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Modified Adaptive Gateway Discovery Scheme Using Hybrid Routing Protocols in Multicast Transmission

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Abstract
This paper present hybrid mobile ad hoc network access to connect internet and other devices through various links at any time. This wireless internet access considers the integration of internet and mobile ad-hoc networks. A very important issue in wireless internet access is to discover an efficient and reliable internet gateway. This paper proposes a Modified Adaptive gateway discovery approach that can exploit the hybrid wireless network conditions. This scheme is incorporated into hybrid protocols named as Modified Adaptive gateway discovery Based - ZRP (MAB-ZRP) and Modified Adaptive gateway discovery Based Muticast - ZRP (MAB-MZRP). These protocols dynamically adjust a proactive zone according to network state of unicast and muticast data transmission. The simulation results show that the proposed protocols performs better than existing protocols, decreases network diffusion, achieves higher packet delivery ratio and lower average end-to-end delay, decreases the routing control overhead and gateway discovery messages overhead.

Keywords: Hybrid MANET, MAB-ZRP, MAB-MZRP, Multicast and Unicast

Introduction
The interconnection of Mobile Ad hoc NET work (MANET) and the internet into a hybrid network increases the network ability, extend the coverage of wireless network and expand the communication base as well as the application range of ad hoc networks[11]. The MANET node interacts inside the Ad hoc Network only. Several applications require connecting an outside network such as Internet or wireless LAN to make users comfortable with the resources present in the outside network. For this reason to increase the moveable devices and evolution of wireless broadband communications, an incorporation of different heterogeneous wireless networks courage the areas of fifth generation wireless networks. To take out perfect heterogeneous wireless networks, this work focus on hybrid wireless mobile ad-hoc networks providing Internet connection. Ad-hoc networks are considered matching to IP networks in an understanding that Internet connectivity can be extended to the ad-hoc networks, making them a constituent of the Internet.
The hybrid wireless mobile ad-hoc network architecture is very much scalable and cost efficient, giving a solution to the easy deployment of hybrid wireless networks. Major issue is discovering the gateway in hybrid Wireless Internet access network. When mobile node requests to connect the Internet, it should be able to connect suitable gateway. There are three Internet gateway discoveries approaches proposed namely as proactive, reactive and hybrid schemes. In proactive approaches, the gateway once in a while sends the Gateway Advertisements messages, which are flooded during the complete ad-hoc network. In reactive approaches, the nodes which involve connectivity to the gateway broadcast the Gateway Solicitation messages. These solicitation messages are answered by the gateways. Most important challenges to design a hybrid scheme are to find out the optimal proactive zone in [10]. To improve existing hybrid schemes, a novel Modified Adaptive gateway discovery scheme is proposed that dynamically adjusts its proactive zone according to changing network conditions. Formerly routes are discovered to gateways, mobile nodes should be able to select one gateway providing the best connection. This selection method distributes data packets into distinct gateways and maintains low control overhead. It minimizes the average delay and increase the packet delivery ratio.
The remainder of this paper is structured as follows: Section 2 discusses literature review of the Internet connectivity in hybrid wireless Internet access networks, Section 3 discusses the basic adaptive gateway discovery concept and describes the propose Modified adaptive gateway discovery, Section 4 presents simulation and performance evaluation. Finally, Section 5 presents conclusions and future work.

Related Work
The gateway discovery can be working in a proactive, reactive or hybrid method. For the mobile nodes to linking out of range, a gateway discovery method is necessary to arrange the nodes to discover the route to the gateway. As contrast to wired networks, where the gateway for all time at a single-hop, the problem of gateway discovery in hybrid networks is frequently change positions of the node, increase number of the nodes in ad hoc networks etc. makes it even more difficult in [1]. The proactive gateway discovery proposals are described in [2]. The Gateway notice or broadcast message route advertisement are once in a while generated, one for a definite interval of time (*T*). This information's are not completely used for configuration process but moreover to renew and/or minimize the routes to the Gateway. As stated in

