International Journal of Computing and Applications | **ISSN: 0973-5704**
Volume 13, Number 1, (January-June 2018), pp 101-107

AN EFFICIENT GATEWAY DISCOVERY AND SELECTION ALGORITHM BASED ON MULTIPLE PATH ATTRIBUTES FOR INTERNET INTEGRATED MANET

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Abstract: Today's by researcher MANET is become a favourite topic for research due to its flexibility and infrastructure less network such as base station and Internet integration with MANET is performed by help of a Gateway node. That means we can say gateway node act as "interface" such that Gateway discovery is first task which performed by every MNs in network. Based on QoS parameters like link quality, Path availability interval, Path link ability and end-to-end postponement, there are numerous selection mechanisms was proposed for Gateway. By this mechanism only single network performance are improved that is packet drop ratio, Packet delivery ration, network throughput and an interruption occurred at end to end are only focused. That's why selection of gateway become essential case for improvement of overall network performance by help of path parameter i.e. Path stability, path with maximum residual load ability with minimum latency. We proposed gateway discovery with selection structure which consider numerous quality of services path parameters like path Accessibility interval, Residual load ability, latency and Hop count, by which we can improve the throughput of network and packet delivery ratio and reduce the packet drop ratio and select gateway with low cost also.

Keywords: Gateway selection, gateway discovery, QoS parameters, MANET, hop-count.

1. INTRODUCTION

Mobile ad hoc networks are self-governing standalone system without any need of centralized authority and infrastructure network. MANET is galaxy of mobile node which can communicate over internet via wireless link, these are free to move and change its location anytime anywhere. Such type of network can be operated by MNs or connected to Internet. MANET can connect to Internet by help of Internet Gateway. Internet integrated mobile ad hoc network stated as a category of wireless access net of Internet. Internet Gateway which has both wireless and wire interfaces is require for such type of internet working.

Main challenges arise in Internet integration of MANET from the need of information regarding the availability of gateway with minimal consumption of scare resource of network obtained by mobile nodes. Thus, well-organized Internet gateway discovery approaches aimed at MANET turn out to be a crucial point for making usage of hybrid networks, wireless and movable network. Mobile nodes receive advertisement messages from more than one gateway node in MANET, due to its multi hop nature and decision regarding which one is for Internet connection must be taken by Mobile nodes [1]. Below Figure 1 illustrate the integration of MANET with Internet.

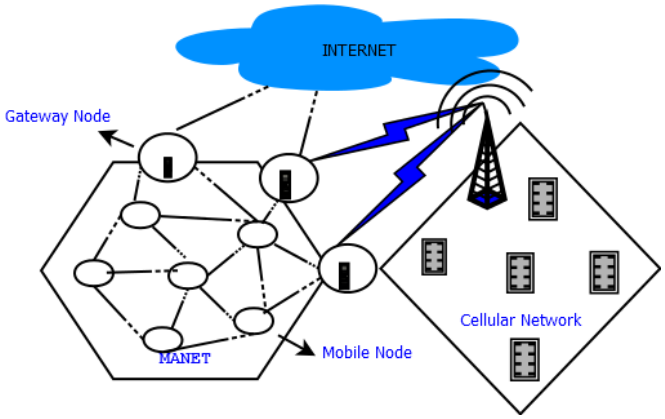

Figure 1: Mobile ad hoc Networks integrated through Internet.

Still, there are several gateway discovery protocols and gateway selection mechanism have been proposed based on the QoS and non QoS parameters, to taken in use an efficient gateway node [1]. Our focus is to plan a newfangled gateway discovery etiquette by considering multiple QoS parameter like Path accessibility interval, accessible capacity, Latency of path and hop count in path to select an efficient gateway node. By help of this parameter our selection mechanism can improve through put and ratio of packet delivery with less energy per consumption per node with low cost compare to solitary QoS pathway attributes gateway assortment mechanism.

The ordered of paper as follows -via section 2 we tagging gateway discovery etiquette also selection mechanism with related work had been done. In next section, we describe several gateway selection parameters and based on these parameters proposed a gateway discovery and selection algorithm which is followed by conclusion via section 4.

2. INTERNET GATEWAY DISCOVERY PROTOCOL

Meant for accessing the Comprehensive facilities in MANET Internet connectivity is achieved by Internet gateway for each node. This route can be used for transmission of packet address to or from Internet by mobile nodes in MANET.

As mention in above section that detection of Internet gateway functionality is not provided by standard ad hoc networks that's why protocol should be expanded based on directing messages.

