

PERFORMANCE EVALUATION OF CROSS LAYER BASED AODV PROTOCOL USING MULTIPATH GATEWAY ROUTE DISCOVERY FOR MANETS

¹K. PALANI, ²P. RAMAMOORTHY

¹Assistant Professor Department of Computer Science and Engineering
Tamilnadu College Engineering, Coimbatore, Tamilnadu, INDIA

²Dean / Department of Electronics and Communication Engineering
SNS College of Technology, Coimbatore, Tamilnadu, INDIA

E-mail: akpgda@gmail.com, covairam@ymail.com

ABSTRACT

The quality of service is a fundamental attribute of MANETs that makes an impression on the performance of the network, when connected to the internet. Several authors have proposed some solutions to improve the performance of the integration of mobile ad hoc network and internet to achieve effective data services at high data rates. A gateway node is needed in this case to establish connection between mobile ad hoc networks and internet. The usage of AODV routing protocol faces problems like establishing a long route, time delay and breakage of routes, which leads to perform degradation in the Quality of Service parameters. This paper focus on the development of a multipath gateway route discovery scheme using a cross layer based AODV protocol. The performance analysis of this protocol brings out a better quality of service for data transfer between MANETs and internet environment.

Keywords - MANET, Multipath gateway Route Discovery, CBAODV Protocol, QoS parameters, Routing Discovery Time, Retransmission Attempts and throughput.

1. INTRODUCTION

Many researchers have tried and established connection between Mobile Ad hoc Network and Internet for data transfer in a bidirectional way and to have a better performance. A mobile ad hoc network does not rely on a fixed infrastructure for its operation. The network is an autonomous transitory association of mobile nodes that communicate with each other over wireless links. These nodes that lie within each other's send range can communicate directly and are responsible for dynamically discovering each other. The interconnection of MANET and the internet into a hybrid network to increases the network capacity, extend the coverage of wireless network and expand the communication base as well as the application range of ad hoc networks. In the Internet connectivity is a provided to potential service that could increase the benefit of MANETs and also make the application scenarios more relevant. A hybrid MANETs consists of nodes that required connectivity to the infrastructure network for the purpose of transfer the data and multimedia services like VoIP and video over IP. Their arises a need to extended services of MANETs for long distance activities which may provide a data transfer between different nodes situated at different places. Researcher's provided the solution

for such types of need by way of the provision of connectivity between MANET and internet. One of the solution providers is the selection of gateway node between MANET and internet. The work has been extended to better services using multiple gateways. It is important to choose an appropriate gateway in order to provide on improved data transmission. The gateway access has an intermediate device between the MANETs and the internet. Even enough various architecture is available for interconnection of MANETs to the internet, they faces the connectivity problem and extension of the connectivity, breakage of link and long time delay for data transmission. So in order to achieve better route establishment and for efficient data transmission an adaptive gateway route discovery has been used.

In this paper a modified AODV protocol has been proposed namely cross layer based AODV protocol to establish an improved QoS for data transmission between MANET and internet. Various cross-layering approaches are utilized to improve the QoS performance of MANETs and their associated routing protocols. This work is investigated a Cross Layer Based AODV routing protocol utilizing Physical layer information received SNR/RP to find its gateway route instead of the default hop count mechanism of AODV protocol

in the multipath gateway route discovery environment. The performance of the proposed protocol provide better QoS based data transmission to improve parameters like reduction in the delay for route discovery, improved traffic and throughput.

The structure of this paper is organized as follows: section II presents literature review about the gateway discovery scheme in mobile ad hoc networks. Section III describes the related works about adaptive gateway discovery mechanisms. Section IV describes the AODV protocol and the modified AODV namely Cross layer Based AODV protocol, which describe route discovery process using CBAODV applied to multipath gateway route discover processes. Section V describes about a simulation environment and performance analysis of AODV protocol and CBAODV. Finally section VI narrates about the concluding remarks and feature work that can be carry out.