[3], the best value of this internal T depends on the network circumstances such as frequently change positions of the nodes, the position, number of sources, traffic load and traffic emission pattern, etc. In the few proactive algorithms that dynamically correct the interval to send control messages in ad hoc routing protocols. For example, the Adaptive Distance Vector [4], modify the frequency and the size of the routing renews according to the network circumstances. In [5], the authors present two timing algorithms to revise routing information, the Dynamic Timer Based on Multi-increase Additive Decrease and Dynamic Timer Based on Demand Proactive Update. In this proposal [6], T is set to a predetermined value, while the Gateway sends out the advertisement message with the TTL (Time To Live) equal to the least number of hops required to accomplish all the sources that use this Gateway to communicate with external hosts. In this approach, the part in which message route advertisements are spread is controlled. In [7], a hybrid scheme is given to get Internet connectivity to MANET nodes, using Mobile IP. The scheme use TTL scoping of agent advertisements, overhear and caching agent advertisements to mingle the benefits of proactive and reactive approaches.

Three-tier architecture using mobile gateways is shown in [8],. An extended AODV protocol is used as the MANET routing protocol. Mobile nodes can maintain links to multiple mobile gateways using hybrid gateway discovery mechanisms. The hybrid gateway discovery scheme for internet gateway discovery is proposed in [9]. In the proactive approach, it provides high-quality connectivity and little delay via repeatedly updates of recent gateway information with the cost of high control message overheads. The reactive approach achieves little discovery overhead, but increase route discovery delay. The hybrid approach merges both schemes with good quality connectivity and little delay. Behind discovery of several relay routes; mobile nodes choose the best gateway to converse with internet hosts outer the ad-hoc networks [6]. The hybrid scheme is fairly fuzzy i.e. significant to the optimized *TTL* value. For that reason, the hybrid scheme should integrate a definite level of adaptation to dynamically react to the network changes, [12]. Furthermore, in an average to large scale network, the overhead to maintain the routes in the direction of the gateway is significantly more expensive than initially discovering the route. To improve an existing hybrid schemes, Modified Adaptive Based Gateway Discovery scheme has been proposed that dynamically adjusts its proactive zone according to changing network conditions with guarantees a well-organized and gainful gateway discovery and maintenance.

Proposed System

Most of the gateway discovery schemes are only working on particular network configuration during dynamic network surroundings. Scalability and performance trouble can start with external zone, because the fixed proactive region in hybrid scheme, do not make easy dynamic network situation [10].The research work in the design of a hybrid approach is involved to find out the most excellent potential proactive region. The failure rate and interruption are reduced by increasing the area, but it force packet overhead to sustain routes in a larger area. The routing overhead is less by decreasing the area, but it may distribute additional delay and experience high loss rates [7]. As a result, fixed value of proactive region is not the best option for the entire levels of network conditions. To reach best performance, a Modified Adaptive **g**ateway discovery method is proposed which dynamically changes Proactive gateway advertisements.

This protocol adapts its performance to current network situations for example the number of mobile nodes or the ad-hoc network range with the aim of provision of large networks area. Gateways are periodically updating their companies in an ad-hoc network by distribution gateway control messages with their information within repetitive interval. To put off the flooding of the Control messages; these Control Messages are controlled by n-hop neighborhood using a time-to-live (TTL) value. This range calculates the gateways discovery scale, called a proactive zone, which dynamically changes by adaptive gateway discovery protocol. To choose the proactive zone, assume that the gateways can estimate total number of node and the size of network. The first computed value of the proactive zone is

$$\textit{Proactive zone}\ (\Omega) = \frac{S}{N \cdot 2T} \cdot \alpha \qquad (1)$$

