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IMPROVED ADAPTIVE GATEWAY DISCOVERY SCHEME USING CAB - PROTOCOLS IN MANET TO INTERNET CONNECTION

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ABSTRACT

Wireless Mobile Ad-hoc Networks has became vital in terms of Quality of Service (QoS) is aimed at delivering different services provided by the network to end users. Hybrid MANET is essential for wireless infrastructure networks and difficult to set up communication over enormous areas, with the evolution of the Internet. Routing packets for connecting the MANET to Internet, to optimize a path for the gateway discovery is a great challenge and vital concentration has been given to the design of routing protocols to attain better performance over existing protocols. Most of these routing protocols use information accessible during the network layer to route the packets. In this proposal, using Contention aware Adaptive Based routing Protocols, the information at the link layer in addition to the information at the network layer are manipulated. This concept is incorporated with existing protocols like OLSR and QAODV. Those new protocols are named as Contention aware Adaptive Based OLSR (CAB-OLSR) and Contention aware Adaptive Based QAODV (CAB-QAODV) protocols. The simulation results have shown that the proposed protocols improved various QoS metrics for the MANET to Internet connection.

Keywords: MANET to internet, CAB - OLSR, CAB - QAODV, packet delivery ratio, control overhead.

1. INTRODUCTION

Mobile ad-hoc network is a self-determining network with portable nodes, which can transmit with each other on many hops and works without any fixed infrastructure. In hybrid MANET, integration provides an efficient data transmission. All the nodes are alike in the mobile ad-hoc networks; there is no controlling entity like an access point in the wired networks. It is formed spontaneously in the areas for creating an infrastructure network, which causes delay and also increases the cost of utilization. This is a combination of portable mobile nodes like notebooks, palmtops, PDAs and handheld mobile phones. The feature of mobile ad-hoc network is the adaptability, ease of deployment and the self-configuration. A node of hybrid MANET contains connectivity to the infrastructure networks for receiving data and multimedia services. Routing among the MANET and the Internet was first proposed by Perkins *et al* [1], where MANET devices gain access to the Internet via special MANET devices running both Mobile IP and ad hoc routing protocol, performing as gateways between the MANET and the Internet. For reducing routing overhead in gateway discovery and achieving high packet delivery ratio has been discussed by Hwang R *et al* [3]. Packet delivery ratio is a very important measure in hybrid MANETs, as better the packet delivery ratio congestion shall be reduced and disruption during communication between MANET nodes also gets reduced. Even though some research works have been carried out to achieve less packet delivery ratio, no studies have so far focused on showing packet delivery ratio over extension of the MANET - Internet traffic. The key problem of this technique is that when packet loss occurs, it is impossible to tell whether the lowered packet delivery ratio was due to loss in the Internet - MANET traffic. This is because all MANET - Internet packets travel through the gateway, thus heavily overloading the gateway with traffic and causing excessive packet loss. An objective here is to put forward Contention aware Adaptive Based protocols such that better performance can be obtained over MANET - Internet connection.

The rest of this paper is prepared as follows: Section 2 describe literature review of the mobile ad-hoc network connectivity in Internet networks, Section 3 describe proposed work and discusses the Contention aware Adaptive gateway discovery Based Protocols, Section 4 presents simulation and performance evaluation. Finally, Section 5 presents conclusion and future work.

2. LITERATURE SURVEY

Different architectures have been proposed to link a MANET to the Internet through a gateway in the earlier period by Ding [4]. Denko *et al.* [8] described a cross-layer routing protocol in which specially selected mobility-aware nodes called brokers, publishers and subscribers route packets based on node mobility when link failures are detected at the link layer. Karbaschi *et al* [10], recommend a cross-layer approach on a proactive protocol to measure the quality of a path between any two given nodes in an MANET based on the amount of contentions arising at each link along that path. It was shown that higher packet delivery ratio could be obtained, if packets were travelling along a path having no or fewer contentions compared to a contention prone path. Bin *et al.* [9] proposed an adaptive gateway discovery scheme that can dynamically adjust the TTL value of Agent Advertisements (GWADV messages) according to the mobile nodes in MANET to Internet traffic and their related position from Gateways with which they registered. Akyildiz, *et al* [5], focused mainly on IP based wireless system architectures that employ Mobile IP since, it is the next step to be implemented to achieve everywhere communication.

