Available online at www.elixirpublishers.com (Elixir International Journal)

Adoc Network

Elixir Adoc Network 46 (2012) 8494-8497

ISSN: 2229-712X

Performance Analysis of Reference Point Group Mobility model, Random Mobility models in Associativity Based long-lived Routing(ABR) protocol

K.Muthumayil[1], V.Rajamani[2], S.Manikandan[3] and M.Buvana[4]

[1,4]PSNA College of Engineering & Tech, Dindigul, Tamilnadu, India.

[2]Indra Ganesan College of Engineering, Trichy, Tamilnadu, India.

[3]R.M.D Engineering, College, Gummudipoondi, Chennai, Tamilnadu, India.

ARTICLE INFO

Article history:
Received: 31 March 2012;
Received in revised form:
15 May 2012;
Accepted: 25 May 2012;

Keywords
ABR,
Link Stability,
RWP,RPGM, RDM.

ABSTRACT

In MANETs, the Associativity Based Long-Lived Routing (ABR) protocol is an good alternative to the position-based and the location-aided routing protocols.In ABR, the associativity is determined by many factors such as residual battery life time, link stability, storage capacity, processing power and etc., In this paper we consider link stability to determine the associativity of the nodes. Link stability refers to how long any two nodes can communicate with each other. If a mobile host is in high mobility , there will be low stability. If there is low mobility, there will be high stability between any two nodes. Moblity causes frequent topology changes and can break the existing path. In this work, we use various mobility models like random waypoint(RWP) model, reference point group mobility(RPGM) and random direction mobility(RDM) models to study the performance of ABR protocol. These models capture the behaviors of ABR protocol in the simulator. The simulation results can show the performance of the ABR protocol varies based on the mobility models across different performance parameters.

Introduction

Current research on MANETs focuses on source initiated on-demand routing protocols. These source initiated on demand routing protocols can be classified into many types like AODV, DSR, TORA, LAR and so on. Among these protocols LAR uses position information of the nodes to communicate. The use of position information used for location tracking and navigation. Global Positioning Systems (GPS) is the technique to determine its own position by using the Global Positioning System. Each node may have a location table to store the location information of other nodes. Based on location information in location table a sender can determine the location of the destination. Because of higher mobility of mobile devices in MANET's communication performance will suffer if data are routed based on location information alone. Recent research has shown that ABR can be a good alternative to Location Aided Routing (LAR) in large MANET's. By using associativity ticks of all the nodes, the path can be determined by the source, specifically associativity is measured by the nodes connectivity relationship with its neighbors changes as it is migrating and its transition period can be identified by associativity ticks or counts.

Related work

As many popular MANET On-Demand Routing[19] algorithms are available, we will present related work on link stability based routing protocol in this section. Link stability depends on the mobility of the nodes that are constituting the path from one to another node. A link is available when the radio quality of the link satisfies the minimal requirement for a successful transmission. Stability based protocols use stability or variations of stability as the routing metric. The implicit goal of most stability based routing protocols is to find and select the long(est)-lived routes. Associativity Based Routing (ABR) [12][13][14][15][16][17][18][20] is probably the first protocol in the class of stability based protocols for MANETs. In ABR, a new metric called associativity is defined to determine link stability. In simple terms, ABR is based on the idea that nodes which are neighbors for a threshold period are more likely to remain as neighbors for longer time, or less likely to move away. ABR assumes that after the threshold period, nodes move with similar speeds and directions and tend to stay together. One of the problem with ABR is the choice of the threshold value. This value may vary depending on the mobility patterns.

Different types of mobility models that had been discussed in [1], like Random mobility models and Group based mobility models. In these previous work, they had discussed the comparison of various on-demand routing protocols on the various mobility models.In [5] [6], the AODV protocol is discussed on various mobility models and in [3] [9], DSR and DSDV were discussed on mobility models and the evaluations are given like measurement of efiiciency, packet delivery ratio, end-to-end delay and routing load and routing overhead. Random Waypoint model [4] [5] [6] and Reference Point Group Mobility model[1] [2] [7][8] [10] [11] were applied on the AODV, DSR, DSDV and etc., and evaluations are made by using performance parameters. In this simulation study, we have discussed the performance of Associativity Based Long-Lived Routing(ABR) protocol on Random Waypoint model, Reference Point Group Mobility model and Random Direction Mobility Model.