2. LITERATURE REVIEW

Commonly there are three approaches for gateway discovery process namely proactive, reactive and hybrid. In proactive approach by Sajendra Kumar et al. [2], the gateway periodically sends the gateway advertisement messages which are broadcasted in the whole network. Whereas in reactive approach by Harpreet Kaur Sandhu et al. [3], the node requiring connectivity to internet sends a gateway solicitation message to the gateway that consequently responds with the advertisement message. The hybrid approach uses the feature of both proactive and reactive approach. In hybrid network, the advertisement messages are sent by the gateway to a predetermined range which is defined by TTL value of the advertisement message. One more approach popular now a day is the adaptive Gateway discovery approach. This method mainly improves network throughput and reduces congestion.

Gateway selection method by Shen et al. [6], proposed to choose a Gateway node on the basis of hop count. A gateway discovery message is broadcasted by gateway and on the basis of that message each node estimates its distance metric to gateway with short distance path in term of hop count, which is preferred for data transmission from MANET to the internet. Safdar Hussain bouk et al. [4], proposed mainly three gateway selection parameters which are path availability period, a residual load capacity and the path latency. The path availability period between two nodes that are not immediate neighbors of each other, is equal to the minimum link availability

period between intermediate nodes in that path. On the basis of these parameters, an overall QoS performance for all paths between a MANET node and gateway nodes are achieved. Brannstrom et al. [8], have proposed to measure the variance in the delay between successive gateway advertisements and use this as a metric for gateway selection. Both a higher number of hops between mobile node and gateway, as well as a higher amount of traffic along the path will lead to increase the variance of the arrival rate of advertisements. Hemaltha et al. [9], focus on gateway selection scheme for improving the QoS performance in the gateway nodes. Many gateway selection schemes have been proposed to select gateway node based on single QoS and multiple non QoS path parameters. This scheme considers that has all QoS and multiple non-QoS parameters present in single gateway node connecting two networks.

Gargi et al. [7], focused for hybrid MANET that considers mobility metric as one of the criteria for the gateway selection, for gateway selection the combined load value is computed based on some metrics mobility, inter and intra MANET load and residual energy using simple additive weight (SAW) technique.. Ratanchandani et al. [12], focus hybrid gateway discovery approach to discover gateways that restrict the effects of broadcast overhead. This method using AODV and two Mobile IP foreign agents are used to be linked between MANET and the Internet. K.Palani et al. [5], focus on the proxied adaptive algorithm creates a proactive zone and a reactive zone, when the node is connecting to the Internet. The Gateway Control message requests (GC REQs) is do not sent flooded to the whole network, and intermediate nodes in the border of a proactive zone reply in unicast to the originator with a gateway control message reply (GC REP), therefore the overhead is reduced. Mari Carmen Domingo et al.[10], discuss an adaptive gateway discovery method that has been mostly considered to decrease congestion problems in an ad hoc network and that helps real-time applications to maintain their QoS parameters. Bin et al. [11] focused an adaptive gateway discovery scheme with the purpose of dynamically change the TTL value of GWADV messages. This protocol provides internet access to MANET nodes using mobile IP.

3. RELATED WORK

Once mobile nodes want to discover route, it is first register the gateway and connects to the internet. Mainly there are three different gateway discovery route mechanisms. First is proactive gateway discovery route approach, in which the gateway from time to time transmits gateway advertisement messages (GW_ADV) containing discovery route mechanisms. First is proactive gateway discovery route approach, in which the gateway from time to time transmits gateway advertisement messages (GW_ADV) containing significant information using which a mobile node can enter by the gateway. Second is reactive gateway discovery route approach, in which the gateway does not send GW_ADV messages. Whenever a mobile node desires Internet connectivity, it broadcasts a gateway solicitation message (GW_SOL). When the GW_SOL message reaches a gateway, it sends a GW_ADV message to the mobile node, which then registers with the gateway.

