Performance Analysis of AODV Routing Protocol for RPGM Mobility Model in MANETS

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Abstract— Mobile ad hoc network (MANET) is a kind of infrastructureless mobile network, which does not rely on any fixed or centralized access points. Mobility models also affect the performance of ad hoc routing protocols and can be divided into entity mobility and group mobility models. Random Waypoint (RWay) is the most widely used entity mobility model in MANET research. In recent years, people noticed that in real-life MANET, mobile nodes tend to move in groups. Here we measure the performance of AODV for group mobility model RPGM. The performances are measured using the metrics like packet delivery, end to end delay and routing overhead. The performance of the protocols has been analyzed using simulations in ns-2.

Key words: AODV, RPGM, NS2

I. Introduction

Over the decades, the use of personal communication devices has taken an exponential growth. With this rapid growth of mobile devices such as laptops, cell phones, tablet PCs, digital cameras etc., the demand for continuous network connectivity regardless of the physical location has spurred interest in mobile networks. In addition, these devices are also getting smaller, cheaper, more user friendly and more powerful. A mobile ad hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any established infrastructure or centralized administration. Hence, MANETs find great applications in areas such as military applications, collaborative and distributed computing, emergency operations and so on.

Many performance analysis of Manets protocols have been done in the past [2, 5] but have considered the random waypoint mobility model. In recent years, people noticed that in real-life MANET, mobile nodes tend to move in groups.

For example military battlefield operations often require the formation of ad hoc networks containing hundreds to thousands of soldiers and personnel which move in groups. Practically In this paper, we have chosen on-demand routing instead of table-driven routing because it has been shown [2, 3] that on-demand routings outperform table-driven routings under various cases. We have selected on-demand routings, AODV, in our performance comparison because they have been widely studied and adopted by MANET researchers. The rest of the paper is organized as follows: The AODV routing protocol Description is summarized in section II. The entity and group mobility model are explained in Section III. The simulation models and performance metrics are described in Section IV.

II. Adhoc On-Demand Distance Vector Routing Protocol (AODV)

The Ad hoc On-demand Distance Vector (AODV) routing protocol [2-5][9][10] is a reactive or on demand routing protocol. By adopting distance vector strategy, every node in the network maintains a Route Table, which contains one route entry for each known destination node in the network. Each node will send a “Hello” message, which contains its ID, periodically to its neighboring nodes to update their routing tables. AODV uses sequence numbers maintained at each destination to determine freshness of routing information and to prevent routing loops. These sequence numbers are carried by all routing packets. In addition, each route entry records the Hop Count (the number of hops needed to reach this particular destination) and Next Hop. When a node wants to send a packet to a destination node, it checks its Route Table for a valid route to the destination. If it finds one, it sends the packet to the Next Hop recorded in the route entry for that destination. If not, it initiates a Path Discovery process, by broadcasting a Route Request (RREQ). An intermediate node processing the RREQ first increments the Hop Count by one. It then generates a Route Reply (RREP) if it is either the destination or has a fresher route to the destination (as indicated by the Destination Sequence Number in the route entry). If the node is not the destination, the Next Hop is set to the neighboring node from which this node received the RREQ, and the Hop Count is set to the value mentioned in the RREQ. Finally, the node broadcasts the RREQ. If a node in the path finds out that its link expires due to broken link or unreachable downstream node, it will broadcast RERR message to all of its predecessors, and each predecessor will rebroadcast the RERR message iteratively, thus effectively erasing all out-dated route.

III. Entity and Group Mobility Models

A. *Random Waypoint Mobiliy Model (RWay) [7]*

RWay is the most widely used entity mobility model in MANET research. In RWay, each MN randomly chooses a destination inside the simulation area and a speed uniformly distributed between [MinSpeed, MaxSpeed]. Then the MN travels toward the destination with the selected speed. Upon arriving, the MN pauses for a certain period of time and then, starts the selection process again.

B. *Reference Point Group Mobility Model (RPGM) [8]*

In RPGM, each group has a group leader, whose movement defines the entire group’s movement, including speed, direction, etc. Group leaders’ movement trajectories can be predefined or based on RWay. A number of reference points are placed around the group leader. The distance and direction between the reference points and their

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corresponding group leader are fixed during whole simulation. Each group member will be assigned one of the reference points and moves around its corresponding reference point. When a new position for one group leader is generated, new positions for reference points are also defined accordingly. Each group member also chooses a new position randomly around its reference point. Then, all mobile nodes in this group will move to their new positions in a same time period with constant speed.