Tele:
E-mail addresses: muthumayil@yahoo.com

Proposed work

Associativity is determined by many factors such as residual battery life time, link stability, storage capacity, processing power and etc., In this paper we consider link stability to determine the associativity of the nodes. Link stability refers to how long any two nodes can communicate with each other.If a mobile host is in high mobility,there will be low stability.If there is low mobility,there will be high stability between any two nodes. The stability of a link depends on how long two nodes, which form that link, remain as neighbors simply known “node moblility’. Two nodes are neighbors when they remain within each others communication range. Likewise, if a mobile host is in high mobility, there will be low associativity. If a mobile host is in low mobility, there will be high associativity with its neighbors. Thus a link stability refers to the ability of a link to survive for a certain duration. The higher the link stability, the longer is the link duration. Two nodes are neighbors when their signal strength is above certain threshold.

Node mobility often affects the link stability in MANETs. Node mobility is one of the most important characteristics of MANET. There are various mobility models and patterns available for MANETs to compute the link stability. Node mobility makes routing in MANETs very difficult. Moblity causes frequent topology changes and can break the existing path. In this work, we use various mobility models like Random Waypoint Model(RWP), Reference Point Group Mobility(RPGM) and Random Direction Mobility Model(RDM) model. These models capture the behaviors of routing in ABR protocol. In our comparison of modility models with ABR protocol, we consider three performance parameters against speed : packet delivery ratio, delay and routing load.

Mobility Models

A*.*Random Waypoint

The random waypoint model consists of pause times between changes in direction and/or speed. An mobile node starts by staying in one location for a certain period of time, is called pause time. After this time expires, the MN randomly selects the next destination in the simulation area and a speed that is uniformly distributed between the minimum speed and maximum speed [minspeed , maxspeed]. The MN travels with a speed v whose value is uniformly chosen in the interval [0, Vmax] [4] [8]. Vmax is the maximum speed that can be set to reflect the degree of mobility. Then the MN moves towards the new destination at the chosen speed. It stays in the new destination for a predefined pause time before it moves to another new destination.

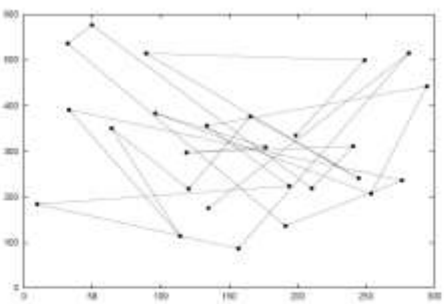

Figure 1:Node movement in RWP

B. Reference Point Group Mobility model

In an ad hoc network, there are many situations to model the behavior of MNs as they move together.Reference point group mobility model is used to simulate group behavior, where each node belongs to a group in which every node follows a group leader that determines the group behavior (logical center). Reference point group mobility model represents the random motion of a group of MNs as well as the random motion of each individual MN within the group. Group movements are based upon the path traveled by a logical center of the group. Then logical center for the group is used to calculate group motion via a group motion vector VtGroup[8] that provides the general motion trend of the whole group. Each member of this group deviates from this general group motion vector VtGroup by some degree, is called Angle Deviation Ratio(ADR). The motion vector VtGroup can be randomly chosen or carefully designed based on their predefined paths.

The movement of group members is affected by the movement of its group leader. For each node, the mobility is assigned with a reference point that follows the group movement. Individual MN randomly moves based on its own predefined reference points, whose movements depend on the group movement.

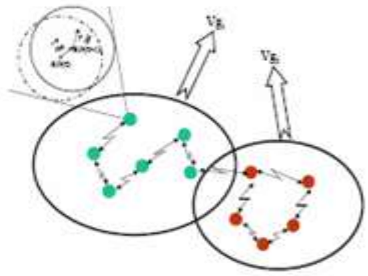

Figure 2: Node Movement in RPGM

The motion vector of group member i from tim ‘t’ is represented by vector Vt^{i+1}, can be described as

$$V_i^{\,t+1} = V^t Group + RM_i^{\,t} \quad (1)$$

where the motion vector RM_i^t is a random vector deviated by group member i from its own reference point. The vector RM_i^t is an independent identically distributed random process whose length is uniformly distributed in the interval $[0,r_{max}]$ [8] where r_{max} is maximum allowed distance deviation and its direction is uniformly distributed in the interval $[0, 2\pi]$. V^tGroup is the motion vector for the group leader, it is also the motion vector for the whole group. RMit is the random deviation vector for group member i.

