INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATIONS AND ROBOTICS
ISSN 2320-7345

PERFORMANCE VALUATION OF REACTIVE ROUTING PROTOCOLS

[1]Ajay Kumar, [2]Deepak Sharma, [3]Sunil Kumar, [4]Suneet Shukla

[1]*Ajay Kumar, School of Engineering & Technology, IFTM University, Moradabad, U.P, India*
[2] *Deepak Sharma , School of Social Sciences & Computer Applications, IFTM University, Moradabad, U.P, India*
[3] *Sunil Kumar , School of Social Sciences & Computer Applications, IFTM University, Moradabad, U.P, India*
[4]*Suneet Shukla, School of Engineering & Technology, IFTM University, Moradabad, U.P, India*

Abstract

Ad-Hoc Networks are the collection of wireless nodes that can exchange information dynamically among them without pre-fixed infrastructure. Because of highly dynamic in nature, performance of routing protocols is an important issue. In addition to this routing protocols face many challenges like limited battery backup, limited processing capability and limited memory resources. Other than efficient routing, efficient utilization of battery capacity and Security are also the major concern for routing protocols. This paper presents simulation based comparison and performance analyses on different parameters like PDR, Average end to end delay, Normalized Routing Load. The study is about two main protocols DSR and AODV.

Keywords: Mobile Ad-Hoc Networks, NS-2.35 Simulator, PDR, Normalized Routing Load, Dynamic Source Routing (DSR) and Ad-Hoc On-Demand Distance Vector (AODV).
.

1. Introduction

Ad-Hoc Wireless Network is a collection of autonomous nodes that communicate with each other by forming a multi-hop network, maintaining connectivity in a decentralized manner [1], [2]. It consists of a set of mobile hosts communicating amongst themselves using wireless links, without the use of any other communication support facilities such as base-stations. The nodes in a MANET (Mobile Ad-Hoc network) can be PDAs, laptops or any other device that is capable of transmitting and receiving information. Each node in such a network acts as a host or end system (transmitting and receiving data) as well as a router at the same time. The nodes in a MANET are generally mobile and may go out of range of other nodes in the network. Therefore, Routing in MANET is difficult since mobility causes frequent network topology changes and requires more robust and flexible mechanism to search for and maintain the routes. When the network nodes move, the established paths may break and the routing protocols must dynamically search for other feasible routes. With a changing topology, even maintaining connectivity is very difficult. In addition, keeping the routes loop free is more difficult when the hosts move. Besides handling the topology changes, routing protocols in MANET must deal with other constraints, such as low bandwidth, limited energy consumption, and high error rates; all of which may be inherent in the wireless environment.
The scope of this paper is to analyze a set of performance parameters in an IEEE 802.11 based Wireless Ad-Hoc network, operating in an ad-hoc mode, and an IEEE 802.11 based network. Two different routing protocol mechanisms are explored, i.e. AODV (Ad hoc On demand Distance Vector) and DSR (Dynamic Source Routing), because of their simplicity and performances when implemented in various Ad-Hoc networks environments. The

paper concentrates on performance analysis of these two protocol schemes in order to better understand the protocol efficiency and flexibility. The basic functionalities of these protocols offer possibilities for further improvements resulting in possible development of more advanced routing schemes as a future work. The paper is organized as follows. Section II gives a short overview of the Protocols used in Ad-Hoc and Wireless networks and briefly explains the protocol mechanism used in the analysis. Section III elaborates the Mobility Models used in Simulative study. Section IV describes the simulation scenario. Section V and shows the Performance Parameter and results obtained by simulation in ns-2.35. Finally, Section VI concludes the paper.

2. PROTOCOL USED

A. Dynamic Source Routing (DSR):

DSR [3] is a reactive routing protocol which allows nodes in the MANET to dynamically discover a source route across multiple network hops to any destination. In this protocol, the mobile nodes are required to maintain *route caches* or the known routes. The route cache is updated when any new route is known for a particular entry in the route cache.