MANET routing is inherently a network layer problem. MANET routing protocols focus on decreasing the number of hops when routing packets to a particular gateway. Ruiz, *et al*. [14], modified Dynamic Source Routing (DSR) by allowing nodes to find out stable paths from link layer frame collisions and channel usage determined from Network Allocation Vector (NAV), but which are not apt for getting high packet delivery ratio over MANET- internet. In IPv6 mobile ad hoc networks architectures [2], [6], [7] can do better when quick Internet connectivity is required, because Mobile IP gateway registrations are not required. Yet, a determining factor of such quickness is the ad hoc routing protocol used in the MANET. Ratanchandani, *et al* [13], a hybrid scheme is given to get Internet connectivity to MANET nodes, using Mobile IP. The scheme use TTL scoping of agent advertisements, eavesdropping and caching agent advertisements to combine the benefits of proactive and reactive approaches. In Song *et al.* [11] focus a Congestion-aware MANET routing protocol that will give global connectivity and enhanced Quality of Service (QoS) for the next-generation networks. Therefore, when an MANET is connected to the Internet, packets travelling to the Internet are routed to the gateway via the shortest path to minimize routing delay. However, when multiple shortest paths are available to a gateway, the choice of the shortest path may become detrimental, if a congested path is chosen. Congestion cannot be determined from the network layer, and it incessant affects the packet delivery ratio.

3. PROPOSED WORK

In this work awareness of QoS based Link-layer approach has been used to determine congestion that arises along any path to a gateway. Contention is one of the most important issues in the wireless link. In a contention prone channel, packets cannot readily be forwarded. As an effect, packet forwarding is interrupted or packets are destroyed, reducing the packet delivery ratio. To find out this contention, an algorithm that has been created based on the theory recommended by Karbaschi et al [10], where each node determines the contention with Request to send frames, Clear To Send frames, data frames and acknowledgment for data frames at the link layer. These four frames can be corrupted due to collisions and results in either the retransmission of Request to send frame or retransmission of the data frame or both. Hence, whenever retransmission of a Request to send or data frame happens, contention occurs. To know how to find out the contention, let's assume that random node forwards n frame in t seconds to its one-hop next nodes. Let j denote the j_{th} frame being sent from a node to its neighbours. Let the overall Retransmitted of Request to Send frame (R_{rts}) and data frame (R_{df}) from a node sending n frames to any random node in an interval of time *t* seconds is define as $T_{over\ all}$

$$T_{over\ all} = \sum_{j=1}^{n} R_{rts}(j) + \sum_{j=1}^{n} R_{df}(j) \quad (1)$$

The node changes its contention value periodically to reflect the change in the stage of contention. The ratio of the overall failed frames to the overall frames sent, in an interval of time *t* seconds, so an expose determine of contention in the channel. Let assume that contention ratio define as $Ratio_c$ is:

$$Ratio_c = \frac{T_{over\ all}}{2n + T_{over\ all}} \quad (2)$$

Finally, compute the stage of contention at a node and name as Contention value (C_v) *is* represents lack of contention around that node. Lower values of C_v indicate survival of contention value C_v , and *is* given by

$$C_v = 1 - Ratio_c \quad (3)$$

The higher number of packets in an interface queue of a node increases the chances of exhausting the queue. Therefore the number of packets in a queue at any given node is an important measure in determining congestion along a path, leading to drop in packet delivery ratio. Higher the length of the queue, higher the chance of the packets getting dropped, so to calculate Queue value (Q_v) *by* taking the average queue length for a period of *t* seconds and dividing it by the queue value. Let *AQL (t)* denote the average queue length at time *t*. Let *N be* the overall queue length analysis taken in an interval of time t seconds. The average of this queue length evaluation is given by:

$$AQL_{(t)} = \frac{\sum_{t=1}^{N} QL_{(t)}}{N} \quad (4)$$

$$Q_v = \frac{AQL_{(t)}}{Q_s} \quad (5)$$

Let Q_s be the queue size in number of packets. Every node in the MANET measures its own C_v and Q_v at given intervals to determine the stage of contention and queue barrier and they can be combined into a single unit with appropriate weights assigned as Self value (S_v), and *is* given by

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$$S_v = \lambda \times C_v + (1 - \lambda) \times Q_v \quad (6)$$

Where $0 < \lambda < 1$ and $\lambda = 0.80$

Here, λ is assigned a higher value of 0.80 because it is likely that the number of nodes accepting contention will be higher compared to the number of nodes accepting queue barrier due to high packet rates. S_v of 1 at any given node means least or no congestion around that node and lower values of S represents congestion. A node's S_v only reveals the contention and queue barrier around and in that node, respectively. But this work is focus to enhance the efficiency along a path to the gateway. Therefore, a measure of the congestion stage of the entire path from a node to the gateway is required. This is done by another value is called Ultimate value (U_v). Every node in the MANET calculates its U_v *by* multiplying its own S_v with the U_v of the node that is the next hop towards the gateway. The U_v and S_v of the gateway are always set to 1 because it is common for all nodes. At any given time, a node's U_v is the product of the entire S_v from that node to the gateway. To understand how to measure the U_v of a given node, let's assume that a node is the j^{th} node from the root (gateway) of the tree, where the root is the first node denoted by i=0. Here U_v of the j^{th} node is:

$$U_{v_j} = \prod_{i=0}^{j} S_{v_i} \quad (7)$$

U_v of any node reveals the stage of congestion in the entire path, from that node up to the gateway. The Figure-1 shows an example a sender, gateway and three intermediate nodes for measurement is U_v .

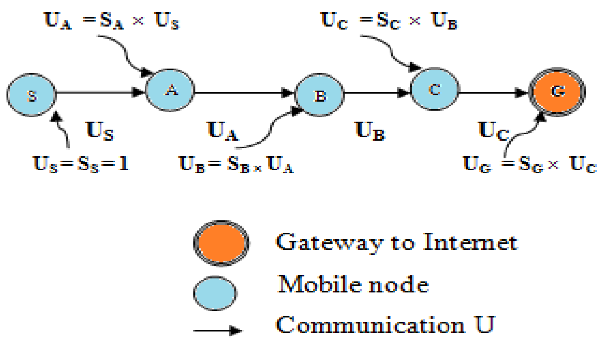

Figure-1. Ultimate values of each node.

Thus, Contention aware Adaptive Based gateway discovery is used to transfer the information only on active path of nodes that can be used in determining the least congested path when multiple paths are available to reach the gateway. This information can help to optimize a network layer.

3.1 CAB-OLSR protocol

The OLSR is one of the proactive routing protocols, where the routes must be available at once when it's required. Thus, it causes the flooding of the topological information to all existing nodes due to topological changes to the network which leads to network overhead. There are two ways to decrease the overhead in the network protocol, the first one use Multipoint Relays (MPR), the second one provides the shortest path by Jacquet, *et al* [12]. Decreasing the time interval for the control message's transmission, will affect to more reactivity in change of topology. It also comes under the flat routing protocol and does not require a central administrative system for routing process. It can minimize the flooding with MPRs. It is most suitable for dense network. It can control the delay process and therefore, does not permit the long delays in the data packet transmission. The host node on the network acting as gateways to another feasible network with the external routing information provided with multiple OLSR interface addresses. The main demerit of OLSR is high protocol bandwidth usage due to updated topological information transmitted by each host node periodically.In the intervening time, the usage of high protocol bandwidth by OLSR can be minimized by indorsing of Contention aware Adaptive with regular OLSR called Contention aware Adaptive Based OLSR (CAB -OLSR) protocol.