In RPGM model, the vector RM_i^t indirectly determines, how much the motion of group members deviate from their leader. The movement can be characterized as follows:

$$|V_{member(t)}| = |V_{leader(t)}| + random() * SDR * max\_speed \quad (2)$$

$$\theta_{member(t)} = \theta_{leader(t)} + random() * ADR * max\_angle \quad (3)$$

where 0 < SDR and ADR >1,
SDR – speed deviation ratio
ADR – angle deviation ratio.

SDR and ADR [2] [8] [11] are used to control the deviation of the velocity(magnitude and direction) of group members from that of the leader. By simply adjusting these two parameters, different mobility scenarios can be generated.

Each model has its own unique and specific mobility characteristics . Hence, a method to choose a suitable set of mobility models is needed. Because of inherent characteristic of spatial dependency between nodes , the RPGM model is expected to behave differently from the RWP model. We find that RPGM model achieves a better performance for ABR protocol than RWP model.

C. Random Direction Mobility(RDM) model

A model that enforces the MNs to travel to the boundary of the simulation area before move changing their direction and speed. This overcomes the drawback of the RWP model which change their destination very often. Instead, Random direction mobility model[1] [5] [6] chooses the random direction inside the simulation area. Then it moves towards the boundary of the simulation area in that selected direction. After reaching the boundary of the simulation area, the node pauses some time and then change its angular direction between 0 and 180 degrees. Since the MNs have to travel to the boundary of the simulation area for every time the node changes its direction, it has higher number of hops when compared to Random Waypoint model and Reference Point Group Mobility model. Since this model has higher number hops for packet transmission, it will have lower packet delivery ratio and high end-to-end delay.

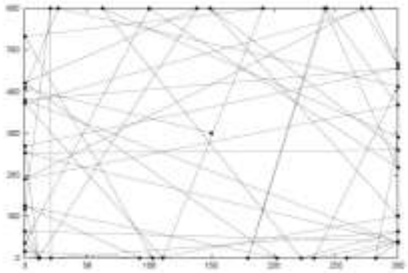

Figure 3: Node Movement in RPGM

Performance Metrics

The MANET network simulations can be implemented using NS-2.

In this paper, we have selected three parameters, packet delivery ratio, average end-to-end delay and routing load as metrics to compute the ABR protocol performance.

Packet Delivery Ratio(PDR)

This is the number of packets sent from the source to the number of packets received at the destination. In the wake of route failure, ABR tries to do a local route repair and creates a LQ packet before going for a global route discovery. During this phase, the data packets are buffered at the intermediate nodes. But local repair is successful at low velocities. If there is high velocity, the local repair will be unsuccessful and global route discovery will be initiated. The packets at intermediate nodes get timeout and dropped. In this paper, we have given the comparison of three mobility models over ABR regarding the packet delivery ratio.

$$PDR = \frac{\text{number of packets received}}{\text{number of packets sent}}$$

If this value is high, then we can assume that the ABR protocol delivers most of the packets.

B.Average End-to-End delay(AED)

This is the average time delay for data packets travel from source to destination.

$$AED = \sum_{i=0}^{n} \frac{\text{packet received at time t} \quad \text{packet sent at time i}}{\text{Total number of packets received}}$$

A higher value of end-to-end delay means that the network is congested and hence the ABR protocol does not perform well.

C. Routing Load :

This is calculated as the ratio between the number of packets transmitted to the number of packets received.

$$\text{Routing Load} = \frac{\text{Number of packets sent}}{\text{Number of packets received}}$$

The higher routing load means the higher routing overhead, Thus the efficiency is low. If there is low routing load means the lower routing overhead, there will be high efficiency.

Simulation Results

In this simulation, we have taken packet delivery ratio, average end-to-end delay and efficiency as metrics to compute the performance of ABR long-lived routing protocol in Reference Point Group Mobility(RPGM) model, Random Waypoint model(RWP) and Random Direction Mobility model(RDMM). The performance comparison of models are represented against number of nodes in the simulations area.In RPGM, the communication between nodes happen in groups. The speed and direction of nodes within the group are determined by a “group leader”. Since the mobility of the group members are decided by group leader, group mobility pattern is expected to have spatial dependence for small values of SDR and ADR. The high spatial dependence, means higher link duration and low routing overhead. This results in higher throughput because of low routing overhead. The higher degree of spatial dependence provides higher packet delivery ratio and throughput, lower routing overhead and small end-to-end delay when compared to Random Waypoint(RWP) model and Random Direction Mobility model(RDMM).