The gateway discovery approaches can be classified in four distinct ways – Proactively, reactive, Hybrid and an Adaptive approach which is showing in figure 3 as bellow.

A. Proactive Gateway Discovery Approach

In this solution [2] the gateway advertisement information has been broadcasted by itself gateway node and after a creation predefined advertisement interval this information is rebroadcast. Based on number of hop counts this advertisement information is used for

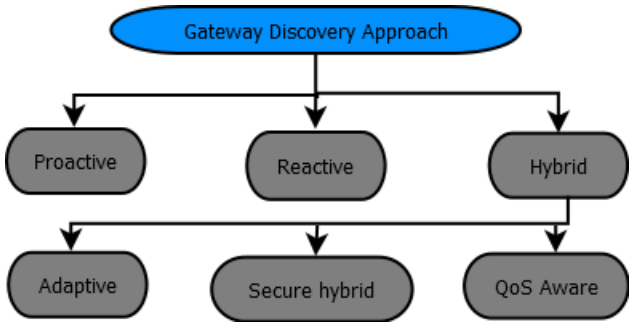

Figure 2: Classification of Gateway Discovery

gateway discovery process, default route creation, movement detection and handoff decision. Good Internet connectivity can be achieving if large no of mobile nodes has interest for Internet connection but overhead problem is faced with small no of MNs.

B. Reactive Gateway Discovery Approach

In this Approach [3] route discovery process is initiated by MN to the gateway reactively. Gateway solicitation information is transmitted by mobile node to find out the gateway node and path to it. A route request messages RREQ broadcasted to IP address of all gateway by MNs to fetch the information from Internet. Only gateway can receive and replied for this message. And gateway send route reply RREP message to source node by unicasting after receiving the RREQ message.

C. Hybrid Gateway Discovery Approach

In this scheme [4] the solution of above two approaches are combined and by using the combination it has several plus points over those approaches such as reduction in gateway advertisement overhead and gateway advertisement message is broadcasted to constrained area with limited no of hop which is known as TTL range of information. Gateway advertisement information are transmitted to maximal no of hops and this type of confined area is known as Proactive zone. Gateway Solicitation information is forwarded for all outsides node of this zone.

D. Adaptive Gateway Discovery Approach

Adaptive gateway discovery mechanism [5] is introduced to achieve the better tradeoff among the

performance and network overhead in MANET. Based on these MANET characteristics dynamically adjustment of TTL and periodicity of gateway advertisement information has been performing in this mechanism. Active source location maintains hop count information in this approach.

E. Related Work on Gateway Discovery Approaches

Various gateway discovery approaches had been proposing which are summarized in this section and represented by Table 1, which describe different protocol which had been proposed and categorized based on gateway discovery approaches.

F. Proposal Based on Gateway Selection Scheme

Strategy 1: Author Brannstron et. al., in [14] has proposed selection scheme for measuring the variances in delay among successive gateway advertisement message and gateway selection is also based on delay in metric variance of arrival rate of advertisement message is increased by two factor, first one is large no of hops between the gateway and MNs. And second one is high amount of traffic along the route.

Strategy 2: Author Bouk et. al., [15] Mainly proposed a method which are based on number of attributes such as available capacity of path, available period of path and latency of path. For two non-neighbor nodes, Available period of path is equivalent to the smallest association available period of two neighbored transitional nodes. At any node including the intermediate node and gateway the minimum load ability of route is known as available load capacity of route. And latency of path is measured by delay measurement between request and access time of route.

Strategy 3: Author De Couto in [16] was proposed a metric which is known as ETX. Where a kind of probe packet per second has been send out and for node if one hello message is send out in time interval $t1$ and time interval $t2$, then $t1$ and $t2$ is used to measure metric ETX. Necessary condition for this calculation is that information regarding the probe packet count should be maintained by the node in the last $t2$ second. And the loss rate of probe packet has been also calculated.

Strategy 4: Author proposed in [17] a gateway selection strategy founded by two parameters that are smallest hop count and the available extreme residual capacity of path from MNs to gateway. The available residual capacity (R) is determined by subtraction of current load (C) on node from total load (T). Where the current load can be calculated by summation of product of average arrival rate per node (A), average packet size per sec (P) and number of linked node (N) with gateway.