Routing in DSR is done using two phases: route discovery and route maintenance. When a source node wants to send a packet to a destination, it first consults its route cache to determine whether it already knows about any route to the destination or not. If already there is an entry for that destination, the source uses that to send the packet. If not, it initiates a route request broadcast. This request includes the destination address, source address, and a unique identification number. Each intermediate node checks whether it knows about the destination or not. If the intermediate node doesn't know about the destination, it again forwards the packet and eventually this reaches the destination. A node processes the route request packet only if it has not previously processed the packet and its address is not present in the route record of the packet. A route reply is generated by the destination or by any of the intermediate nodes when it knows about how to reach the destination.

B. Ad-Hoc On-Demand Distance Vector Routing (AODV):

AODV [4] is basically an improvement of Dynamic Destination-Sequenced Distance-Vector (DSDV) routing protocol. But, AODV is a reactive routing protocol instead of being proactive. It minimizes the number of broadcasts by creating routes based on demand, which is not the case for DSDV. When any source node wants to send a packet to a destination, it broadcasts a route request (RREQ) packet. The neighboring nodes in turn broadcast the packet to their neighbors and the process continues until the packet reaches the destination. During the process of forwarding the route request, intermediate nodes record the address of the neighbor from which the first copy of the broadcast packet is received. This record is stored in their route tables, which helps for establishing a reverse path. If additional copies of the same RREQ are later received, these packets are discarded. The reply is sent using the reverse path. For route maintenance, when a source node moves, it can reinitiate a route discovery process. If any intermediate node moves within a particular route, the neighbor of the drifted node can detect the link failure and sends a link failure notification to its upstream neighbor. This process continues until the failure notification reaches the source node. Based on the received information, the source might decide to reinitiate the route discovery phase. Each of these routing protocols was tested in our simulation experiments. The details of our works and our built prototype are mentioned in the following sections.

3. MOBILITY MODEL USED IN SIMULATIVE STUDY

Random Way Mobility Model:

In random-based mobility models, the mobile nodes move randomly and freely without restrictions. To be more specific, the destination, speed and direction are all chosen randomly and independently of other nodes. This kind of model has been used in many simulation studies.

Random mobility model is the Random Way Point mobility model [5]. This can be considered as an extension of the Random Walk mobility model, with the addition of pauses between changes in direction or speed. However, also in this case, the realism of the model in terms of geo graphical movement is far from being realistic. First of all, the initial placement of the nodes in the network does not mirror any real world situation3. The model also suffers from the fact that the nodes concentrate in the middle of the area if we consider a bounded area. A possible solution is to assume spherical or thyroidal surfaces, but clearly these geometrical abstractions are utterly unrealistic. An additional problem is related to the stationary of the model (i.e., the variance of the characteristics of the model over time). This model suffers from the fact that the transient (i.e., non-stationary) regime may last for a very long time. One method for avoiding such a bias is to remove the initial part of the simulations in order to avoid the transient regime. However, this does not guarantee that the simulation has reached a stationary regime, since the time that is necessary to reach a stationary regime may be longer than the duration of the simulation itself. Finally, it has also been shown that the model also exhibits speed decay over time [6]. A partial solution to this problem has been proposed in [7].

In [8, 9], the authors present a generalization of the Random Walk and Random Way-Point mobility models that they call Random Trip model. The authors introduce a technique to sample the initial simulation state from the stationary regime (a methodology that is usually called perfect simulation) based on Palm Calculus [10] in order to solve the problem of reaching time-stationary. Perfect simulation for the Random Way-Point model was originally proposed by Navidi and Camp in [11]. The analytical properties of the Random Way-Point model have been analyzed in several works from different perspectives such as the stationary distribution of nodes [12, 13], the node spatial distribution [14] and the evolution of the distribution of the nodes by means of partial differential equations [15].

