREP propagates back to the source, nodes set up forward pointers to the destination. Once the source node receives the RREP, it may begin to forward data packets to the destination. If the source later receives a RREP containing a greater sequence number or contains the same sequence number with a smaller hop count, it may update its routing information for that destination and begin using the better route.

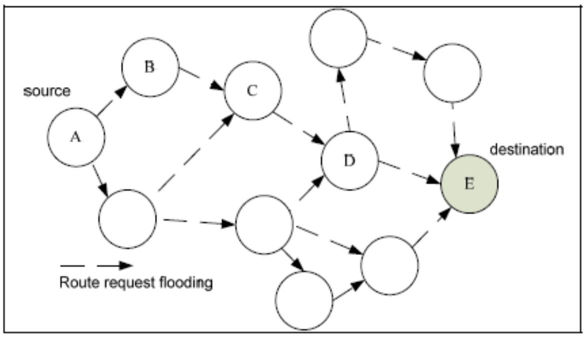


Figure 1.1. Route Request (RREQ) flooding

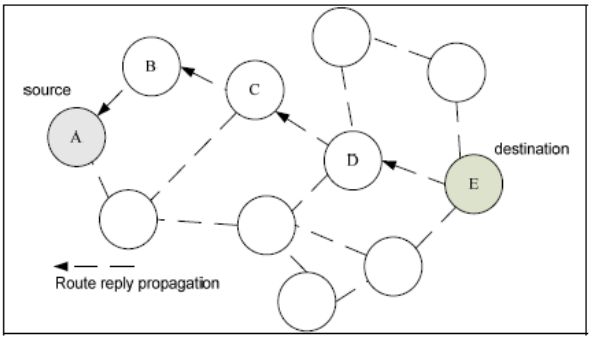


Figure 1.2. Route Reply (RREP) propagation

As long as the route remains active, it will continue to be maintained. A route is considered active as long as there are data packets periodically traveling from the source to the destination along that path. Once the source stops sending data packets, the links will time out and eventually be deleted from the intermediate node routing tables. If a link break occurs while the route is active, the node upstream of the break propagates a route error (RERR) message to the source node to inform it of the now unreachable destination(s). After receiving the RERR, if the source node still desires the route, it can reinitiate route discovery.

III. Dynamic Source Routing (DSR)

Dynamic Source Routing (DSR) is a routing protocol for wireless mesh networks [16]. It is similar to AODV in that it forms a route on-demand when a transmitting computer requests one. However, it uses source routing instead of relying on the routing table at each intermediate device [8]. Many successive refinements have been made to DSR, including DSRFLOW.

Determining source routes requires accumulating the address of each device between the source and destination during route discovery. The accumulated path information is cached by nodes processing the route discovery packets. The learned paths are used to route packets. To accomplish source routing, the routed packets contain the address of each device the packet will traverse. This may result in high overhead for long paths or large addresses, like IPv6 [14]. To avoid using source routing, DSR optionally defines a flow id option that allows packets to be forwarded on a hop-by-hop basis. This protocol is truly based on source routing whereby all the routing information is maintained (continually updated) at mobile nodes. It has only 2 major phases which are Route Discovery and Route Maintenance [4].Route Reply would only be generated if the message has reached the intended destination node (route record which is initially contained in Route Request would be inserted into the Route Reply). To return the Route Reply, the destination node must have a route to the source node. If the route is in the Destination Node's route cache, the route would be used. Otherwise, the node will reverse the route based on the route record in the Route Reply message header (symmetric links). In the event of fatal transmission, the Route Maintenance Phase is initiated whereby the Route Error packets are generated at a node. The erroneous hop will be removed from the node's route cache; all routes containing the hop are truncated at that point. Again, the Route Discovery Phase is initiated to determine the most viable route.

IV. Destination-Sequenced Distance-Vector Routing (DSDV)

Destination-Sequenced Distance-Vector Routing (DSDV) is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm. It was developed by C. Perkins and P.Bhagwat in 1994 [21]. The main contribution of the algorithm was to solve the Routing Loop problem. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number [18]. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently.DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle. Whenever the topology of the network changes, a new sequence number is necessary before the network re-converges; thus, DSDV is not suitable for highly dynamic networks. (As in all distance-vector protocols, this does not perturb traffic in regions of the network that are not concerned by the topology change.)