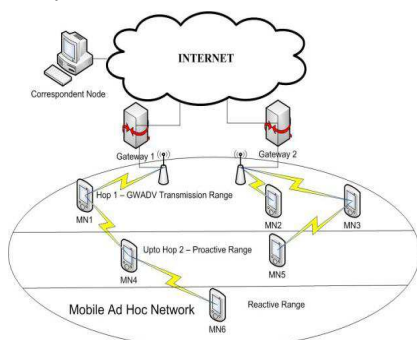


Figure 1. Hybrid Gateway Route Discovery Mechanisms In Manets

Third is hybrid approach, figure 1 refer in which the mobile nodes in a part of the mobile ad hoc network, defined by the TTL value use the proactive approach for gateway discovery and the rest of the nodes outside the TTL range use the reactive approach, the primary challenge in the design of Hybrid Gateway Discovery is to determine an optimal proactive area. If the proactive area is large (i.e. a large TTL value) more overhead is incurred in maintaining routes in a wider area. On the other hand, if proactive area is small, then less maintenance overhead is incurred but more delay in Gateway Discovery is experienced. A modified Hybrid Gateway Discovery mechanism which dynamically adjusts value of TTL and periodicity of GW_ADV messages depending on the MANET characteristics in order to achieve a good trade-off between

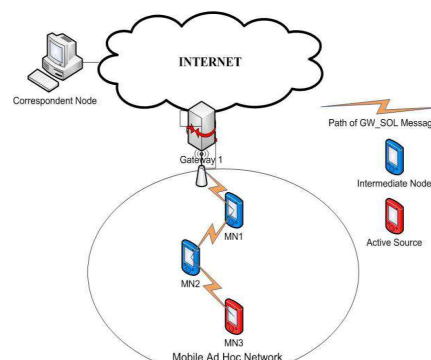


Figure 2. Adaptive Gateway Route Discovery Scheme

performance and network overhead is called an Adaptive Gateway Discovery Mechanism. (refer to figure 2) The first adaptive gateway discovery mechanisms proposed on dynamic adjustment of TTL value using maximal source coverage algorithm does not address the issue of periodicity of the GW_ADV messages. Pedro et al. [13] proposes a work, which is based on the dynamic adjustment of the TTL value of GW_ADV messages using maximal benefit coverage algorithm wherein gateways set the TTL value of their GW_ADV messages which gives maximal benefit. Pedro et al. [14] proposes a work, gateway discovery scheme is suitable for real-time applications. It adjusts the frequency of GW_ADV messages dynamically. The GW_ADV time interval is associated with the quality of service of the traffic, whenever a source node chooses to send real-time traffic, if the real-time traffic is not delivered within a stipulated time period, the destination sends a QoS_LOST message back to the source. A load-adaptive access gateway (AG) discovery scheme is proposed by Bok-Nyong Park et al. [15], which dynamically resizes the range of proactive AG advertisements and reduces AG acquisition latency. Maximum source coverage scheme may not be applicable to all scenarios since one part of the network may be highly loaded and other part may be lightly loaded. A new scheme called Adaptive Distributed Gateway Discovery (ADD) is proposed by Javaid et al. [16], which is based on the hypothesis that gateway advertisements should be targeted at active sources and not at other nodes. Instead of adjusting TTL at the gateway, a distributed approach is used. The authors Fang Xie et al. [17] propose the optimal TTL value depends on the particular scenario and network conditions. A futuristic architecture combining cellular and WLAN networks is proposed in which each base station or gateway

decides its TTL value independently according to the link quality as well as density of active source nodes in the network.