Where Ω is a proactive zone by *TTL*, S is network size defined as a rectangular area of a given length and width, T is the total number of nodes, N is data packet size, and α is a constant 0.1. The proactive range expands or shrinks according to network traffic which is predictable by gateways during the time interval ($t1$, $t2$).To compute the accessible load, consider that the average traffic arrival rate is γ and the average traffic length is υ per time interval, and consider with reference to a periodic time interval of length $t > 1$ between two successive estimations. The number of path linked to the gateway over this interval is $n(t)$ and the amounts to be generated are $\gamma 1 \cdot \upsilon 1, \gamma 2 \cdot \upsilon 2, \ldots, \gamma n(t) \cdot \upsilon n(t)$. For ease, let us further assume that the packet sizes are independent. In the interval $t1$, $t2$, the presented load is given by

$$L = \sum_{t=1}^{n(t1)} \gamma_i \cdot \sum_{t=1}^{n(t1)} \upsilon_i = \sum_{t=1}^{n(t1,t2)} \gamma_i \cdot \upsilon_i \qquad (2)$$

In addition, the residual energy *of* a node on a path $E(p)$ is calculated as

$$E(p) = min_{l=1,\ldots,j} E_i\ (\text{or})\, E_{\infty} = \sum_{l=1}^{j} E_l \qquad (3)$$

It denotes degree to which the path is in critical energy. Usually, the paths with significant least residual energy are desirable. Since the residual energy is applied to the links of the path P which is having the links l =1, 2, 3… j and the residual energy $E_l = E_1 + E_2 + E_3 \ldots E_j$, as applied respectively.

The current transmission powers used by the nodes on a path $P(t)$ is given by

$$\mathrm{P}(t) = \sum_{l=1}^{j} P_l \ (\text{or}) \ P_\infty = \max_{l=1,\dots,j} P_l \qquad (4)$$

The parameters only captures the current energy state of the network and as a result also use the transmission power $\mathrm{P}(t)$ which is mandatory for exact reception in the link *l*. $\mathrm{P}(t)$ is measured from conjoining the link metrics by applying minimization additive operator whereas P_∞ is measured from conjoining the link metrics by applying maximization operator. Finally put together into the present load, residual energy and transmission power β is given by

$$\beta = \sum_{i=1}^{n(t1,t2)} \gamma_i \, \upsilon_i + \sum_{i=1}^{j} E_l + \sum_{i=1}^{j} P_l \qquad (5)$$

To avoid unnecessarily frequent resizing of the proactive area begin two threshold - max threshold (μ max) and min threshold (μ min), which are based on the traffic load and always μ max > μ min. If the estimation value is larger than the max threshold (β > μ max), the area size is addition by 1. Similarly, if the estimation value is less than the min threshold (β < μ min), the area size is subtraction by 1. In other words, if Ω (*now*) is the current proactive range, the next proactive area becomes

$\Omega\ (now + t) = \Omega\ (now)$ or

$$\Omega\ (now + t) = \Omega\ (now) \pm 1. \qquad (6)$$

The μ max and μ min are β + β · 0.05 and β + β · (−0.05), respectively.

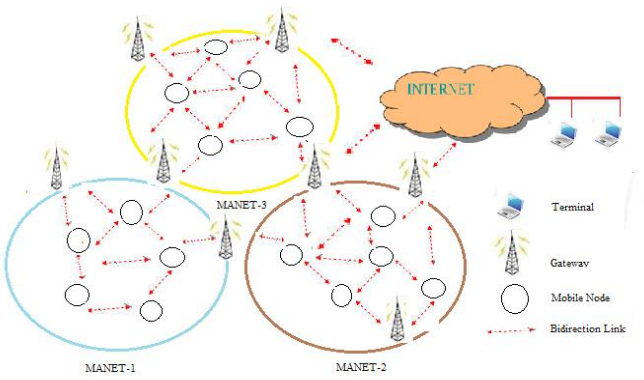


Fig. 1 Modified adaptive gateway discovery.

As shown in Fig. 1. Mobile nodes within the TTL receive the periodic gateway advertisement messages from gateways. If they are out of the range, the mobile nodes broadcast Gateway Request messages (GRQ). Mobile nodes inside the proactive area of the gateway respond with Gateways Response messages (GRP) to the
soliciting mobile nodes or relay to gateways. On receipt of GRQ messages, gateways send the GRP message which has the gateways' prefix and information back to the soliciting mobile nodes. Data packets within the proactive area are routed by means of proactive routing protocols. Routes from a source node to the edge of the proactive area are reactively maintained. The efficient adaptive gateway discovery scheme provides effective and fast discovery of gateways by the integration of three traditional gateway discovery schemes. If many gateways discovered, mobile nodes decide on the best gateway to communicate with Internet hosts outer the mobile ad-hoc networks.