V. PERFORMANCE METRICS

The project focuses on 3 performance metrics which are quantitatively measured. The performance metrics are important to measure the performance and activities that are running in NS-2 simulation. The performance metrics are:

Packet delivery fractions (PDF) — also know as the ratio of the data packets delivered to the destinations to those generated by the CBR sources. The PDF shows how successful a protocol performs delivering packets from source to destination. The higher for the value give use the better results. This metric characterizes both the completeness and correctness of the routing protocol also reliability of routing protocol by giving its effectiveness.

$$\text{Pkt Delivery } \% = \frac{\sum_1^n \text{CBRrecv}}{\sum_1^n \text{CBRrecv}} \times 100 \ \ldots\ldots \text{equation 1}$$

Average end-to-end delay of data packets — There are possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times. The thesis use Average end-to-end delay. Average end-to-end delay is an average end-to-end delay of data packets. It also caused by queuing for transmission at the node and buffering data for detouring. Once the time difference between every CBR packet sent and received was recorded, dividing the total time difference over the total number of CBR packets received gave the average end-to-end delay for the received packets. This metric describes the packet delivery time: the lower the end-to-end delay the better the application performance.

$$Avg\_End-to-End\_Delay = \frac{\sum_1^n (CBRsentTime - CBRrecvTime)}{\sum_1^n CBRrec} \ldots\ldots Equation2$$

Data Packet Loss (Packet Loss) — Mobility-related packet loss may occur at both the network layer and the MAC layer. In the thesis packet loss concentrate for network layer. When a packet arrives at the network layer. The routing protocol forwards the packet if a valid route to the destination is known. Otherwise, the packet is buffered until a route is available. A packet is dropped in two cases: the buffer is full when the packet needs to be buffered and the time that the packet has been buffered exceeds the limit.

$$PLose = DataAgtSent - DataAgtRec\ldots\ldots Equation\ 3$$

Throughput:
Throughput is the number of bytes of data successfully delivered per unit time. Throughput is controlled by available bandwidth, as well as the available signal-to-noise ratio and hardware limitations. In communication networks, such as Ethernet, throughput or network throughput is the average rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot. The system throughput or aggregate throughput is the sum of the data rates that are delivered to all terminals in a network.

Throughput = Number of bytes delivered*8/time in seconds

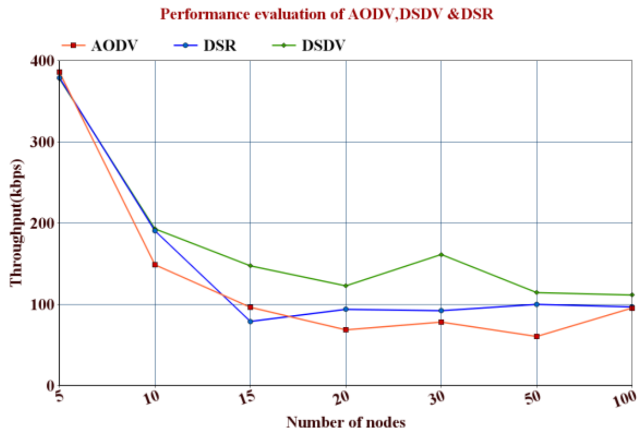
VI. SIMULATION RESULTS

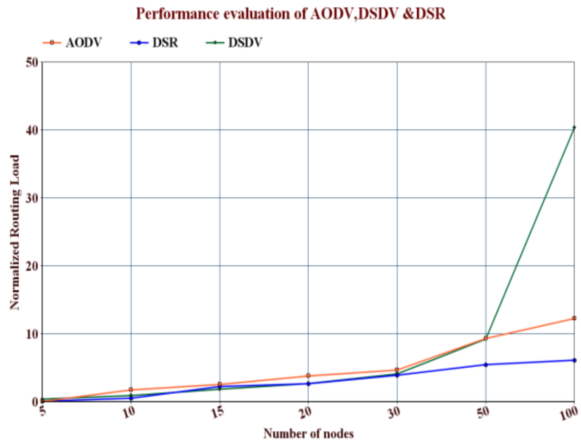
Simulation parameters are as follow:

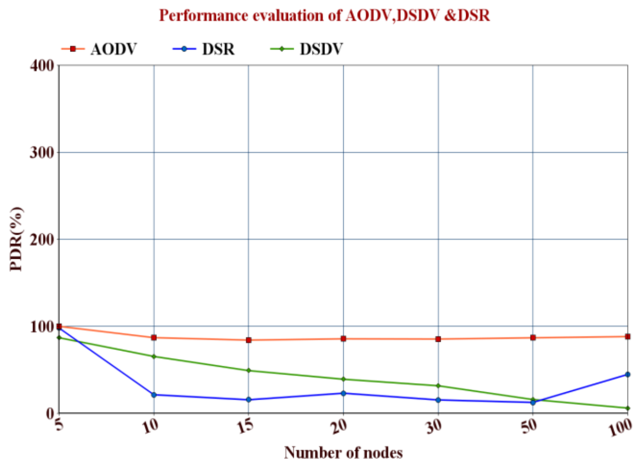
PARAMETER	VALUE
Simulator	Ns2
Protocols studied	AODV,DSR,DSDV
Simulation time	200sec
Simulation area	1000* 1000
Number of nodes	5,10,15,20,30,50,100
Traffic type	CBR(Constant Bit Rate)
Data Payload	Bytes/Packet
Packet Size	1500 bits
Buffer size	500

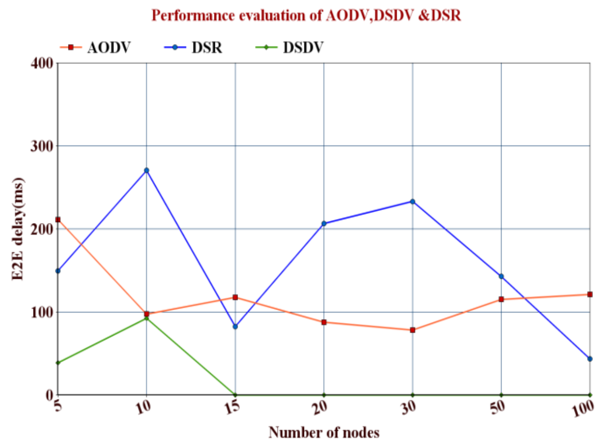
Comparisons of AODV, DSR, DSDV

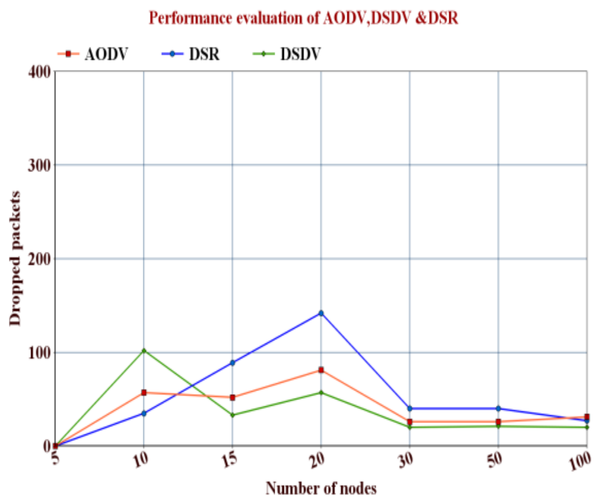
Protocol	Throughput (kbps)	E2E delay (ms)	PDR (%)	Drop. packets	NRL
AODV	Low	AVG	High	AVG	AVG
DSR	AVG	High	AVG	High	Low
DSDV	High	Low	Low	Low	High











VII. CONCLUSION:

In this paper we compared the performance of DSDV, AODV and DSR routing protocols for ad hoc networks using ns-2 simulations. DSDV uses the proactive table-driven routing strategy while both AODV and DSR use the reactive On-demand routing strategy.

Among AODV, DSR, and DSDV: AODV has low throughput, moderate dropped packets, end to end delay, normalized routing load and highest packet delivery ratio. Whereas DSR has highest dropped packets, end to end delay, moderate packet delivery ratio, throughput, and low normalized routing load. For DSDV protocol it has highest throughput, normalized routing load, lowest dropped packets ,packet delivery ratio,end to end delay.Final conclusion from the above simulations is:

Among the proactive and reactive protocols reactive routing protocols are efficient. Among all the three protocols AODV routing protocol is the best and efficient protocol. Next best routing protocol is DSR routing protocol and least efficient one is DSDV routing protocol

Thus, reactive routing protocols have better scalability than proactive. But when using reactive routing protocols, source nodes may suffer from long delays, hence these protocols are not suitable for real time applications.