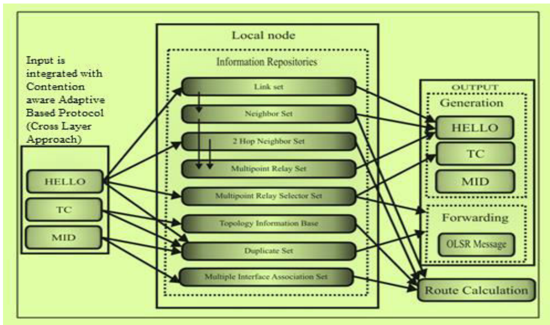

Figure-2. CAB-OLSR architecture.

In the Figure-2 shows architecture of CAB - OLSR uses two different classes for control messages named Hello message and Topology Control (TC) message. Hello Message is used to the get the information on the link status as well as a host node's neighbor. The function of Multipoint Relay is relaying a message between the nodes. From the Hello message, the Multipoint Relay (MPR) Selector set can be formed. It depicts the neighbor node can choose this node to act as MPR. So, information about a node can be calculated for a particular set of the MPRs. The Hello messages are transmitted only one hop away from the network whereas the TC messages transmitted all over the complete network. TC message uses the transmitting information with neighbor node details of at least one MPR selector list. It is transmitted at regular intervals and forwards the TC messages only by MPR nodes. In addition, Multiple Interface Declaration (MID) messages are also used to notify other nodes. The broadcasting node contains multiple Contentions aware Adaptive Based - OLSR interface addresses. It is also transmitted all over the entire network only by MPRs. Host and Network Association (HNA) message are also there to provide the external routing information. It affords the chance for routing to the external addresses of nodes. The HNA message gives details about the entire network and net mask addresses. Hence the CAB-OLSR node deliberately allows the broadcasting node to act as gateway nodes in the broadcasting set of addresses.

The routing table contains gateway address, next address (next hop), number of hops to the gateway and local interface address. The routing table entries are maintained by the host node. The details are obtained from the base of local link information (Hello message) and topologically set (TC messages). Based on the changes in these sets the recalculation of routing table has been done. Since CAB -OLSR is a proactive protocol; it should have routes for all accessible hosts on the network. The broken links and partially known links are not updated or stored in the routing table. The routing table gets changed in the following circumstances like appearance or disappearance of the neighbour node links, found between distant two hops neighbour, topological link or link failure or changes in Multiple Interface messages.

3.2 CAB-QAODV protocol

The extended ad hoc on-demand distance vector (QAODV) routing protocol to provide QoS support in mobile ad-hoc networks. To provide QoS, packet formats have been modified in order to specify the service requirements which must be met by the nodes forwarding a Route Request or Route Reply. The QoS Lost message is forwarded to all sources potentially affected in the change in the QoS parameters. The advantage of QoS AODV protocol is the simplicity of extension of the AODV protocol that can potentially enable QoS provisioning. No resources are reserved along the path from the source to the gateway. The disadvantage is a major part of the delay occurs at a node contributed by packet queuing and contention at the MAC layer. The proposed protocol Contention aware Adaptive Based QAODV (CAB-QAODV) routing protocol with cross layer mechanism has to send a Hello message; the data source starts a path-discovery process to discover the route. When there is an effective routing to the gateway node in a routing table it starts to send a Route Reply packet (RREP) which also can reach the source node in the reverse route; if it fails, it will retransmit again RREQ. The similar process will be repetitive until the RREQ reaches the gateway node or the node attains the routing information about the gateway node. Then it again sends the RREP signal and all the nodes which receive RREP records in a similar way the path from the source node in the gateway node in order to deliver routing services for the arrival of successive data packets. This CAB-QAODV routing protocol provides the reform of the source node as well as the local repair. The function of local repair is that when the intermediate node identifies the link break, it catches data packets from the source node and simultaneously sends an RREQ signal. If the gateway node receives the RREQ, and then replies RREP; it indicates that the routing is repaired effectively. If the node does not receive an RREP within the stipulated time period, it will inform the routing error packet to source node.