Modified Adaptive gateway discovery Based ZRP (MAB-ZRP)

The major issue in the mobile ad hoc networks absorbs routing overhead, asymmetric connection between the nodes among the transmission and structure of network topology in the networks. To overcome these difficulties, a number of proactive, reactive and hybrid routing protocols are build up by researchers. The ZRP was offered in 1997 by Haas and Pearlman, which are mainly reformed and suggested to use in ad-hoc networks for network enhancement has been given in [13]. The Adapting Zone Routing Protocol for heterogeneous scenarios in ad-hoc Networks. The performance of Zone Routing Protocols in ad-hoc networks are analyzed in [14]. The merit of ZRP is, it reduces network traffic and there is no single point of failure. It can identify the multiple routes and also ensures that all the routes loop free. It provides less connection setup delay and high network reliability. The demerit of ZRP is having high complexity and rather improved act than pure protocol techniques. Furthermore, the delays and overhead is also a major complication in improving the performance of ZRP. To overcome the above curb, a routing mechanism called Modified Adaptive gateway discovery Based ZRP (MAB-ZRP) is proposed.

In the unicast routing, a proactive routing protocol, Intra-zone Routing Protocol is employed inside the routing zone, and a reactive routing protocol, Inter-zone Routing Protocol is employed between routing zones. In the local zone, a route to a destination node can be recognized from the sources proactively using cached routing table provides on Intra-zone Routing Protocol. With the intention of discovering in new neighbour nodes and broken links and failures, the MAB-ZRP depends on a Neighbour Discovery Protocol (NDP) supported by the Media Access Control (MAC) layer. The NDP has broadcasts "HELLO" beacons at uniform periods. The advantages offered by routing zones, relate with the overhead of proactively routing zone topology, establish the optimal frame configuration. By way of network circumstances change; the frame configuration can be efficiently and quickly reconfigured with adjustment on all the nodes presented in routing zone. The routing protocol named as Modified Adaptive gateway discovery Based Zone Routing Protocol (MAB-ZRP) is proposed, to find an optimal path for effective unicast data transmission and to enhance their overall network performance in hybrid mobile ad hoc networks.

Modified Adaptive gateway discovery Based Multicast Zone Routing Protocol (MAB-MZRP)

MZRP is the extended version of unicast ZRP. It is a combined strategy of both proactive and reactive routing concepts. MZRP does not depend on any underlying unicast protocol. The proactive routing procedure inside a zone can be implemented with periodic beacon exchange and the reactive routing procedure to communicate across dissimilar zones is recognized through on demand flooding and multicast tree construction. Multicast routing is used to send the same message or the same data stream to be forwarded to multiple gateways. It is an efficient data transmission method to support group- communications in one-to-many or many-to-many applications. Since the multicast group gets the better results with source tree topology of MZRP, and this proposed work enhance the hybrid mobile ad hoc network performance with modified adaptive gateway discoveries method. This method are carefully examined and optimized with existing MZRP protocol named as Modified Adaptive gateway discovery Based-MZRP. The entire node in the zone announces to other zone members by propagating an advertisement control packet, and its transmission regulated by Time-To-Live (TTL) value that is normally set to the zone radius. The nodes that receive advertisement control messages make an entry for the source node in their zone routing table, and which can update their neighbor table with the upstream node that sent the advertisement control message. The source node transmits a tree create packet. It consists a session ID with a TTL value set to the radius of the zone. By receiving the tree created packet, any one of the nodes within the zone which wants to be a receiver of the multicast session reacts with a tree to create acknowledge packet, and the packet routes back to the source on the reverse path traversed by the tree create packet. In the same path, any intermediate node receives.

