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Congestion Aware Reverse AODV Routing Protocol for MANET

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Abstract— One of the enhancement that was made to AODV is called Reverse AODV (RAODV). The RAODV routing algorithm considers the stability of the link during route discovery phase. It was found that, such an enhancement reduces the routing overhead of AODV protocol. However, it was observed that, the packet loss at any node generally occurs due to the congestion across the link. Thus by considering the congestion across the link we can obtain a more stable path with less packet loss. However, RAODV does not take into consideration, congestion across the link during path selection. This paper takes into consideration, the active load of the path during route discovery process and selects a path which is less congested for routing packets. The algorithm is simulated using NS2 and the results are compared with the RAODV. The results of comparison indicate that, the modification indeed reduces the packet loss and provides a better throughput in a small network environment.

Keywords— MANET, AODV, RAODV CA-AODV, Active Load, Congestion

I. INTRODUCTION

Ad Hoc on Demand Distance Vector (AODV) routing protocol is a reactive protocol [1]. It uses destination sequence number during route discovery to avoid broadcasting of duplicate route requests (RREQ). The destination uses route reply packet (RREP) to establish a route, back towards the source. During link failure, route error packets (RERR) are used to maintain the existing path [2]. In principal, AODV assumes that the network topology does not change during the route reply message. However, in a network with high mobility, network topology may change very often. Due to this the route reply message may be lost. And, when this happens, the source may reinitiate the route discovery process once again. This results in wastage of network resources, as additional route discovery packets needs to be rebroadcasted once again in order to establish the route. This lowers the performance of the network. In reverse AODV, the destination also uses a reverse route request message to reply back to the source node [3]. Even, if there is at least one path between the destination and source, there is a chance of reverse route request to travel back to the source. This way, Reverse AODV (RAODV) reduces the retransmission of route request from source node. It will also reduce the unnecessary congestion and improves the performance of AODV. However, during route discovery process, RAODV does not take into consideration link congestion across the link. Selecting a congested path for data transmission can lead to packet loss and delay. Thus, by considering the active load across the link during route discovery and avoiding congested path, can improve the performance of the network.

II. RELATED WORK

One of the major reason for packet drop during data transmission is congestion, is congestion. It was found that AODV is not effective in a congested network. Lu et al. [5] Proposed CADV protocol, which selects a nodes with smaller queuing delays during route discovery. However this protocol has a longer delay and high overhead. Also, CADV is not adaptive to congestion. To overcome this dynamic load-aware routing protocol (DLAR) was proposed [6], which favors the node with low routing load during route discovery. Jiawei Huang et al. proposed explicit congestion notification (ECN) based, access point congestion control algorithm called APCC (AP Congestion Control) [7]. In this technique, load on the channel and queue length of the buffer is used as parameters to indicate the level of congestion. In this algorithm each flow is given a different ECN marking by setting ECN bit in TCP DATA and ACK packets. This algorithm achieves a high throughput with low packet loss rate. A cross-layer congestion control framework (CCF) was proposed by C. Antonopoulos et al. [8]. In this protocol, whenever the congestion intensity of a node exceeds its threshold, a notification is sent to all nodes, whose packets are delivered via this node. This way source node can reduce the traffic rate. However, the problem with the CCF is that, it does not explicitly notifies the high traffic sending node, rather the notification is send to all source node. This leads to poor channel utilization.

An Early congestion detection and adaptive routing protocol EDAPR was proposed by T. Senthil Kumaran and V. Sankaranarayanan [9]. It uses early congestion detection techniques to detect congestion and chooses alternate a non-congested node within two hops for transmission. This protocol provides higher packet delivery rate, lower control packets and reduced end to end delay. Modified Reverse Ad Hoc On Demand Vector (MRAODV) protocol was proposed by M. Zarei, et al [10]. In this algorithm, the destination uses reverse RREQ to find the source node. This reduces path failure correction messages and improves the performance. Reverse AODV with learning Automata (RAODVA) routing algorithm was proposed by M. Zarei [11]. It uses learning automata while selecting the feasible route and selects the route with highest stability. This algorithm shows decent performance in high mobility environment.

III. CONGESTION AWARE REVERSE AODV PROTOCOL

Congestion along a path can be estimated by measuring the size of the occupied buffer size [4]. Active load for given path containing n_p number of hops is given by (1)

$$\text{Active\_load} = Min\left[\frac{1}{n_p}\sum_{i=1}^{n_p} \text{buffer\_size}(i)\right] \quad \text{---} \quad (1)$$

Here buffer_size(i) indicates the size of the occupied buffer of the intermediate node i along path.

A reverse AODV protocol is on demand routing protocol. When the source node wants to discover a destination, it broadcasts RREQ messages to all its neighbors. However, unlike the original AODV protocol, the destination does not unicasts the RREP back to the source node, instead upon receiving a route request from the source, the destination broadcasts a reverse route request back to the source [3]. Upon receiving reverse route request the source node starts sending data packets towards destination.