4. SIMULATION CONSTRAINT

Simulations have been carried out by the Network Simulator version 2.35 (NS2) [4]. Hardware and operating system (OS) configuration for performing simulations is specified in Table 2. The basic mobility scenario generation tool is BONNMOTION [5].

Table 1: Performance Parameters

Parameter	Value
Channel type	Wireless channel
Simulator	NS 2 (Version 2.35)
protocols	AODV, DSR
Simulation duration	300sec
Number of nodes	20,50,100,150
Queue length	200
Movement Model	Random
MAC Layer Protocol	802.11
Antenna	Omni antenna
Traffic type	CBR(Constant Bit Rate)
Environment Size	700m * 700m

For each simulation, the position and movements of the nodes are put randomly as well as the traffic among them. BONNMOTION is the accountable for the random properties of the positions and movements of the nodes and for the traffic NS-2.35 random variables are used. Setting the random variables accurately is a key point because if this is done wrong, some simulations can be associated and we can come up with bad results even if we think we have performed a sufficient amount simulation to describe a general case [11]. BONNMOTION 2.0 is the responsible to produce all movements' information in tcl according to the mobility model selected. When they are generated, the movement patterns present a brief period so we have to be alert to skip this first seconds since they do not present the properties of the mobility model wanted. Each model must be checked or analyzed in order to see how much time is necessary to be skipped. Furthermore, according to [12], CBR traffic under UDP must be used to compare accurately the different protocols. TCP has a slow.

5. PERFORMANCE PARAMETER AND RESULTS

A. Performance Parameters

The management of routing protocols is with the following significant Quality of Services (QoS) metrics for routine measures:

1. ***Packet Delivery Ratio (PDR):***

Packet delivery ratio is an important metric as it describes the loss rate that will be seen by the transport protocols, which run on top of the network layer. Thus the packet delivery ratio in turn reflects the highest throughput that the network can support. It is defined in [9,10] as the ratio between the number of packets originated by the application layer Constant Bit Rate(CBR) sources and the number of packets received by the Constant Bit Rate(CBR) sink at the final destination[13,14]. It is the ratio of data packets delivered to the destination to those generated from the sources. It is calculated by dividing the number of packets received by destination through the number packet originated from the source.

$$PDR = (Pr / Ps)*100$$

Where Pr is total Packet received & Ps is the total Packet sent.

2. ***Average End-to-End Delay:***

This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times [9,10]. It is defined as the time taken for a data packet to be transmitted across an Ad Hoc from source to destination.

$D = (Tr - Ts)$, Where T_r is receive Time and Ts is sent Time.

3. ***Normalized Routing Load:***

The number of Routing packets transmitted per data packet delivered at the destination. Every hop-wise transmission of a routing packet is counted as one transmission. The first two metrics are the most important for best-effort traffic. The routing load metric evaluates the efficiency of the routing protocol. Conversely, that these metrics are not entirely independent.

B. Result Analysis

Here in case of performance analysis we have consider above performance parameters. In Figure1, 2 the simulations are focusing in analyzing the performance on routing overhead, throughput and packet delivery ratio. The results also compared with two mobility models that we had chosen .The result will show the performance for mobility models with respect to protocols that had been selected under different mobility models, which is shown in fig. 1 and 2.

1. ***Packet delivery ratio (PDR):***

Packet delivery ratio is an important parameter for performance analysis it explain the loss rate that will be observed by the transport protocols. Thus the packet delivery ratio in turn reflects the highest throughput that the network cans support. In the above discussed scenario the performance of DSR is far better than the AODV due to its route discovery mechanism. The given graph produced the comparatively result of AODV and DSR on the mobility of 25 node, 50 nodes, 100 nodes and 150 nodes. At lower speed 10 of node movement, the routing protocols AODV performed particularly well, they delivering the large amount of data packets regardless of mobility rate from DSR but in all cases of nodes speed, protocols AODV and DSR always perform better at low speed of nodes; When movement speed of nodes greater than 2 m/s the routing protocols AODV can delivered data packet between 80% to 70% and DSR routing protocols can delivered data packet between 20% to 30%, unlike when the speed greater than 20m/s the ratio of delivered packet will go to decreasing in all routing protocols. AODV Perform particularly well, delivering over 95% of the data packets regardless of mobility rate.