Source node sends a tree refresh packet in particular time interval. Any node that is disconnected from the tree sends a join packet recognizing the multicast session to all of its zone nodes. Any other node of the multicast tree that has not disconnected reacts with join acknowledge packet and adds the neighbour node that sends the join packet to the list of downstream nodes. The similar processes are accepted to entire nodes that receive the join or join acknowledge packets. After sending the join packet, if any disconnected node does not receive the join acknowledge packet within a limited time, it sends a join propagate packet to all of its gateway nodes that in turn send the join packets to all their zone nodes. Similar process will be repeated up to a gateway node receives a join acknowledge packet, which is forwarded to the disconnected member node. A receiver node disconnects from the multicast session by sending a tree reduce message to its upstream node in the tree. The upstream node will eliminate the receiver node then the node sends a tree reduce message to its upstream node further up in the multicast tree.

Simulation

The proposed Modified Adaptive gateway discovery Based Protocols are implemented and consequent test has been carried

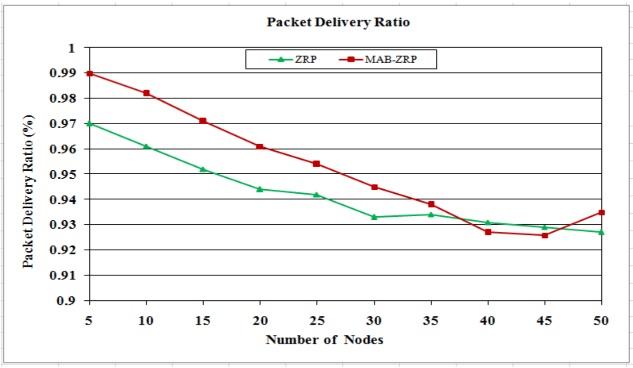
out using the Network Simulator. Also, all the adaptations were made and written using tcl scripts in NS2 for the implementation of ZRP, MAB-ZRP, MZRP and MAB-MZRP routing protocols with necessary simulation parameters. This simulation has set up a scenario consisting of 50 mobile nodes using 802.11b at 2 Mbps with a radio range of 250 m. The two-ray ground wireless propagation model is used. Nodes are placed in a rectangular area of 1500x300 m^2 and varied the number of gateways from 1 to 6, being located in the corners of the simulation area. In the case of 2 gateways, they are at opposite corners. The 5^{th} and 6^{th} gateways are located in the centre on the X axis, at the top and the bottom respectively. 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.

Comparison of MAB-ZRP and ZRP for Unicast Transmission

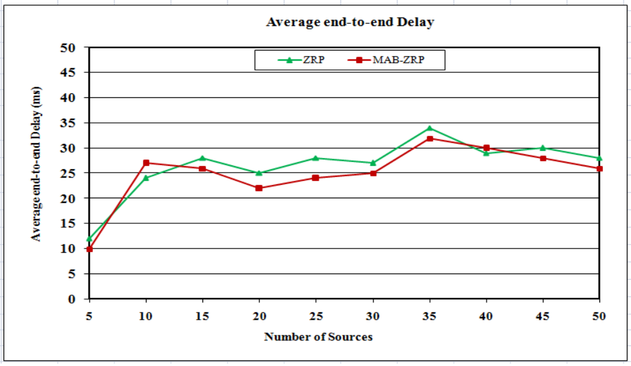
The following shown the graphs would be helpful to evaluate the network performance metrics such as Packet Delivery Ratio, Average end-to-end Delay, Routing Control Overhead and Gateway discovery messages overhead of proposed MAB-ZRP and regular ZRP protocols in the Unicast transmissions. The packet delivery Ratio comparison between ZRP and MAB-ZRP as a function of varying number of nodes with finite initial energy showed in Fig .2 a. The ZRP starts with a low delivery ratio for the transmission in the initial point of simulation. Based on the overall performance the proposed MAB-ZRP produced better performance than the regular ZRP. Fig .2 b illustrates the Average end-to-end delay comparison of the existing protocol ZRP and the proposed protocol MAB-ZRP. It is an observed from the figure that the average end-to-end delay of ZRP varies has the number of node increases. It is an observed from the figure that the average end-to-end delay for MAB-ZRP is comparatively less for the corresponding the number of nodes. The fig 2.c illustrate the comparison of routing control overhead of ZRP, and MAB-ZRP. it is an observed that has the number of gateway increases the routing control overhead of MAB-ZRP is less compare to ZRP. The figs 2.d illustrate the comparison of Gateway Discovery Messages Overhead for ZRP and MAB-ZRP. it is an observed that The Gateway Discovery Messages Overhead of MAB-ZRP is less compared to ZRP has number of gateway increases.