4. SIMULATION AND PERFORMANCE EVALUATION

The proposed Contention aware Adaptive gateway discoveries Based Protocols are implemented and consequent test has been carried out using the Network Simulator. Also, all the adaptations were made and written using tcl scripts in NS2 for the implementation of OLSR, CAB-OLSR, QAODV and CAB-QAODV routing protocols with necessary simulation parameters. This simulation has been set up using a scenario consisting of 50 mobile nodes using 802.11b at 2 Mbps with a radio range of 250 m. Interface queue length 50 packets , Interface queue type Droptail. The two-ray ground wireless propagation model is used. Nodes are placed in a rectangular area of 1600x400 m^2 and varied the number of gateways from 1 to 6, being located in the corners of the simulation area. Sources send UDP traffic at a constant bit rate of 10 Kbps, with 320 bytes per packet. All data packets are sent from nodes in the MANET to nodes in the fixed network. Every source begins transmitting data within the first 50 seconds of the simulation, at a randomly chosen time. All the simulations have been carried out for 1000 seconds.

4.1 Comparison of CAB-OLSR and OLSR

The following comparison is evaluating the performance of CAB-OLSR and OLSR routing protocols. The factor of a packet's delivery ratio with initial finite energy, the CAB-OLSR holds the high packet delivery ratio than the OLSR protocol.

The overall report shows that the OLSR has the low packets delivery ratio at 50 nodes evacuation, and comparatively the CAB-OLSR, which is shown in the Figure-3(a). The average end-to-end delay simulation was carried out to find the better performance between OLSR and CAB-OLSR protocol illustrated in the Figure-3(b). The Figure-3(c) depicts the Normalized routing load simulation results were compared with OLSR and CAB-OLSR protocol. During the initial simulation, both the protocols have shown with slight deviation up to reaching of 300 pause time's evacuation, and then the CAB-OLSR turned to down, the simulation until to reach the maximum of 800 pause times.

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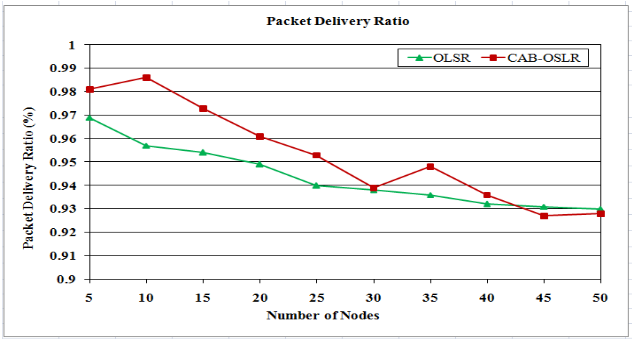
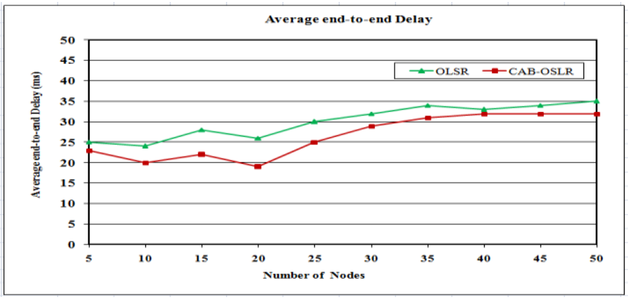
The Routing Control Overhead comparison with constant incrementing of gateways in the simulation, the result shows that the CAB-OLSR carried more control packets than the regular protocol OLSR. The more overhead control packet's traversal leads to less performance of the protocol depicted in Figure-3(d). In the Figure-3(e) depicts the comparison of OLSR and CAB-OLSR on Gateway discovery messages overhead. The variation of the Gateway discovery message's overhead count carried out where at the gateways counts 4, 5 and 6, the CAB-OLSR provides 49000, 44000 and 35000 respectively, it concludes that the CAB-OLSR provides the less gateway discovery messages overhead than the existing protocol OLSR.