To incorporate the congestion level, an additional field namely, buffer_size is added to the RREQ packet. The structure of RREQ is shown in Fig. 1.

Type	Reserved	Hop Count
Broadcast ID		
Destination IP Address		
Destination Sequence Number		
Source IP Address		
Source Sequence Number		
Request Time		
Buffer Size		

Figure 1. *Route Request Structure*

The structure of reverse route request is shown in Fig. 2.

Type	Reserved	Hop Count
Broadcast ID		
Destination IP Address		
Destination Sequence Number		
Source IP Address		
Reply Time		
Buffer Size		

Figure 2. *Reverse Route Request Structure*

When an intermediate node receives a reverse route request packet, it checks the Broadcast ID and Destination Sequence Numbers within the packet. If the intermediate node has already received such a packet, then it will drop the packet otherwise it will rebroadcast the packet to its neighbours.

Every node maintains a routing table containing following fields as shown in Table 1.

TABLE I. ROUTING TABLE OF THE NODE INFORMATION.

Destination Address	Source Address	No of Hops	Destination Sequence No	Route Expiry Time	Next Hop	Congestion Level

When a node receives the reserve route request. It follows the following procedure.

Step 1: IF Packet_Type = R-RREQ and the packet is not received before **THEN**

Step 2: buffer_size = buffer_size + occupied size of the buffer for the link

Step 3: Congestion level for the given route = buffer_size /hopcount

Step 4: IF Number of entries for the destination address is less than 4 **THEN** Add the entry into routing table

Step 5: END IF for step 4

Step 6: **IF** node address ≠ source address of the packet **THEN** Broadcast the R-RREQ to all the neighbours

Step 7: ELSE IF node address = source address of the packet **THEN**

Step 8: Select an entry having least Hop count and Congestion Level and send data packet

Step 9: END IF for step 6

Step 10: END IF for step 1

When the source node receives the first RREP from the destination, it uses this path as its active route and then the source node waits for next three RREP from the destination. If no additional RREP is received, then same path is taken as the active route. However, if it receives any additional RREP, then it selects the path with lower hop count and congestion as active path. The path selection process is as follows. Arrange the paths in ascending order of congestion level. If the paths have same congestion level, then a path with short length (less hops) is chosen.

When the path fails, the node at which path failed generates RERROR and sends it back towards the source. When this error message reaches the source node, it deletes the route entry from the routing table and checks for any other paths towards the destination. If such a path exists it uses the next feasible path and when there are no more path available, the source node initiates a fresh route discovery process.

IV. SIMULATION AND RESULTS

The performance of AODV and Congestion Aware Reverse AODV (CR-AODV) routing protocols is compared using NS-2.34 simulation framework [12]. The MAXSPEED of the nodes are increased from 10m/s to 50m/s with an increment of 10m/s every time and various parameters, such as Average Delay, Delivery ratio and throughput is measured. Detailed description of simulation environment is shown in Table 2.

TABLE II. EXPERIMENTAL SETUP

Parameter	Value
Dimensions	1000X1000 sq. m.
Number of Nodes	50
Number of Connections	25
Source Type	CBR
Packet Size	512 bytes
Buffer Size	50 packets
Mac Layer	802.11 b
Simulation Model	Random Way Point
Routing Protocols	AOMDV, CR-AODV
Propagation Radio Model	Two Ray Ground
Radio transmission range	250m
Physique layer	Band width as 2 Mb/s
Maximal Speed	10 -50 m/s
Pause Time	0 s
Interval Time To send	2 packets /s
Simulation Time	100 s

A. Packet Delivery Ratio:

It was observed that, with an increase in speed, packets delivered to the destination decreases. This is evident from the Fig. 3. When the speed increases the link between the nodes breaks and it results in the path failure. However, CR-AODV maintains three additional paths, so that it can switch to other alternate paths without resorting to a new route discovery. For this reason, observe an improvement in the packet delivery ratio.

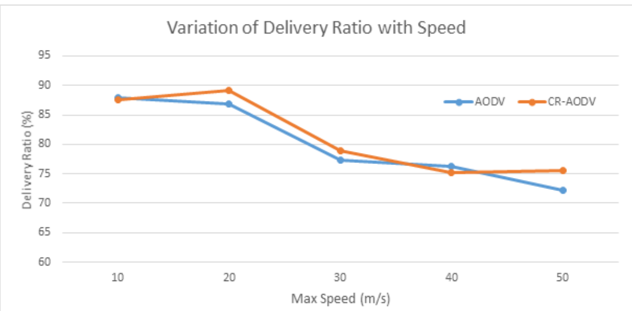

Figure 3. *Variation of % of PDR with Max Speed*

B. End-to-End delay:

From the Fig. 4 it is evident that as the CR-AODV is able to deliver the packet quite faster than AODV. It is due to the fact that, CR-AODV uses less congested path for delivering the packets and when a path fails, it does not have to wait for a fresh route discovery. This result in smaller wait time and a smaller end-to-end delivery.