In RWP, a mobile node chooses a random destination at every instance and moves toward it with a speed uniformly distributed [0, Vmax], where Vmax is the maximum allowable speed for a node. After reaching the new destination, the node stops for a duration defined by the parameter “pause time”. After this duration, it again chooses a random destination and repeats the process again. RWP model is not sufficient in the characteristics of temporal dependence and spatial dependence. Since RWP changes the node’s destination every time, it reduces the packet delivery ratio when compared to the RPGM. But the RWP has higher throughput than RDM model. RWP model performs better in delivering packet data to the destination by considering the “pause time. Also it has lower end-to-end delay since there is higher throughput than RDMM.

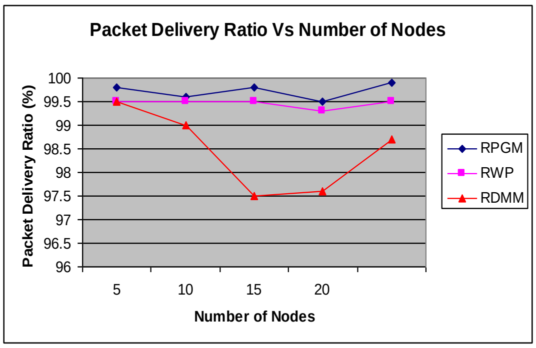

Figure 4 :packet delivery ratio vs Number of nodes

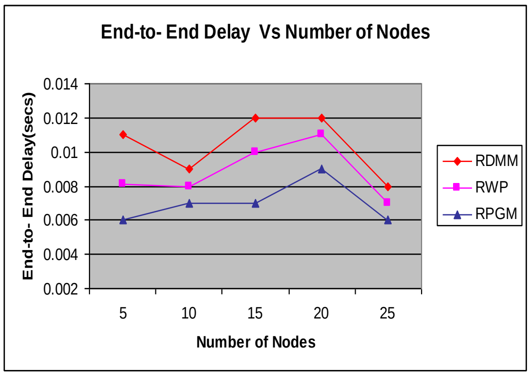

Figure 5 :End to End Delay Vs Number of nodes

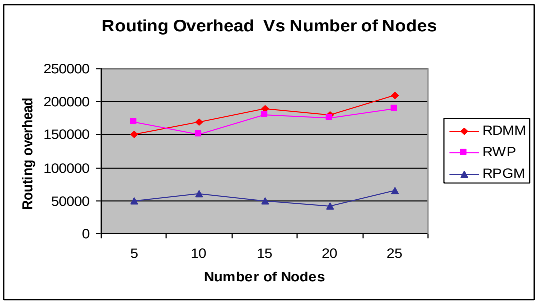

Figure 6 : Routing overhead Vs Number of nodes

Conclusion

In this paper we calculate packet delivery ratio, end-to-end delay and efficiency to evaluate the performance of ABR long-lived routing protocol. The results show the performance of the ABR protocol over three mobility models. It has been observed that the mobility patterns have high impact on the performance of any routing protocol. We observed that the spatial dependency is affected by the speed of the node increases. Therefore it reduces the throughput of the ABR protocol. Among the models that have been discussed, the RPGM model has higher throughput when compared to RWP and RDMM models. Since in RPGM, the nodes do not move to new destination area and to the boundary of the simulation area for every time the MNs move from previous position, the RPGM performs better than RWP and RDMM.. The MNs only move to the new destination area in RWP, it has lower number of hops for packet transmission than RDM model. Also it has low end-to-end delay and high efficiency when compared to RDM model. Therefore we conclude that the RPGM model has better packet delivery ratio, low end-to-end delay and high efficiency when compared to other two models RWP and RDMM.

References

[1] T. Camp, J. Boleng, and V. Davies, "A survey of mobility models for ad hoc network research," *Wireless Communications & Mobile Computing (WCMC): Special issue on Mobile Ad Hoc Networking: Research, Trends and Applications*, vol. 2, no. 5, pp. 483–502, 2002.

[2] X. Hong, M. Gerla, G. Pei, and Ch.-Ch. Chiang, "A group mobility model for ad hoc wireless networks," in *ACM/IEEE MSWiM*, August 1999.