4.2 Comparison of CAB-QAODV and QAODV

The comparison between the QAODV and CAB-QAODV routing protocols on the factor of a packet's delivery ratio in the initial count of sources 5; the QAODV protocol gives an output of 0.95 where the CAB-QAODV gave an outcome of 0.97 and Illustrated in Figure-4(a). The average end-to-end delay of CAB-QAODV and QAODV as a function in the number of nodes evacuated with finite initial energy shown in Figure-4(b). Both the protocols show the uniformity of delay performance from simulation starting itself. The overall delay of CAB-QAODV produces a less average end-to-end delay in the data transmission than the existing protocol QAODV. The comparison result shows that the CAB-QAODV protocol produced less normalized routing load than the QAODV protocol.



(a)



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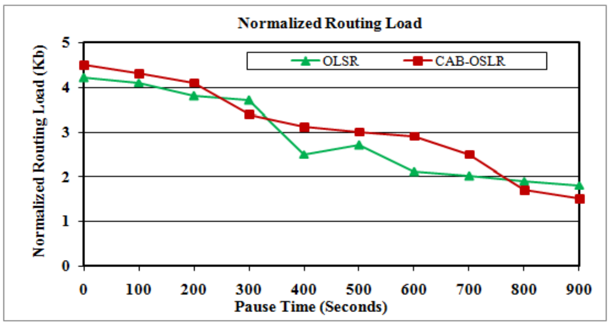

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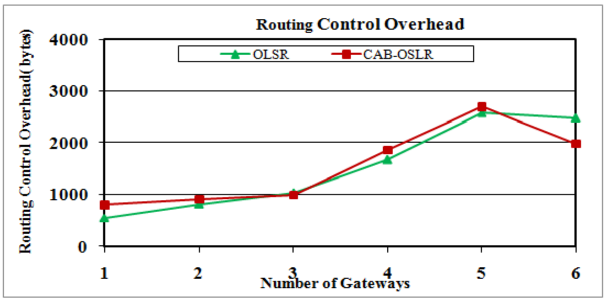

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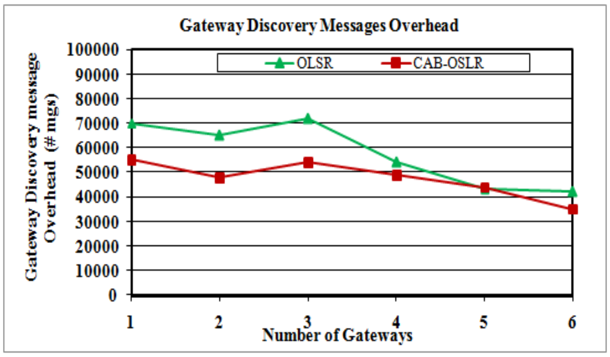
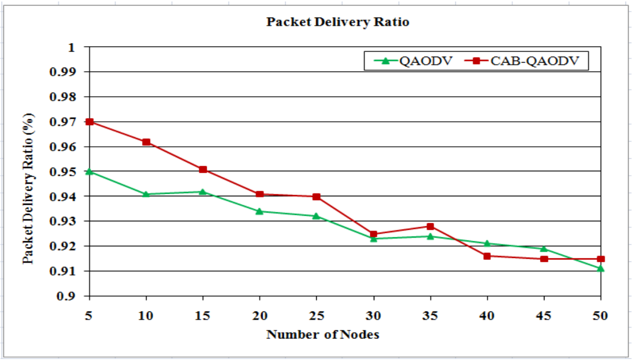
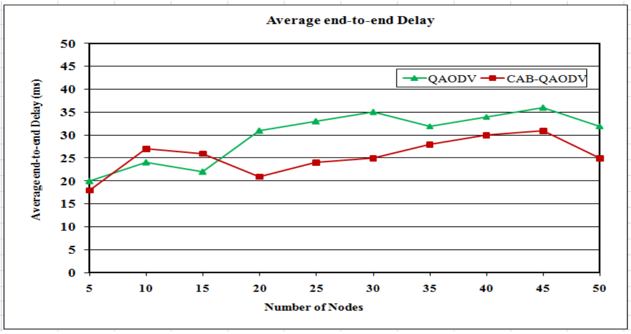