IV. SIMULATION MODELS AND PERFORMANCE METRICS

A. *Simulation Models*

The NS-2 simulator, version 2.35, with wireless extension [6] is used for simulating the performance of AODV. NS-2 can simulate the physical, MAC and data link layer of a multihop wireless network. The distributed coordination function (DCF) of IEEE 802.11 for wireless LANs is utilized as the MAC layer [6]. Lucent's WaveLAN is used as the radio model, which is a shared-media radio with a nominal bit rate of 2Mbps and a nominal transmission range of 250 m. With the use of a NS-2 simulator, we can correctly model the effects of contention for the media and the distance between mobile nodes in determining whether a transmitted packet will be successfully received.

We generate CBR traffic with the ''cbrgen'' tool and scenario for random waypoint mobility model (Rway) [7] with the "setdest" tool in NS2 [6]. Bonnmotion tool is used for generating the scenario for reference point group mobility model (RPGM). The largest group diameter is 100m. The default group-based scenario contains 5 groups (5 MNs for each group). The size for each data packet is 512 bytes and the packet generation rate is 4 data packets per second. Table I shows the default parametric values used in the simulations. In order to make our simulation results more reliable, a number of simulation runs (more than 5 runs for each point) have been made.

V. SIMULATION PARAMETERS

Parameters	Values
Simulation time	300 s
Number of mobile nodes	25
Simulation area	1000 m*200 m
Transmission range for mobile nodes	250 m
Pause time for mobile nodes	0.0s
Max. Speed for mobile nodes, Vmax	15 m/s
Speed for mobile nodes	Uniformly distributed between 0 – Vmax
Traffic pairs	5,10,15,20
Data Traffic Rate for each source	4 packets/second
Propagation Model	Two ray ground
Node Movement Model	Random waypoint, RPGM
MAC	IEEE 802.11

A. *Performance Metrics*

Following are the metrics which are measured.

1) Packet Delivery Ratio (PDR): it is the ratio of the number of (data) packets received to the number of (data) packets sent in the entire network. Being an end-to-end metric, it is calculated on the basis of the packets sent or received at the application layer.
2) Normalized routing overhead (NRL): It refers to the total number of non-data packets transmitted at the IP layer over the total data packets received during the simulation. Each transmission of a non-data IP layer packet from one hop to another hop is counted as one packet.
3) Average end to end delay: It is average packet transmission delay between the time the packet generated at the source and the time the packet arrived at the destination.