There is a need for gateway discovery mechanisms that support several Heterogeneous Wireless and Mobile Networks (HWMN) applications. Boukerche et al. [18] proposes a work, which is based on HWMN architecture. Vehicular Ad Hoc Network (VANET) is considered as a multi-hop network, as an alternative to Mobile Ad Hoc Network (MANET). In this architecture, the proposed protocol is a layer on top of the network layer. Palani et al. [19] focus on Contention Aware QoS based Adaptive routing Protocol by manipulating the information gained at the link layer as well as to the information obtainable at the network layer to achieve higher PDR compared to existing protocols. In this paper a modified version of AODV routing protocol has been proposed which is based multipath gateway discovery scheme.

4. PROPOSED WORK

The main advantage of proactive routing protocols is an existing route always ready to the target. But it comes with cost of an intense a huge part of the bandwidth; most of resources may not be used. Therefore, a suitable routing protocol for MANETs should imply a sensible over-head in order to conserve the partial bandwidth. Message complexity must be kept very low. The other option is the reactive routing protocol reduces the overhead traffic by creating a route only when it is necessary. While a route is no longer used in reactive protocols, it is just expunged from the routing table. For these reasons reactive protocols are of more attention for the MANET community as reactive protocols. This work selected Ad Hoc On-Demand Distance Vector (AODV) protocol for improving performance. As an outcome, a route is conventional only when it is essential by a source node for transmitting data packets. It employs destination sequence numbers to identify the most recent path. The source node and the intermediate nodes store the next hop information corresponding to each flow for data packet transmission.

This work focus on the design of cross layer concept in the lower to upper layers move to where information from physical layer is used in the network layer. The physical layer is responsible for convey of bits and to acquire minimum bit error rate. The most common parameters are used in the physical layer for bit error rate, signal-to-noise ratio and signal to- noise-interference ratio captures the barrier outcome from the environment. Other

main issue is the transmitting power and battery level, the design of physical layer and information very useful from physical layer setting to be capable of work the upper layer solutions. In this work is carried out for the duration of gateway discovery process and each node has associate with the channel side information offered in terms of likely SNR/RP in to packet transmission. When a node receives the route request, it also has the information of the SNR/RP. If the node takes part in the route reply process, then it stores the SNR/RP value in the buffer. In the reverse path setup of routes the SNR/RP values beside. The same concept is proposed on Fuad Alnajjar et al. [20] used for DSR protocol, but this methodology adopting the multipath gateway discovery approach for Cross layer Based AODV protocol with respect to a suitability of application. It is consider that, in the MANET, when a node receives the packet and it has the channel side information existing in terms of likely SNR/RP, CBAODV route reply packet format is refer in Figure 3.

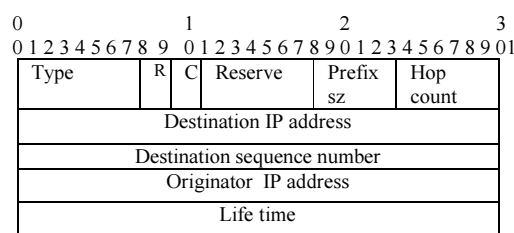


Figure 3: Cross Layer Based AODV Route Reply Packet Format

The above format has nine reserved bits in the packet, which is set to zero in AODV operation. In order to insert the SNR/RP information in the route reply process, modify the use of reserve bits as exposed in Figure 4.

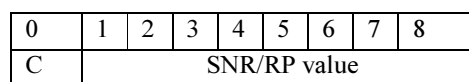


Figure 4: Cross Layer Based AODV Route Reply Packet Reserve Bits Allocation

C= 1 bit: Catch bit 1 or 0; If 1, then the proposed Cross layer Based AODV will be activated and if 0 then traditional default AODV will be activated. SNR/PR= 8 bits: puts the received SNR/RP at node W from a transmission of route request from (S, W) as described below. Figure 5 describe the values on links represent the values of Signal to Noise Ratio of the link or values of received power of the link. When node S needs to send a packet to node G. Node S sends 2 route request packets

along path 1 and path 2. Node G generates 2 route reply packets to node S along the reverse routes of paths 1 and 2. Now, at node S there 2 available routes to Gateway G, path1 with 5 hops but the lowest value of SNR or RP found in the end-to-end