REFERENCES

[1] Azizol Abdullah, Norlida Ramly, Abdullah Muhammed, Mohd Noor Derahman: Performance Comparison Study of Routing Protocols for Mobile Grid Environment, pp 82-88, IJCSNS International Journal of Computer Science and Network Security, VOL.8 No.2, February 2008

[2] C. S. R. Murthy and B. S. Manoj, Ad Hoc Wireless Networks: Architecture and Protocols, ch. Routing Protocols for Ad Hoc Wireless Networks, pp. 299{364.Prentice Hall Communications Engineering and EmergingTechnologies Series, New Jersey: PrenticeHallProfessional Technical Reference, 2004.

[3] Irving,M., Taylor.G., and Hobson.P. (2004). Plug in to Grid Computing. IEEE Power & Energy Magazine,March/April, pp.40-44.

[4] Staub.T., (2004). Ad-hoc and Hybrid Networks:Performance Comparison of MANET Routing Protocols in Ad-hoc and Hybrid Networks. Institute of Computer Science and Applied Mathematics, University of Berne,Switzerland, pp.1-38.

[5] Chao,C-M., Sheu,J-P.,and Hu,C-T. (2003). Energy-Conserving Grid Routing Protocol in Mobile Ad HocNetworks. IEEE Proceedings of the 2003 International Conference on Parallel Processing (ICPP'03).

[6] Z.Alexander, Performance Evaluation of AODV Routing Protocol: Real-Life Measurements, SCC,June 2003

[7] Altman E, and Jimenez T., (2003). NS Simulator for Beginners. Lecture notes. Univ.de Los Andes, Merida,Venezuela and ESSI.Sophia-Antipolis, France.

[8] D. Johnson, Dynamic Source Routing for Mobile Ad Hoc Networks, IEFT MANET Draft, April 2003

[9] S. Nesargi, R. Prakash, "MANETconf: Configuration of Hosts in a Mobile Ad Hoc Networks", 21st Annual Joint Conf. of the IEEE Computer and Communications Societies (INFOCOM), Jun. 2002.

[10] Wen,Y., Mobile Grid. (2002). Department of Computer Science, University of California, Santa Barbara,pp.1-7.[11] S. Das, C. Perkins, and E. Royer. Performance comparison of two on-demand routing protocols for ad hoc networks. In INFOCOM'2000 (1), pages 3–12, 2000.

[12] K. Fall. ns notes and documentation. The VINT Project, 2000.

[13] D.Johnson. Validation of wireless and mobile network models and simulation. In DARPA/NIST Network Simulation Validation Workshop, Fairfax, Virginia, USA,May 1999.

[14] D. Johnson, D. Maltz, and J. Broch. DSR: The Dynamic Source Routing Protocol for Multihop Wireless Ad Hoc Networks. In Ad Hoc Networking, C. Perkins (ed), Chapter 5, pages 139–172, 2001.

[15] Charles E. Perkins and Elizabeth M. Royer, "Ad Hoc On-Demand Distance Vector Routing," in Proceedings of the 2nd IEEE Workshop on Mobile Computing Syslems and Applications, Feb. 1999, pp. 90-100.

[16] David B. Johnson and David A. Maltz, ''Dynamic source routing in adhoc wireless networks," in Mobile computing, T. lmielinski and H. Kmh, Eds, Kluwer Academic, 1996,

[17] David B. Johnson and David A. Maltz. Dynamic Source Routing in Ad Hoc Wireless Networks. In Mobile Computing, edited by Tomasz Imielinski and Hank Korth, chapter 5, pages 153–181. Kluwer Academic Publishers, 1996.

[18] Perkins,C.E., and Bhagwat.P. (1994). Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers. ACM, pp.234 – 244.

[19] The Network Simulator NS-2 homepage, http://www.isi.edu/nsnam/ns/

[20] The Network Simulator NS-2 tutorial homepage,http://www.isi.edu/nsnam/ns/tutorial/index.html

ACKNOWLEDGEMENT

I would like to express my deep sence of thanks to TEQIP-II office, UCE, OU and its officials for sponsoring me to present my research paper in the conference at New Cavendish Campus University of Westminster, London, UK during 01-02 June, 2014.

AUTHOR BIOGRAPHIE

Dr. Nirmala Devi .L received B.E and M.E degrees in Electronics and Communication Engineering in 1997 and 2005 from Osmania University Hyderabad, India.

She joined the Department of Electronics and Communication Engineering Osmania University as an Assistant professor in 2007. She has received Ph.D Degree in 2014, her research interest includes Optical networks, Mobile Adhoc and sensor networks, She has published papers in IEEE and various international conferences and journals.