Weighted Load Balanced Adaptive Gateway Discovery in Integrated Internet MANET

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Abstract. An Integrated Internet MANET (IIM) is a heterogeneous network which is an interconnection of the wired Internet and the wireless MANET. Two of the issues which arise in Integrated Internet-MANET are gateway load balancing and efficient gateway discovery. These two issues have been addressed separately in the literature. In this paper, a mechanism is presented which incorporates gateway load balancing and adaptive gateway discovery together. The proposed mechanism uses the Maximal Source Coverage algorithm for dynamically adjusting the proactive range of the IIM while using the WLB-AODV routing protocol for gateway load balanced routing of packets in the MANET. Simulation results using ns-2 network simulator show that the proposed protocol gives better performance in terms of packet delivery ratio and end to end delay than the existing approach.

1 Introduction

An interconnection of MANET and Internet is called an Integrated Internet MANET (IIM) [1]. This interconnection is achieved through intermediate gateways. Mobile nodes in the MANET discover and register with the gateways in order to access Internet connectivity. Strategies for integrating mobile ad hoc networks with the Internet have been proposed which address the issue of routing of packets from one network to the other [1]. The issue of gateway load balancing has been addressed in the literature [2] [3] and also that of efficient adaptive gateway discovery [4] [5]. But none of the authors have addressed these two issues together. In this paper, the issues of gateway load balancing and gateway discovery are addressed together as part of a single mechanism. In the proposed approach, WLB-AODV [3] routing protocol is used for load balanced routing of packets between mobile nodes within the MANET, and between mobile nodes and gateways. The maximal source coverage gateway discovery mechanism is used to dynamically adjust the proactive zone of the IIM. The proposed algorithm has been simulated in network simulator ns-2. Its performance has been compared to the WLB-

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AODV approach which does not use adaptive gateway discovery. It is observed that the proposed approach gives better performance delivery ratio and end to end delay than the existing approach.

2 Adaptive WLB-AODV Protocol

The features of gateway load balancing and adaptive gateway discovery are combined to give the adaptive WLB-AODV protocol based on the maximal source coverage algorithm. The mobile nodes in the ad hoc network run the WLB-AODV routing protocol in order to facilitate gateway load balancing. The maximal source coverage adaptive gateway discovery is used to achieve dynamic adjustment of the proactive range of gateway advertisements. The proactive ranges of all the gateways in the IIM have been initialized to 2 hops. In fig1, mobile node MN6 is an active source which is outside the proactive range in the current gateway advertisement cycle. MN6 receives gateway advertisements from two different gateways viz. gateway1 and gateway2 via the paths MN1-MN3 and MN1-MN4-MN8. MN6 registers with gateway 2 since the path MN1-MN4-MN8 is lightly loaded when compared to MN1-MN3 which is heavily loaded. Initially, MN6 was 3 hops away from both the gateways. Now, since MN6 has become an active source of gateway2, the TTL value of the gateway 2 is adjusted to 3 hops in the next gateway advertisement cycle to increase the proactive range and include MN6 into the proactive range.

In this way, the advantages of load balanced routing of packets and adaptive gateway discovery are combined into a single protocol.

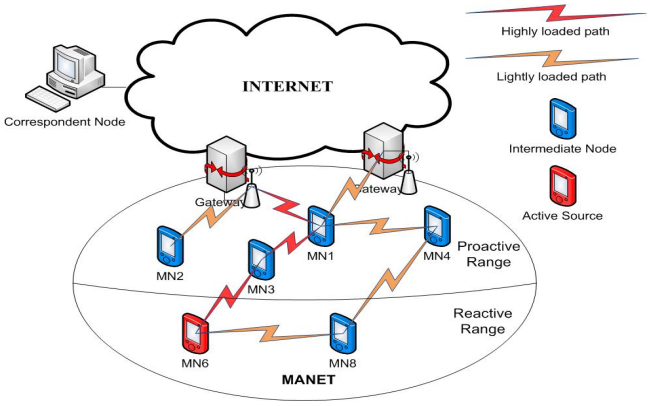

Fig. 1. Working of the proposed Adaptive WLB-AODV protocol

3 Performance Evaluation

The proposed protocol has been simulated in the network simulator ns-2.34 [7]. Its performance is compared with the integration strategy running WLB-AODV routing protocol without any adaptive gateway discovery mechanism. For the integrated Internet-MANET framework, we use the AODV+ routing protocol [6]. The parameters for the

simulation scenarios are given in table I. The variable parameter is speed of mobile node which varies between 1 mt/sec to 6 mts/sec. The performance of the proposed routing protocol is analyzed with respect to the following performance metrics:

Table 1. Simulation Parameters

Simulation Parameter	Value
Number of Mobile Nodes	15
Number of gateways	2
Toplogy	800 X 500
Mobile node radio range	250m
Simulation time	900 sec
Number of traffic sources	5
Traffic Type	CBR
Mobility Model	Random Waypoint
Node Speed	1-6 Mts/Sec
Packet Sending Rate	5 packets/ sec
Number of destination nodes	2
Pause Time	60 seconds
Ad Hoc Routing Protocol	AODV+

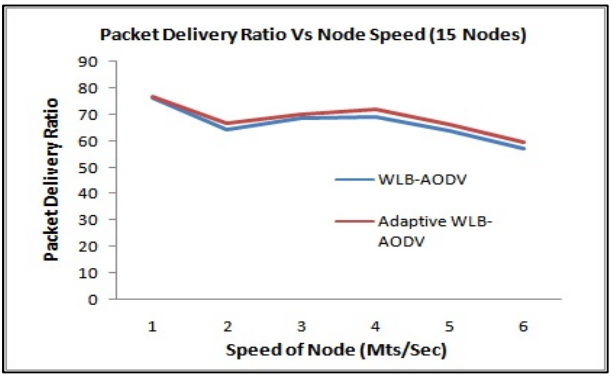

Fig. 2. Packet Delivery Ratio Vs. Node Speed for 15 Nodes

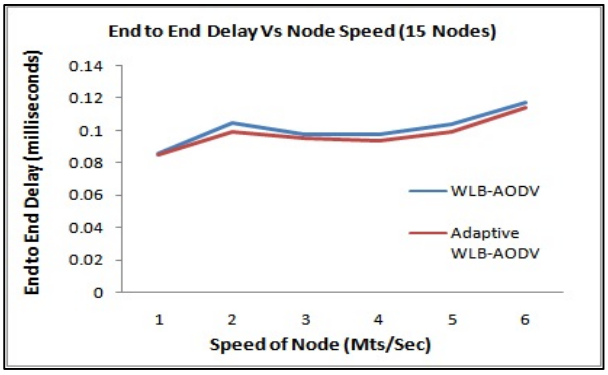

Fig. 3. End to End Delay Vs. Node Speed for 15 Nodes

Packet Delivery Ratio: It is the percentage of the number of packets received by the destination to the total number of packets sent by the source.

End-to-End Delay: It is the average overall time taken (delay) for a packet to traverse from a source node to a destination node.

From figures 2 and 3, we observe that the proposed protocol performs better than the existing approach in terms of packet delivery ratio and end to end delay. Thus we observe that for lightly loaded MANET with 15 mobile nodes, the proposed protocol outperforms the existing approach in terms of packet delivery ratio and end to end delay.

4 Conclusion

In this paper, a protocol to implement gateway load balancing and adaptive gateway discovery, called Adaptive WLB-AODV was proposed which addressed these issues together. The proposed mechanism has been simulated in the network simulator ns-2. The simulation results show that the proposed protocol gives better performance than the existing approach in terms of packet delivery ratio and end to end delay. In the proposed approach, only the gateway advertisement proactive zone is dynamically adjusted. In the future, it is proposed to modify the protocol to include dynamic adjustment of gateway advertisement periodicity.

References

[1] Ding, S.: A survey on integrating MANETs with the Internet: Challenges and designs. Computer Communications 31(14), 3537–3551 (2008)

[2] Zaman, R.U., Khan, K.-U.-R., Venugopal Reddy, A.: Gateway load balancing in integrated internet-MANET using WLB-AODV. In: Proceedings of the International Conference and Workshop on Emerging Trends in Technology, pp. 411–416. ACM (2010)

[3] Zaman, R.U., Khan, K.U.R., Venugopal Reddy, A.: A Review of Gateway Load Balancing Strategies in Integrated Internet-MANET. In: IEEE International Conference on Internet Multimedia Services Architecture and Applications (IMSAA), pp. 1–6 (2009)

[4] Ruiz, P.M., Gómez-Skarmeta, A.F.: Maximal Source Coverage Adaptive Gateway Discovery for Hybrid Ad Hoc Networks. In: Nikolaidis, I., Barbeau, M., An, H.-C. (eds.) ADHOC-NOW 2004. LNCS, vol. 3158, pp. 28–41. Springer, Heidelberg (2004)

[5] Zaman, R.U., Venugopal Reddy, A.: A Survey of Adaptive Gateway Discovery Mechanisms in Heterogeneous Networks. International Journal of Computer Network and Information Security (IJCNIS) 5(7), 34 (2013)

[6] Hamidian, A.: A Study of Internet Connectivity for Mobile Ad Hoc Networks in NS2, Masters Thesis, Department of Communication Systems, Lund Institute of Technology, Lund University (2003)

[7] Ns 2 Home page, `http://www.isi.edu/nsnam/ns/index.html`