(e)

Figure-3. Comparison between OLSR and CAB-OLSR Protocols. a. Packet Delivery Ratio, b. Average end-to-end delay, c. Normalized Routing Load, d. Routing control Overhead, e. Gateway Discovery Messages Overhead.



(a)



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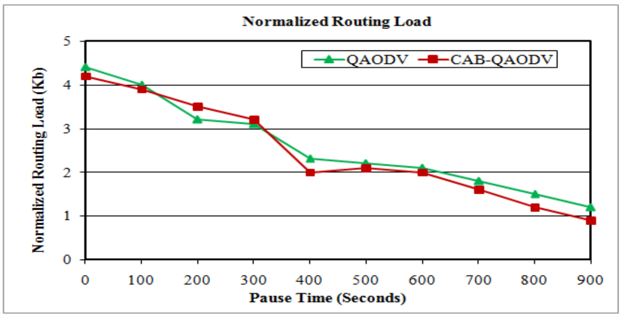

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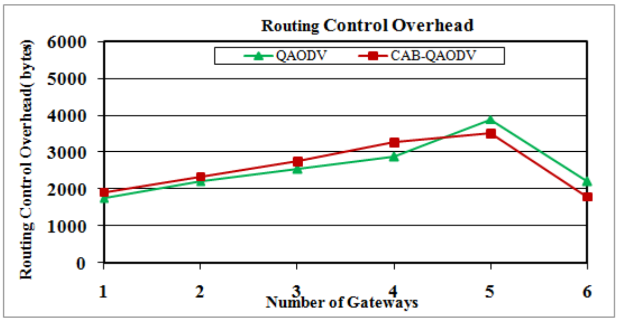
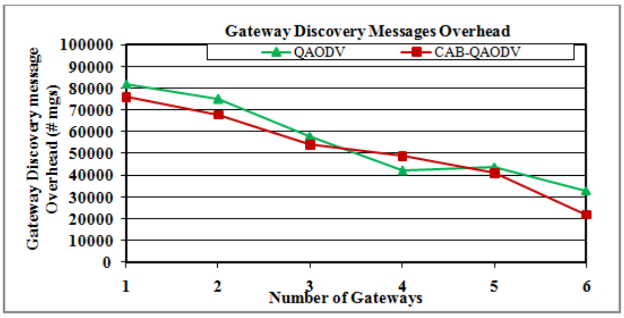


(d)



(e)

Figure-4. Comparison between QAODV and CAB-QAODV Protocols. a.Packet Delivery Ratio, b. Average end-to- end delay, c. Normalized Routing load, d. Routing control Overhead, e. Gateway Discovery Messages Overhead.

The CAB- QAODV raise up to 300 pause times evacuated and gradually incurs to fall when increasing the pause time evacuation in Figure-2(c). In the Figure-4(d) shows that the protocol CAB-QAODV carried more Control Overhead between the intermediate nodes than the existing protocol QAODV. The maximums of Routing Control Overhead of 3512 bytes were carried by CAB-QAODV while 3887 bytes by QAODV at the gateway count of 5. The carrying of more overhead, while transmitting leads to maximum energy consumption of the network as discussed earlier. The simulation result shows that the QAODV protocol produces more Gateway discovery messages overhead than the proposed protocol CAB-QAODV. From the initial position to the gateway increment of 1, both the protocols produce small variation of Gateway discovery messages overhead. The gateway count at 2 onwards the performance deviations between the protocols were increased shown in the Figure-4(e).