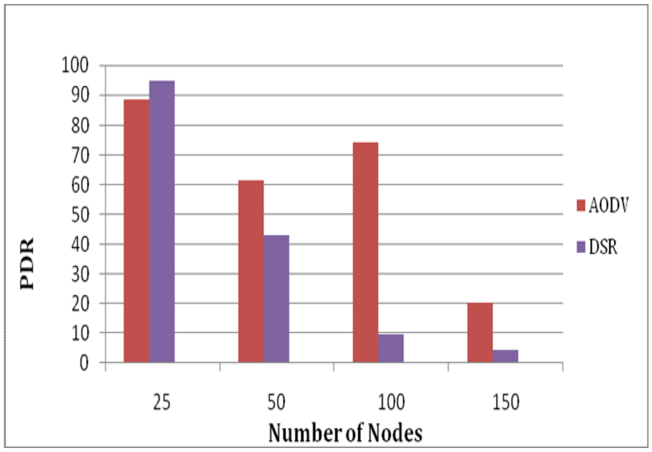

Figure1: Packet Delivery Ratio

2. Normalized Routing Load

Normalized Routing Load defined as the sum of the routing control messages such as RREQ, RREP, RRER, HELLO etc, counted by k bit/s. When run our simulation due to simulated time 100 s, we find that this metric exchange in the same way when speed of the movement nodes increase as Figures show that When nodes density increases, the normalized routing load increase for the protocols AODV and DSR, but when the speed of node movement increase, the normalized routing load for DSR begin with low load and it will reach to highest load when the speed increases protocol shows the best routing load unlike AODV which don't effect with network size and be saturated in all cases of node low movements.

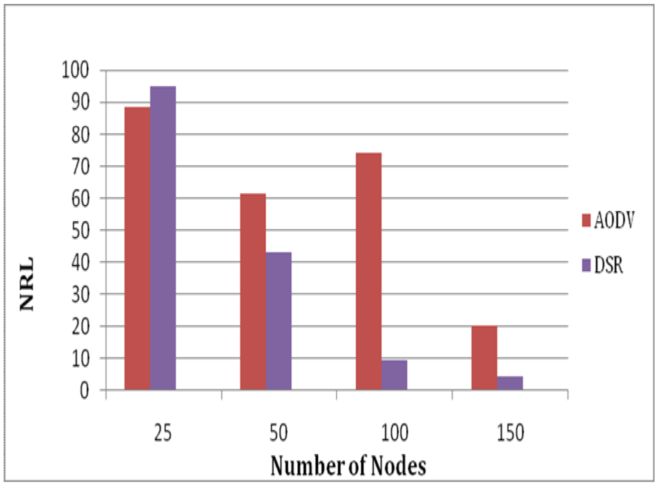

Figure 2: Normalized Routing Load

Vol.1 Issue.6, Pg: 39-44
September 2013

6. CONCLUSION

DSR is a widely used routing protocol for mobile Ad-Hoc networks, but has very low delivery rates and poor performance in lightly loaded networks with high node mobility. Several of the modifications proposed in the literature such as turning off intermediate node replies improves the performance somewhat. This paper presents three simple (and used in other routing protocols) techniques limiting replies sent by destination, keeping only one route per destination, and preferring fresher routes over shorter ones to further improve the performance of DSR. Factorial analysis indicates that both limited replies and one route per destination improve performance significantly and the third feature does not impact performance. While multiple routes may benefit at higher traffic loads, keeping only one route per destination helps sender nodes gather routes when the topology changes. Without using any complicated strategies, our proposed techniques perform significantly better than previously proposed modifications at very low traffic loads (50-100 Kbps) and about the same at higher traffic loads. Additional factorial analysis indicates that, besides routing protocol features, network density impacts the overall performance measurably. In future we intend to expand the statistical analysis to evaluate the significance of mobility and traffic patterns.