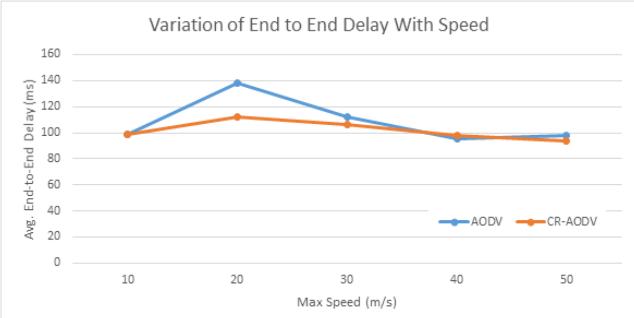

Figure 4. Variation of End-to-End Delivery with max speed

C. Throughput:

It is observed that CR-AODV provides a better throughput as shown in Fig. 5. This is evident from the fact that the CR-AODV has a smaller delay and has a better delivery ratio.

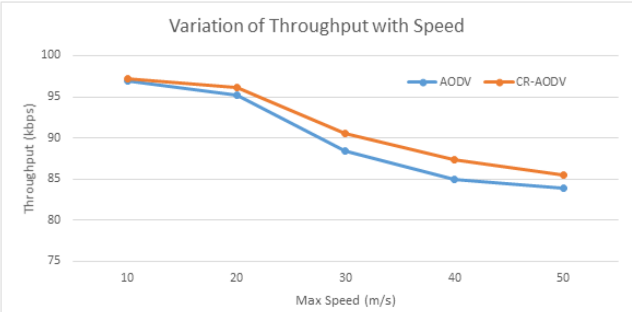

Figure 5. *Variation of Throughput with Max Speed*

V. CONCLUSION

Reverse AODV (RAODV) routing algorithm considers the stability of the link during route discovery phase and reduces the routing overhead of AODV protocol. However it did not take into consideration the congestion across the link during route selection. In this paper, the effect of node mobility and congestion along the path are taken into consideration during route discovery. The enhanced protocol CR-AODV, was simulated for a small network consisting of 50 nodes using NS-2. The simulated results are compared with the original protocol. It was observed the CR-AODV was able to provide a better throughput and packet delivery ratio, while reducing the delay during packet transmission. Thus, by using CR-AODV better performance can be obtained over a small network.

REFERENCES

[1] B. Paul, K. A. Bhuiyan, K. Fatema and P. P. Das, "Analysis of AOMDV, AODV, DSR, and DSDV Routing Protocols for Wireless Sensor Network," 2014 International Conference on

Computational Intelligence and Communication Networks, Bhopal, pp. 364-369, 2014.

[2] B. Ding, Z. Chen, Y. Wang and H. Yu, "An improved AODV routing protocol for VANETs," 2011 International Conference on Wireless Communications and Signal Processing (WCSP), Nanjing, pp. 1-5, 2011.

[3] Chonggun Kim, Elmurod Talipov and Byoungchul Ahn, "A reverse AODV routing protocol in ad hoc mobile networks," EUC'06 Proceedings of the 2006 international conference on Emerging Directions in Embedded and Ubiquitous Computing , pp. 522-531 , 2006 .

[4] M. Tekaya, N. Tabbane and S. Tabbane, "Multipath routing mechanism with load balancing in ad hoc network," in The 2010 International Conference on Computer Engineering & Systems, Cairo, pp. 67-72, 2010.

[5] Lee, S.-J and Gerla, Mario, "Dynamic load-aware routing in Ad hoc networks," Proceedings of IEEE ICC. 10, vol. 10, pp. 3206 - 3210, 2001.

[6] Lu Y, Wang W, Zhong Y and Bhargava B., " Study of Distance Vector Routing Protocols for Mobile Ad Hoc Networks," First IEEE International Conference on Pervasive Computing and Communications (PERCOM '03). IEEE Computer Society, Washington, DC, USA, p. 187, 2003.

[7] Jiawei Huang and Jinaxin Wang, "An ECN-Based Congestion Control Algorithm for TCP Enhancement in WLAN," 11th IEEE International Conference on High Performance Computing and Communications, 2009.

[8] Antonopoulos, C and Koubias, S, "Congestion Control Framework for Ad-Hoc Wireless Networks," Wireless Pers Commun 52, p. 753–775, 2010.

[9] T.Senthil Kumaran and V.Sankaranarayanan, "Early congestion detection and adaptive routing in MANET," Egyptian Informatics Journal, vol. 12, no. 3, pp. 165-175, November 2011.

[10] M. Zarei, K. Faez and J. M. Nya, "Modified Reverse AODV routing algorithm using route stability in mobile ad hoc networks," 2008 IEEE International Multitopic Conference, Karachi, pp. 255-259, 2008.

[11] M. Zarei, "Reverse AODV routing protocol extension using learning Automata in ad hoc networks," 2nd International Conference on Computer, Control and Communication, Karachi, 2009, pp. 1-5, 2009.

[12] T.Issariyakul E.Hossain, "Introduction to Network Simulator NS2", Springer,New York, pp. 363-381 2009

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