5. CONCLUSIONS

The proposed work is analysis of cross layer approach using an improved adaptive gateway discovery scheme called Contention aware Adaptive Based routing Protocols namely CAB-OLSR, CAB-QAODV. In this the information at the data link layer in addition to the information at the network layer is manipulated and involved to choose an optimal path for route establishment in MANET to Internet. The simulation results shows that there is some considerable improvements in the performance metrics like Packet Delivery Ratio, Average end-to-end Delay, Normalized routing load, Routing Control Overhead and Gateway discovery messages overhead. The future work is involved in the development of modified adaptive gateway discovery scheme using hybrid protocols of different natures.

REFERENCES

[1] Perkins C.E. 1996. Mobile-ip, ad-hoc networking, and nomadicity. In: Proceedings of 20th International Computer Software and Applications Conference (COMPSAC 1996), Seoul, South Korea. pp. 472-476.

[2] Nilsson A., Perkins C, Tuominen A, Wakikawa R and Malinen J. 2002. AODV and IPv6 internet access for ad hoc networks. SIGMOBILE Mobile Computing and Communications Review. 6(3): 102-103.

[3] Hwang R, Li C, Wang C and Chen Y. 2005. Mobile IPv6-based ad hoc networks: Its development and application. IEEE Journal on Selected Areas in Communications. 23(11): 161-2171.

[4] Ding S. 2008. A survey on integrating MANETs with the internet: Challenges and designs. Computer Communications. 31(14): 3537-3551.

[5] I. F. Akyildiz, J. Xie and S. Mohanty. 2004. A survey of mobility management in next-generation all-IP-based wireless systems. Wireless Communications. 11(4): 16-28.

[6] Xi J and Bettstetter C. 2002. Wireless multihop internet access: Gateway discovery, routing, and addressing. in International Conference on Third Generation Wireless and Beyond, San Francisco, CA, USA. pp. 109-114.

[7] Wakikawa R, Malinen J, Perkins C, Nilsson A and Tuominen A. 2006. Global connectivity for IPv6 mobile ad hoc networks. Mobile Ad Hoc Networking Working Group.

[8] Denko M.K Shakshuki E and Malik H. 2007. A mobility-aware and cross-layer based middleware for mobile ad hoc networks. in Proceedings of the 21st International Conference on Advanced Networking and Applications, Niagara Falls, ON, Canada. pp. 474-481.

[9] Bin S, Bingxin S, Bo L, Zhonggong H and Li Z. 2005. Adaptive Gateway Discovery Scheme for Connecting Mobile Ad Hoc Networks to the Internet. Proceedings of International Conference on Wireless Communications, Networking and Mobile Computing. 2: 795-799.

[10] Karbaschi G and Fladenmuller A. 2005. A link-quality and congestion-aware cross layer metric for multi-hop wireless routing. In: IEEE International Conference on Mobile Ad Hoc and Sensor Systems (MASS 2005), Washington, United States. pp. 649-655.

[11] Jacquet P, Muhlethaler P, Clausen T, Laouiti A, Qayyum A and Viennot L. 2001. Optimized Link State Routing Protocol for Ad Hoc Networks. IEEE Multi Topic International Conference on Technology for the 21st Century, pp. 62-68.

[12] Ratanchandani P and Kravets R. 2003. A hybrid approach to internet connectivity for mobile ad hoc networks. in Wireless Communications and Networking Conference. vol. 3, New Orleans, LA, USA. pp. 1522-1527.

[13] Ruiz P and Gomez-Skarmeta A. 2005. Adaptive gateway discovery mechanisms to enhance internet connectivity for mobile ad hoc networks. Ad Hoc and Sensor Wireless Networks. 1(1): 159-177.