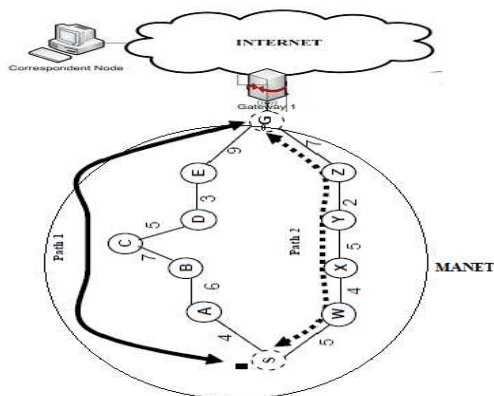


Figure 5. Multipath Gateway Route Discovery Scheme

path is 3, and path 2 with 4 hops but the lowest value of SNR or RP found in the end-to-end path is 2. Source node S will sort the two routes and select path 1 based on our new mechanism since the best worse value of path 1 is 3 is greater than the worse value of the other path which is 2. Default AODV and CBAODV protocols will select Path 2 that has minimum number of hops even though the path has low-quality of service.

Algorithm for Multipath gateway Route discovery process for Cross layer Based AODV

Step 1- A route is established from Source to Corresponding node via gateway. The nodes in the network will identify to put C=1 to activate Cross layer Based AODV protocol in the route reply packet.

Step 2- The neighbor nodes of Source and so on get delivery of route request packet and received SNR/RP of the packet for the time of delivery.

Step 3- The every node can performs the following options:

Step 3.1- If the node itself is gateway, it provides the normal SNR /RP value in the route reply packet.

Step 3.2- If the node is to rebroadcast the route request to its neighbors', it supplies the SNR/RP value in its buffer for helpful use.

Step 3.3- If the node is neither the gateway, nor is to rebroadcast the route request, it junks the Predictable SNR/PR value.

Step 4- With the communicate method; the route request reaches the gateway. Step 3.1 above is executed.

Step 5- In the reverse path transmission of route reply, every pair of nodes compares the SNR /RP values 'stored in the buffer' and 'received via route reply'. Only the lesser value of the two is stored in the next route reply reverse path. The process continues till getting back to Source node.

Step 6- The Source node receives one or several routing paths. For multiple routing paths, each route reply packet for all paths has the lowest existing SNR/PR value available through that path. In its place of lowest hop count, the Source selects the path with privileged value of SNR/RP, and which is among the lesser of each path.

Step 7- The data starts transmitting in the recently defined privileged SNR /RP path.

The proposed work namely as Cross layer Based AODV protocol applied to multipath gateway route discovery processes to achieve QoS performance objectives such as reduction in average delay, low response time and less number of Retransmission Attempts. This scheme is provides the advantage of an increase in traffic and improve throughput for data transmission application.

5. SIMULATION AND RESULTS ANALYSIS

Performance of this scheme has been verified used NS-2 simulation for two controlled scenarios namely Manet's traffic and FTP applications.

Scenario-1(MANET Traffic)

Parameters	Value
Area	2000 m X 2000 m
Nodes	25 (10 m/s)
Gateway	1
Traffic	Raw MANET Traffic
Protocol	AODV default & CBAODV
MAC	802.11b CSMA/CA
Pause Time	100,200,300,400,500,600
Packet Size	512 bits
Node range	300 m

Figure 6 show that the routing traffic sent is little greater than for Cross layer Based AODV protocols on average. But, the Cross layer Based AODV received more MANET traffic at the gateway which leads to more throughputs. Figure 7 show that even to achieve this more throughputs,