References

[1] S.K. Pathan, C.S. Hong, Routing in Mobile Ad Hoc Networks, in: S. Misra, I. Woungang, S.C. Misra (eds.), Guide to Wireless Ad Hoc Networks, Springer London, ISBN: 978-1-84800-328-6, 2009, pp. 59-96.

[2] S. Marti, T.J. Giuli, K. Lai, M. Baker, Mitigating routing misbehavior in mobile ad hoc networks, Proceedings of ACM MOBICOM 2000, Boston, MA, USA, pp. 255-265.

[3] J. Broch, D.B. Johnson, D.A. Maltz, The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks, IETF Draft, October 1999, Available at http://tools.ietf.org/html/draft-ietf-manet-dsr-03

[4] C.E. Perkins, E.M. Royer, I.D. Chakeres, Ad Hoc On-Demand Distance Vector (AODV) Routing. IETF Draft, October 2003, available at http://tools.ietf.org/html/draft-perkins-manet-aodvbis-00.

[5] D. B. Johnson and D. A. Maltz. Dynamic Source Routing in ad hoc wireless network. In T. Imielinski and H. Korth, editors, Mobile Computing, chapter 5, pages 153–181. Kluwer Academics Publisher, 1996.

[6] J. Yoon, M. Liu, and B. Noble. Random waypoint considered harmful. In Proceedings of INFOCOM'03, 2003.

[7] J. Yoon, M. Liu, and B. Noble. Sound mobility models. In Proceedings of Mobi- Com'03, pages 205–216, New York, NY, USA, 2003. ACM.

[8] J.-Y. Le Boudec and M. Vojnovic. The random trip model: stability, stationary regime, and perfect simulation. IEEE/ACM Transactions on Networking, 14(6):1153–1166, 2006.

[9] J.-K. Lee and J. C. Hou. Modeling steady-state and transient behaviors of user mobility: formulation, analysis, and application. In Proceeding of MobiHoc'06, pages 85–96, New York, NY, USA, 2006. ACM.

[10] J.-Y. Le Boudec. Understanding the simulation of mobility models with Palm calculus. Performance Evaluation, 64(2):126–147, 2007.

[11] W. Navidi and T. Camp. Stationary distributions for the random Way point mobility model. IEEE Transactions on Mobile Computing, 3(1):99–108, 2004.

[12] C. Bettstetter, H. Hartenstein, and X. P´erez-Costa. Stochastic properties of the random waypoint mobility model. Wireless Networks (Special Issue on Modeling and Analysis of Mobile Networks), 10(5):555–567, 2004.

[13] C. Bettstetter, G. Resta, and P. Santi. The Node Distribution of the Random Waypoint Mobility Model for Wireless Ad Hoc Networks. IEEE Transactions on Mobile Computing, 2(3):257–269, 2003.

[14] G. Resta and P. Santi. An analysis of the node spatial distribution of the random waypoint mobility model for ad hoc networks. In Proceedings of POMC'02, pages 44–50, New York, NY, USA, 2002. ACM.

[15] M. Garetto and E. Leonardi. Analysis of random mobility models with PDE's. In Proceedings of MobiHoc'06, pages 73–84, New York, NY, USA, 2006. ACM.

Biography

***Ajay Kumar* –** Sunil Kumar, M.Tech (CS), Research Scholar, Department of Computer Applications, IFTM University, Moradabad, Uttar Pradesh, India.

***Suneet shukla* –** Mr. Suneet Shukla, Assistant Professor- School of CSE, IFTM University, Moradabad, UP.