MANET: An Effective Gateway Discovery by Using Link Lifetime

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Abstract- Mobile ad hoc networks (MANETs) connected to the Internet requires a gateway to operate. The gateway is responsible for providing the configuration parameters to the nodes by means of message exchanges. As MANET nodes move freely, these messages are generated at the beginning of the connections, when the route to the gateway breaks or when the gateway proactively sends them. The Integration of the MANETs and infrastructure networks such as Internet, known as heterogeneous network, extends the network coverage and increases the application domain of the MANET. The ad hoc routing protocol AODV is extended and used to achieve interconnection between a MANET and the Internet. In the existing approaches of gateway discovery either interface queue length or the minimum hop metric criteria or a combination is used for selecting the gateway by the mobile nodes. But in this paper we have proposed an efficient reactive gateway discovery algorithm is devised that takes into account the length of the routing queue in addition to the minimum hop count metric for selecting an efficient gateway and also selecting the routes to other mobile nodes as well as it also selects the stable node by using the properties of link lifetime.

Keywords – Mobile ad hoc network, gateway discovery, routing.

I. INTRODUCTION

Mobile ad hoc networks (MANETs) are formed by autonomous mobile nodes that are able to communicate among themselves without any infrastructure. In most practical applications, ad hoc mobile nodes usually demand the access to external hosts such as the Internet. MANET can communicate in any environment without communication infrastructure, so it may receive the Internet service through the gateway node and extend the Internet service to the region without infrastructure, such as battleground correspondence, disaster rescue and so on, which requests MANET to become wireless multi-hop accessing network. This kind of expansion can not only strengthen Internet coating ability but is also important to each kind of migration distributional application with strong demand. The Integration of the MANETs and infrastructure networks such as Internet extends the network coverage and increases the application domain of ad hoc networks. The Internet Gateway is a specific device installed in those scenarios where the connectivity of a MANET to the Internet is required. In particular, the Gateway announces its presence to the network by means of modified router advertisement (MRA) messages; an MRA message contains the number of hops that the message has traversed. Thus, upon reception, the MANET node knows to which neighbor it should send the packets addressed to any Internet host as well as how many hops are necessary to reach the Internet Gateway. With these two parameters, the route to the Gateway is constructed.

In the proactive gateway discovery, MRA messages are periodically broadcast by the Internet Gateway into the whole network. Through different paths, a node could receive several copies of the same MRA message. Under these circumstances, the node should decide which path to store in its routing cache. Under the conventional gateway discovery process, the chosen route is usually the path composed of the lowest number of hops. If there are multiple paths holding this condition, the first discovered path prevails. However, the decision of selecting the path impacts on the network performance since the use of invalid routes to the Internet Gateway obliges the nodes to search for a path to the Gateway in a reactive way. For a node, determining the remaining lifetime of a path is not a trivial task because of the arbitrary movements of the nodes that form the MANET routes. In order to overcome this shortcoming, this paper proposes the identification of the paths that are composed of stable links. Every node will be exclusively responsible for deciding about the stability of the links to its neighbors which are part of a path to the Gateway. Specifically, any MANET node in the paths will analyze whether these links are stable, that is, if they are expected to be active along the next interval of emission of the
MRA messages. Once the stable links are detected, a node will only retransmit the MRA message if the link from which the message has been received is predicted to remain stable at least along the above-mentioned period. With this method, only stable routes are established to communicate with the Internet Gateway.

The remaining part of our paper is organized as follows: In section II we will discuss the related work done in field of gateway discovery for using internet in MANET and in section III we will discuss the proposed mechanism for gateway discovery and also present the flow chart. The analysis of the mechanism will be discussed in section IV and finally in section V we will conclude the paper and give the future scope of this paper.

II. RELATED WORK

The interconnection of MANETs and the Internet is supported by an Internet Gateway that provides the necessary configuration parameters to the mobile nodes. In order to announce its presence and enable nodes to construct the routes to the Internet, the Gateway sends special messages that can be generically named as MRA. The different integration supports presented in the literature mainly differ in how these messages are created and propagated in the network [2, 5]. Among them, the Global Connectivity support outstands because of its popularity [4].

The Global Connectivity mechanism specifies three types of gateway discovery. In the reactive scheme, the Gateway only emits unicast MRAs on demand. Nodes desiring a route to the Internet Gateway demand these unicast MRAs by flooding MRS messages. Once these messages reach the Gateway, the Gateway replies with a unicast MRA messages.

Alternatively, the proactive gateway discovery is supported by the periodic emission of multi-cast MRA messages. These messages are periodically sent by the Internet Gateway to all the nodes. The MRA is employed to update the route to the Internet Gateway. The interval of emission of these messages is set to a fixed value (T). When a stored route is used, the node can detect that it is no longer valid (e.g. link layer feedback mechanism can inform about the route unavailability). Under these circumstances, the node will emit an MRS message and it will wait for a unicast MRA message originated by the Internet Gateway. Further works propose the setting of the timing of the process (T parameter) to the network conditions. In this sense, one of the first adaptive algorithms was proposed in [6]. According to this scheme, the gateway sends an MRA message when a coefficient called regulated mobility degree (RMD) exceeds a threshold. This coefficient is defined based on the number of active sources that communicate with external hosts. In addition, the number of intermediate nodes that forward packets to the Internet Gateway is also considered for its computation. In [7], the authors propose to broadcast the MRA messages only when a change in the topology is detected. In order to identify this change, traffic and mobility are observed. Conversely, Ghasemian et al. [8] used an autoregressive filter to adjust the value of T depending on the changes of the link stability, the traffic rate of sources and the number of received MRS messages. Unfortunately, there is no analytical expression that allows the implementation of that proposal.