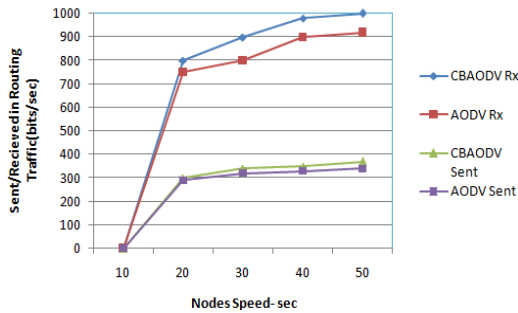


Figure.6: Routing Traffic - Sent And Received By Destination

Scenario-2 (FTP Application)

Parameters	Value
Area	2000 m X 2000 m
Nodes	20 (5 m/s)
Access points	1
Application	FTP
Protocol	AODV default & CBAODV
Traffic rate	11 Mbps
Packet Size	1024 bits
Freq	2.4 GHz

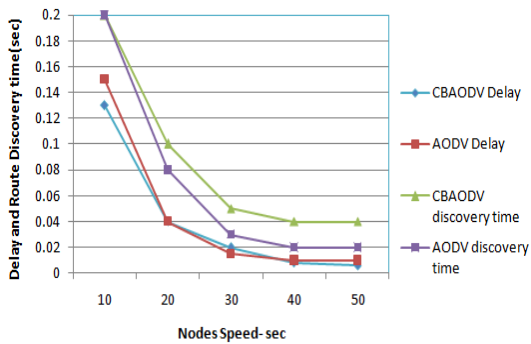


Figure 7: Delay And Routing Discovery Time

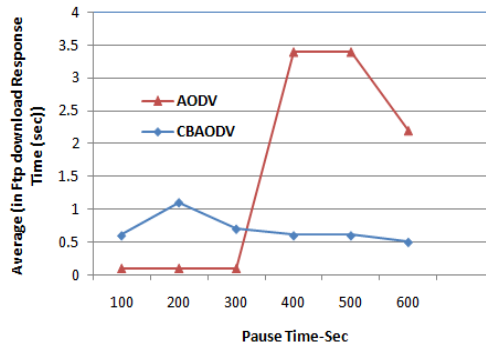


Figure 9: Response Time Of FTP Download

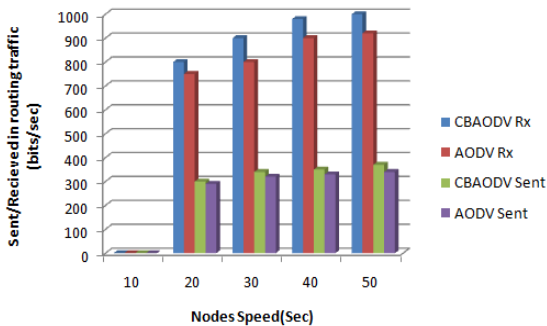
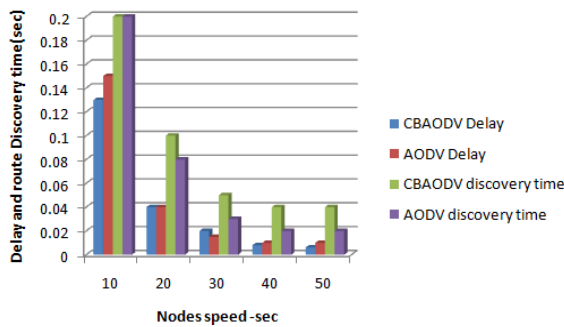


Figure.8: Result Of Manet Traffic Scenario - Delay, Routing Discovery Time And Sent, Received Packets By The Destination,