[3] Fan Bai, N Sadagopan and A Helmy, " IMPORTANT: A framework to systematically analyze the impact of mobility on performance of Routing Protocols for AdHoc Neworks*", IEEE 2003*.

[4]E. Hyyti¨a and J. Virtamo, "Random waypoint mobility model in cellular networks, "*Wireless Networks, vol. 13, no. 2, pp. 177– 188, 2007*.

[5] Mohd Izuan Mohd Saad, Zuriati Ahmad Zukarnain, " Performance Analysis of Random-based Mobility models in MANET Routing protocol". *European Journal of Scientific Research, Vol. 32 No.4 (2009), pp. 444-454.*

[6] S.Gowrishankar, T G Basavaraju, Subir Kumar Sarkar, " Effeect of Random Mobility models pattern in mobile Ad Hoc Networks*". IJCSNS International Journal of Computer Science and Network Security, Vol.7 No.6, June 2007*.

[7] Guolong Lin, Guevara Noubir, and Rajmohan Rajaraman, "Mobility Models for Ad hoc Network Simulation". *IEEE INFOCOM 2004*

[8]Geetha Jeyakumar and Gopinath Ganapathi, " Reference Point Group Mobility and Random Waypoint Models in Performance Evaluation of MANET Routing Protocols", *Journal of Computer Systems, Networks and Communications, Vol.2008*.

[9]G.Santhosh kumar, M.V.Vinu Paul and K.Poulose Jacob, " Impact of Node Mobility on Routing Protocols for Wireless Sensor Networks". *International Conference on Sensors and Related Networks(SENNET'07)*, VIT University, Vellore, India. Dec.12-14, 2007. pp.480-485.

[10] Dongsoo S.Kim and Seok K.Hwang, "Swarm Group Mobility Model for Ad Hoc Wireless Networks". *TR ECE-07-01*

[11] D.Rajini Girinath and Dr.S.Selvan, " Performance Analysis of Dispersion Model in Mobile Ad Hoc Networks". *". IJCSNS International Journal of Computer Science and Network Security, Vol.8 No.3, March 2008*

[12] Sridhar K N and Mun Choon Chan, "Stability and Hop-Count based Approach for Route Computation in MANET*". ICCCN'05,IEEE.*

[13] Said Abu Shaar, Fawaz A.M. Masoud, Ayman Murad, Riyad Al-Shalabi and Ghassan Kanaan, " Analysis of Enhanced Associativity Based Routing Protocol". *Journal of Computer Science 2 (12) : 853-858, 2006*.

[14]Fawaz A M Masoud, Said Abu Shaar, Ayman Murad and Ghassan Kanaan, " Enhanced Route Re-Construction Method for Associativity Based Routing Protocol for Mobile Ad hoc NETworks (MANET*)". Journal of Computer Science 2 (12): 859-869, 2006.*

[15] Dr. Natarajan Meghanathan, "A Simulation Study on the Stability-Oriented Routing Protocols for Mobile Ad Hoc Networks". *Wireless and Optical Communication Networks, IFIP International Conference 2006.*

[16] Shafqat Ur Rehman, Wang-Cheol song and Gyung-Leen Park, "Associativity-Based On-Demand Mulut-Path Routing In Mobile Ad Hoc Networks", *KSII TRANSACTIONS ON INTERNET AND INFORMATION SYSTEMS VOL.3, NO.5, October 2009.*

[17] Shafinaz Buruhanudeen, Mohamed Othman, Borhanuddin Mohd Ali, "Performance Comparison of MANET Associativity Based Routing (ABR) and the Improvisation Done for a More Reliable and Efficient Routing".

[18] Shafinaz Buruhanudeen, Mohamed Othman, Mazliza Othman, Borhanuddin Mohd Ali, " Existing MANET Routing Protocols and Metrics used Towards the Efficiency and Reliability". *ICT 2007*

[19] C. E. Perkins, E. M. Royer, S. R. Das, and M. K. Marina. Performance Comparison of Two On-demand Routing Protocols for Ad Hoc Networks. *IEEE Personal Communications, 8(1):16–28, 2001*.

[20] CHAI-KEONG TOH__, "Associativity-Based Routing for Ad-Hoc Mobile Networks", *Wireless Personal Communications 4: 103–139, 1997.*