On the other hand, according to the Global Connectivity support, the hybrid gateway discovery could be considered as the combination of the two previous schemes. This algorithm follows a proactive scheme in an area close to the Gateway. The area can be easily delineated with the time to live (TTL) parameter present in the IP header of MRA messages. Thus, the nodes that are more distant to the Gateway than TTL hops should acquire the route to the Gateway on demand (by broadcasting an MRS) when needed. Some works focus on how to tune the TTL parameter conveniently. Ruiz and Gomez-Skarmeta [9] propose that the gateway broadcasts the MRA messages with the TTL equal to the minimum number of hops required to reach all the sources that use this Gateway to communicate with external hosts in that moment. This scheme is known as the maximal source coverage (MSC). Another hybrid approach is presented in [10], in which some intermediate nodes are allowed to answer MRS messages based on local information.

The Internet Gateway is in charge of the previous optimizations as it decides the value of the TTL in the MRA messages. In [11], the authors present a novel strategy in which nodes make a decision about the convenience of retransmitting the MRA message. Specifically, the work (named adaptive distributed gateway discovery (ADD)) proposes that just the mobile nodes that are retransmitting data packets to the Internet will be allowed to forward the MRA messages. The presented simulation results show that this scheme can outperform the MSC algorithm.

Decentralising the decision about the retransmission of MRA messages has demonstrated to be effective as more variables could be taken into account [11]. For instance, Zhuang et al. [12] present an algorithm to remove unidirectional links from the routes to the Gateway.

Here we also follow the decentralized technique to find the gateway discovery by using the characterization of the link lifetime as well as mobile nodes parameters.
III. PROPOSED MECHANISM FOR GATEWAY DISCOVERY

In this paper we proposed a mechanism by using AODV [1] routing protocol with additional metric of link lifetime is introduced for updating the route to the gateways and the mobile nodes. Our proposed mechanism works on following four parameters which is discussed below:

3.1. Computation of congestion level: We compute level of congestion at a particular node along a path i.e. avg_q_occupancy as per the following equation

\[
\text{avg}_q_{\text{occupancy}} = \frac{n \cdot q_{\text{occupancy}} + \sum_{k=1}^{n} nb_{q_{\text{occupancy}}}}{n + 1}
\]

Where \( q_{\text{occupancy}} \) node’s own queue occupancy
\( nb_{q_{\text{occupancy}}} \) node's neighbours queue occupancy
And \( n \) is the number of neighbor nodes.

3.2. Finding the stability of node: We can find the stable nodes through which we can perform the routing through which we can find the gateway and the stability of the node can be achieved by finding the link lifetime, the more the value of link lifetime the more the links will be stable. The lifetime of the link can be found with the help of following formula:

\[
F_{RP} = \frac{K_{\text{min}}(W_A, W_B) + D_S}{\text{Dist}(A, C)}
\]

Where \( D_S \) is the difference of two signal strength received at a node at two different times.

3.3. Broadcasting advertisement: Here a mobile node will receives advertisement from multiple gateways, a reactive approach is used where every gateways sends its advertisements periodically. Whenever a mobile node receives a non duplicate gateway advertisement, select a suitable gateway by comparing the gateway_adv_queue in the gateway advertisement message with its routing table message. Further this mobile node broadcasts gateway advertisement to its neighbors, if the gateway advertisement from another gateway having less congested path the mobile node needs to switch new gateway as the default gateway.

3.4. Updating the routing entries: In the MANET, a mobile node uses multiple hops for communicating with the other nodes in the ad hoc domain. This feature helps us in updating the routing entries from one mobile node to another when a request is being processed. We make the use of the minimum number of hops and the packet
load present between the two mobile nodes to update the routing entry between the nodes. So that in this way by using following the steps discussed above can be beneficial for the gateway discovery are summarized in the flow diagram.

IV. PERFORMANCE ANALYSIS

The following performance metrics will be considered for comparison of the proposed approach and that of khaleed [3] as well as hamidian [13].

Packet Delivery Ratio: It is defined as the total number of data packets received divided by total number of data packets sent at all the mobile nodes present in the simulation.

Routing Overhead: It is defined as the ratio of the AODV packets to the data packets sent and received by all the mobile nodes.

End-to-End Delay: It is defined as the delay for sending packets from source node to the fixed host.

Simulation Results: We will implement our proposed mechanism by using network simulator ns-2.31[14]. The performance of the proposed mechanism will be compared with hamidian [13] and khaleed [3] proactive discovery approaches in similar simulation environment.

V. CONCLUSION

In This paper we have proposed a mechanism for efficient gateway discovery with flow chart and the simulation results is in progress which will give the comparative analysis with other already given strategy for gateway discovery in MANET. The main characteristics of our proposed mechanism is that it takes into account the number of hop count used in the gateway discovery process as well as the lifetime of the link which makes it efficient and effective that other strategy. Our mechanism is expected to decrease the congestion in the network and improve the performance of the networks in terms of packet delivery ratio, routing overhead and end – end delay.

REFERENCES