VI. SIMULATION RESULTS

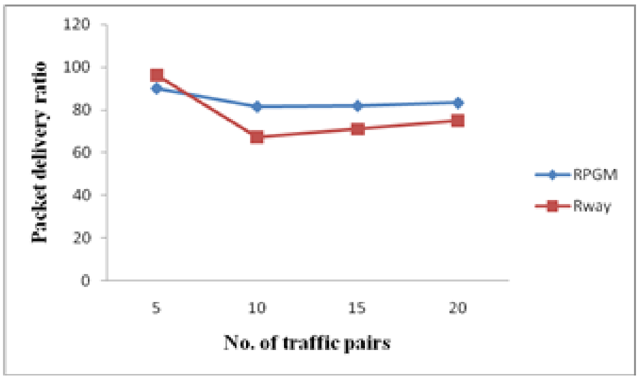

Fig. 1: Packet delivery ratio for AODV

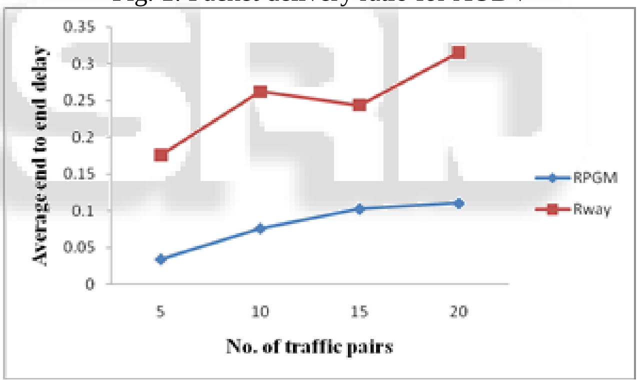

Fig. 2: Average end to end delay for AODV

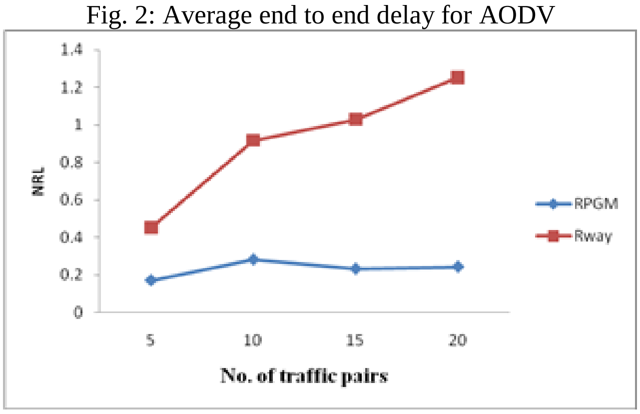

Fig. 3: Normalized routing load for AODV

VII. CONCLUSION

In this paper we have analyzed the performance of AODV routing protocol. When traffic pair is small, AODV routing protocol in group mobility perform worse than in entity mobility. In group mobility model, intra-group transmissions, in which the source and destination nodes are inside the same group, are quite reliable. Packet dropping generally comes from inter-group transmissions in which the source and destination nodes are from two different groups. Thus, there is no link connection between these two groups. In fact, no protocols can manage transmission if there is definitely no route. So the performance on group mobility model is poor even when traffic load is low. It has been shown that for entity mobility model, RWay, PDR decreases as traffic pair increases. The increase of traffic pair produces more routing and data packets. Thus, the network traffic becomes busy and packets will be easily dropped due to network congestion. The PDR of the AODV routing protocol in group mobility increases with traffic pair because as traffic pair increases there are more source-destination pairs inside a group and thus, there are more reliable link due to these intra-group transmissions. In addition, the reliable intra-group transmissions will generate less routing overhead for route setup & route maintenance because the source and destination nodes are always within the group and no link breakage will occur. It can be seen that the flat routing protocols in group mobility perform better than those in entity mobility when traffic pair is large because for entity mobility model, mobile nodes are randomly placed and traffic pairs are randomly selected.

References

[1] David B Johnson, David A Maltz & Yih-Chun Hu. The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks (DSR), IETF Internet Draft, draft-ietf-manetdsr-10.txt. 2004.

[2] J. Broch, and D. A. Maltz, et al., A performance comparison of multi-hop wireless ad hoc network routing protocols. In Proc. Of the 4th Annual ACM/IEEE International Conference on Mobile Computing and Networking, pp. 85–97, 1998.

[3] A. Boukerche, Performance evaluation of routing protocols for ad hoc wireless networks, Mobile Networks and Applications, Vol.9, pp. 333–342, 2004.

[4] E. Perkins, E. M. Royer, and S. R. Das, Ad Hoc On-Demand Distance Vector (AODV)Routing, Internet Draft, draft-ietf- manet- aodv-10.txt, work in progress, 2002

[5] 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, Vol. 8, pp. 16–28, 2001.

[6] K. Fall and K. Varadhan, ‘‘The ns Manual’’ The VINT Project, UC Berkeley, LBL, USC/ISI, and Xerox PARC. http://www.isi.edu/nsnam/ns/doc/index.html, March 2008.

[7] T. Camp, J. Boleng and V. Davies, A survey of mobility models for ad hoc network research, Wireless Communications and Mobile Computing, Vol. 2, pp. 483–502, 2002.

[8] X. Hong, M. Gerla, G. Pei, and C.C. Chiang, “A group mobility model for ad hoc wireless networks,” in Proc. 2nd ACM International Workshop on Modeling, Analysis and Simulation of Wireless and Mobile Systems, Seattle, Washington, 1999.

[9] A. Boukerche, “Simulation based performance comparison of routing protocols for mobile ad hoc networks”, Simulation, Vol. 78. Issue 7, July 2002, pp. 401-407.

[10] A. M. Royer and C. K. Toh, “A review of current routing protocols for ad hoc mobile wireless networks”, IEEE Personal Communications magazine, April 1999, pp. 46–55.