Comparison of MAB-MZRP and MZRP for Multicast Transmission

The above shown the graphs would be useful to evaluate the network performance metrics such as Packet Delivery Ratio, Average End-to-End Delay, Routing Control Overhead and Gateway discovery messages The comparison of Packet Delivery Ratio between MAB -MZRP and MZRP protocols as a function of varying number of node in the networks are depicted in the Fig .3 a. From the observed that, it is found the MAB -MZRP had a better packet delivery ratio than MZRP on multicast data transmission. The average end-to-end delay between MZRP and MAB -MZRP protocols are shown in the Fig.3 b. The minimum average end-to-end delay of MZRP is 26 ms whereas 22 ms for MAB -MZRP at the bare minimum delay.



(a)



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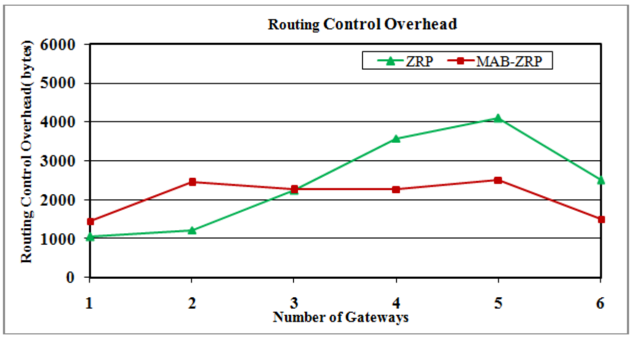
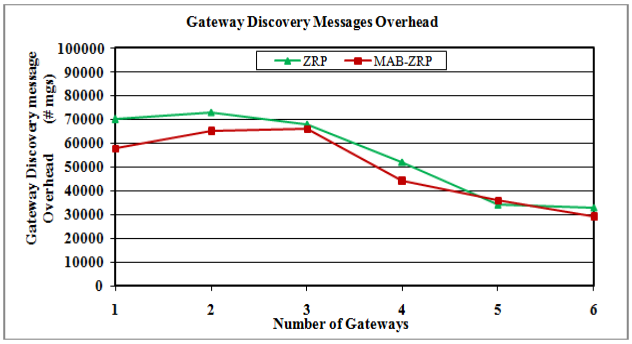
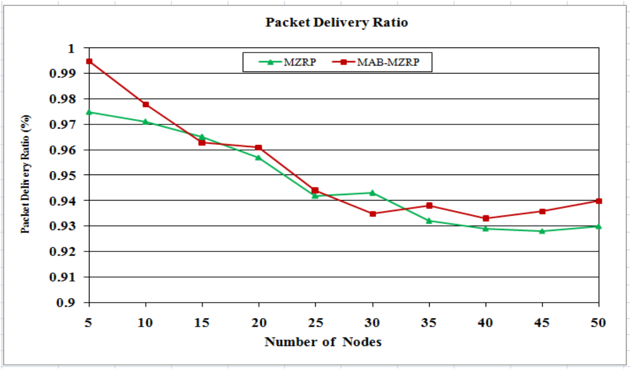


(c)