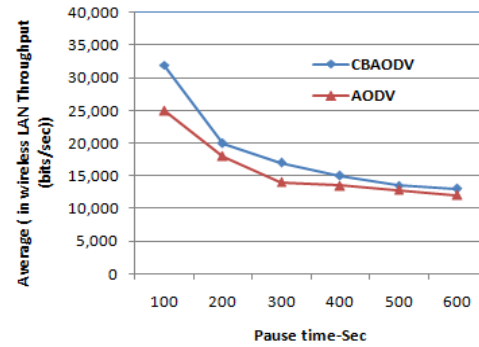


Figure 9.1: Throughput Of Wireless LAN

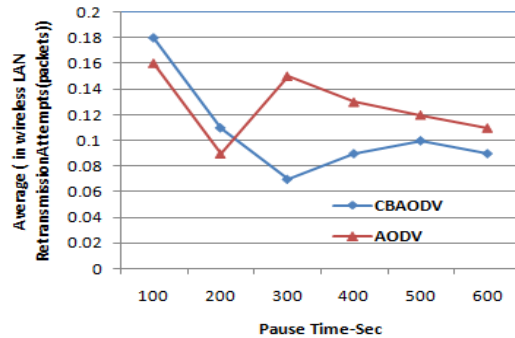


Figure 9.2: Retransmission Attempts Of Wireless LAN

the MANET delay was little more in the default AODV over than the Cross layer Based AODV protocol and the default AODV has less route discovery time which is also expected since the Cross layer Based AODV takes more hops. Figure 8 describe the result of MANET Traffic scenario with respective QoS parameters. Figure 9 shows greatly lesser download response time for Cross layer Based AODV which is a popular parameter for FTP application. Figure 9.1 shows that the Cross layer Based AODV has enhanced throughput than the default AODV protocol. Figure 9.2 shows that, due to link permanence in the Cross layer Based AODV, the retransmission attempts are greatly lesser than that of default AODV. This in return helps the network to have less routing overhead and sending the same data again, and thereby consuming the bandwidth. Hence, it is observed that, the Cross layer Based AODV protocol outperforms the default AODV routing protocol in some of the major performance metrics as shown. It is also observed that, some of the data applications, the stability of the link helps to achieve higher throughput in the Cross layer Based AODV protocol.

6. CONCLUSION

MANETs are infrastructure-less networks, when all the nodes are activate as host as well as routes to deliver data. By the nature and the architecture, the performance is affected by channel conditions, network connectivity, mobility and resource limitations. Various cross-layering approaches are utilized to improve the QoS performance of MANETs and their associated routing protocols. This work is investigated a Cross Layer Based AODV routing protocol utilizing Physical layer information received SNR/RP to find its gateway route instead of the default hop count mechanism of AODV protocol. The simulation results shows that the proposed protocol is little higher than for traffic in sending and received packets, Delay is less and Discover time is small greater than default AODV for the MANETs scenario. In the FTP scenario is Download Response Time is very less and Retransmission Attempts is small less with throughput of wireless LAN is small greater than default AODV. An overall performance of CBAODV is better for the default AODV protocol.

REFERENCES:

- [1] IETF, Mobile Ad Hoc Network Working Group, <http://www.ietf.org/html.charters/manet-charter.html>.
- [2] Sajendra Kumar, Sachin Chaudhary, (Jan. – March 2012) "Performance Analysis of Three Gateways Discovery Approaches in AODV Routing Protocol for Connectivity with Wired Network", IJCST Vol. 3, Issue 1.
- [3] Harpreet Kaur Sandhu and Roopali Garg, " (June 2012) " performance evaluation of gateway discovery Routing protocols in manets", International Journal of Computer Science, Engineering and Applications (IJCSEA) Vol.2, No.3.
- [4] Safdar Hussain Bouk, Iwao Sasase, Syed Hassan Ahmed, and Nadeem Javaid, (august 2012) "Gateway Discovery Algorithm Based on Multiple QoS Path Parameters Between Mobile Node and Gateway Node", Journal of communications and networks, vol. 14, no. 4. .
- [5] K.Palani, P.Ramamoorthy, (May 2012)" QoS based Analysis of Proxied Adaptive Gateway Discovery Scheme for Mobile Ad hoc Networks", IJCSI International Journal of Computer Science Issues, Vol.9, Issue 3, No.3.
- [6] B. Shen, B. Shi, B. Li, Z. Hu, and L. Zou, (Sept. 2005) "Adaptive gateway discovery Scheme for connecting mobile ad hoc networks to Internet," in Proc. WiCOM, , pp. 795–799.
- [7] Rajesh Gargi, Yogesh Chaba, R.B Patel, " Multi - Criteria Gateway Selection & Multipath Routing Protocol for Hybrid MANETs"
- [8] R. Brannstrom, C. Ahlund, and A. Zaslavsky, (November 2005) " Maintaining Gateway Connectivity in Multi-hop Ad hoc Networks in Proc. IEEE WLN 2005, Tampa, USA .
- [9] R. Hemalatha, M. Yamuna Devi, S. Aishwarya, J. Vijitha Ananthi, (February 2013)" Improving QoS Performance in the Gateway node" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 2, Issue 2,
- [10] Mari Carmen Domingo, (April 2007) " An Adaptive Gateway Discovery Algorithm to support QoS when providing Internet Access to Mobile Ad Hoc Networks ", journal of Networks, vol. 2, issue. 2.

- [11] S. Bin, S. Bingxin, L. Bo, H. Zhonggong, and Z. Li, "Adaptive Gateway Discovery Scheme for Connecting Mobile Ad Hoc Networks to the Internet," Proceedings of International Conference on Wireless Communications, Networking and Mobile Computing, vol. 2, pp. 795-799, 2005.
- [12] P. Ratanchandani, and R. Kravets, (March 2003). "A Hybrid Approach to Internet Connectivity for Mobile Ad Hoc Networks," in Proceedings of the IEEE WCNC 2003, New Orleans, USA, vol. 3, pp. 1522-1527,
- [13] Pedro M. Ruiz, Antonio F. Gomez-Skarmeta: *Maximal Source Coverage Adaptive Gateway Discovery for Hybrid Ad Hoc Networks*, Lecture Notes in Computer Science, vol.3158, 28-41, (2004).
- [14] Pedro M. Ruiz, Antonio F. Gomez-Skarmeta: *Enhanced Internet Connectivity for Hybrid Ad hoc Networks Through Adaptive Gateway Discovery*, 29th Annual IEEE International Conference on Local Computer Networks, 370-377, (2004).
- [15] Bok - Nyong Park, Wonjun Lee, Choonwa Lee, *QoS-aware Internet access schemes for Wireless ad hoc networks*, Computer Communications 30 (2007), 369-384.
- [16] Javaid, U., Rasheed, T.M., Meddour, D., Ahmed, T. *Adaptive Distributed Gateway Discovery in Hybrid Wireless Networks*. WCNC – 2008, 2735-2740.
- [17] Fang Xie, Lei Du, Yong Bai, Lan Chen, *Adaptive Gateway Discovery Scheme for Mobile Ubiquitous Networks*, WCNC 2008, 2916-2020.
- [18] Boukerche, A.; Abrougui, K.; Pazzi, R.W.; "An Efficient Hybrid Adaptive Location-Aided Gateway Advertisement and Discovery Protocol for Heterogeneous Wireless and Mobile Networks," Global Telecommunications Conference, 2009. GLOBECOM 2009. IEEE, vol., no., pp.1-6, Nov. 30 2009- Dec. 4 2009
- [19] K.Palani, P.Ramamoorthy, " QoS aware Of cross layer approach On Adaptive Gateway Discovery Scheme for Mobile Ad Hoc Networks", Journal of Computer Science 9(10):1329-1340, 2013, ISSN: 1549-3636.
- [20] Fuad Alnajjar, Yahao Chen, (November 2009) — *SNR / RP Aware Routing Algorithm: Cross - Layer Design for Manets*, International Journal of Wireless & Mobile Networks (IJWMN), Vol .1, No 2.