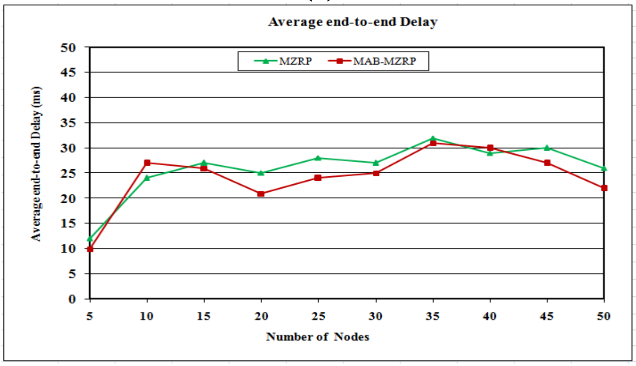


(d)

Fig.2. Comparison between ZRP and MAB-ZRP for unicast transmission. a.Packet Delivery Ratio, b. Average end-to-end delay , c. Routing control Overhead , d. Gateway Discovery Messages Overhead



(a)



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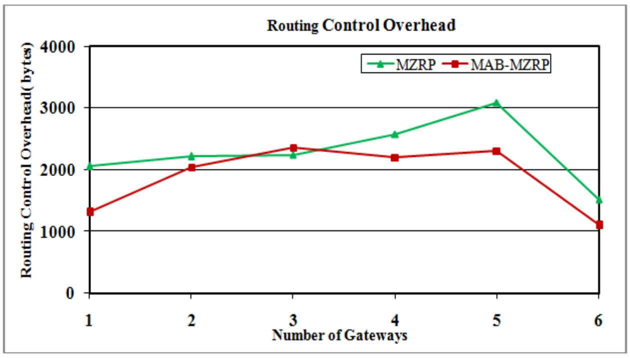

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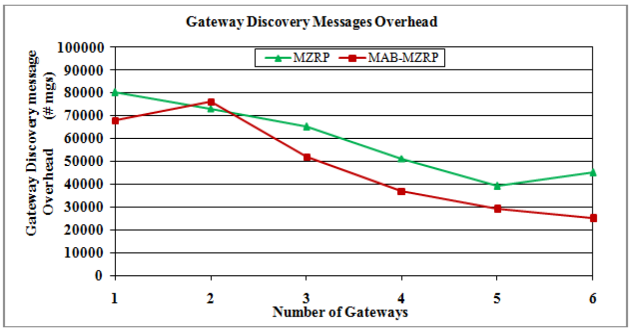

(d)

Fig .3. Comparison between MZRP and MAB –MZRP for multicast transmission. a.Packet Delivery Ratio, b. Average end-to- end delay , c. Routing control Overhead , d. Gateway Discovery Messages Overhead

The comparison of routing control overhead between MZRP and MAB – MZRP protocols are depicted in the Fig .3 c. The MAB -MZRP produced lesser routing control overhead than the MZRP. The Gateway Discovery message's overhead comparisons of MZRP and MAB -MZRP protocols are indicated in the Fig.3.d, it is an observed that The Gateway Discovery Messages Overhead of MAB-ZRP is less compared to MZRP has number of gateway increases. The multicast transmission performance metrics of Packet Delivery Ratio has increases from 9.47% to 9.52 %, Average End to End delay decreases from average of 260 ms to 243 ms, Routing Control Overhead reduced from average of 13,670 bytes to 13,300 bytes and Gateway Message Control Overhead from average of 35,300 mgs to 28,700 mgs for MZRP and MAB-MZRP respectively. The overall result shows an enhance performance by MAB-MZRP than MZRP in multicast data transmission on hybrid MANETs.

Conclusion

The proposed work analysis of Modified Adaptive gateway discovery scheme using hybrid protocols, the proposed protocol MAB-ZRP has been examined with standard ZRP in unicast data transmission and the overall simulation results show that the proposed MAB-ZRP produced better performance on most of the network performance metrics. Since the proposed work emphasis on the multicast transmission, Modified Adaptive gateway discovery Based-MZRP has been considered as an efficiency routing technique with enhanced adaptive gateway discovery function and the overall observation states that the MAB –MZRP produces better performance than the MZRP in multicast data communication in the hybrid MANETs. Future work will focus on the adaptive gateway discovery scheme can be designed based upon the characteristic of the wireless network

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