We can represent as:

$$R = T - C$$

where, $C = \sum_{i=1}^{n} A_i P_i N_i$

3. PROPOSED GATEWAY SELECTION SCHEME

Under this part, our aim to describe the planned algorithm for gateway selection via number of assortment attributes such as available path interval, available load ability of node, path Latency and hop count to discover an appropriate gateway node. we calculate the overall QoS value of each possible path among source to gateway and select a gateway node with high QoS value since these attributes.

A. Gateway Selection Parameters

There are no of parameter is available for gateway selection process such as path latency, available path interval, available ability of path, hop count end-to-end delay and link quality etc. now a detailed description on some parameter which we use for selection algorithm is given as follow-

1. Path Availability Interval

Path availability period is period as the minimum link availability period among the all intermediate node of path, but necessary condition is that, these nodes are not continuous neighbor of each other. Path availability interval is represented by P_i and the link availability

interval among the nodes from the sender S to GW Nodes G is represented by l_i, we can represents as

$$P_i = \min\{l_i\} \quad (1)$$

2. *Residual Path Load Ability*

Our purpose to select a gateway path with maximum accessible load ability and the residual path load capacity is defined as at any node the smallest accessible load ability counting all midway node and gateway node.

Let's L_n = represents the maximum load ability of node n and C_n = represent the current load ability handled by node n, then the residual load ability R_n at node n is calculated as:

$$R_n = L_n - C_n \quad (2)$$

$$\text{where, } C_n = \sum_{i=1}^{s} r_i s_i \quad (3)$$

when C_n is current load at node n which relay traffic from traffic source s and where r_i and s_i represent the average arrival rate and average packet size of traffic from source i respectively. Then we can define the residual load ability R_p of path p is computed as:

$$R_p = \min\{C_i\} \quad (4)$$

The residual ability of an Internet gateway $\mu_{current}$ is obtained by subtraction of current traffic load on Internet gateway from the total load C.

$$\mu_{current} = \sum_{i=1}^{s} r_i s_i \quad (5)$$

where, s = number of nodes connected to Internet gateway.

3. *Path Latency*

Processing time is taken from one node to another node for packet plus the propagation delay is introduced a term latency, which was increased whenever the conveyed in node via node mode from sender to receiver of packets or once node with high traffic load in path. Latency (L_p) of path p is computed by additive calculation of latency on each link in path among mobile node to gateway node.

4. *Hop Count*

This parameter is calculated among the source s to the gateway node or destination node d.

$$C(s, d) = \text{(a) } \min\{C(p)\} : s \rightarrow pd, \text{ if path } p \text{ from } s \text{ to } d \text{ node.}$$

$$\text{(b) else } 0 \quad (6)$$

Now by using these formulas we can estimate the overall QoS value for possible path and by this calculation we can choose one of the best QoS valued path.

$$QoS_i = (P_i/P_{max}) + (R_i/R_{max}) + (L_{min}/L) + (C_{min}/C_{(s,d)}) \quad (7)$$

where, P_{max}, R_{max}, L_{min}, and C_{min} are maximum path availability interval, maximum residual path load ability, minimum latency of path and minimum number of hop count. After computing the QoS_i for all possible route and the mobile node choose the highest value of QoS.

Figure 3 explain the hybrid network structure and represent the communication with internet.

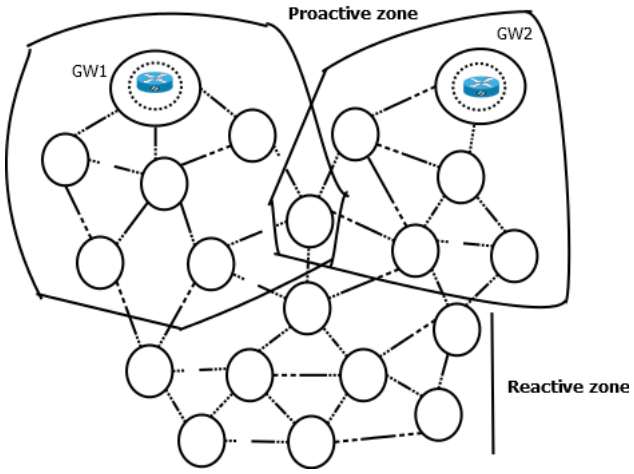

Figure 3: Hybrid Mobile ad hoc Network.

B. Algorithm for Discovery and Selection of Gateway Node

This section consists of three phase by which we can describe our algorithms. We mainly analyze our hybrid gateway discovery algorithms.

In case of proactive zone each parameter of gateway node is periodically advertised illustrated in Figure 4

with *k*-hops, via passing a Gateway Advertisement (GW-ADV) messages over in addition done with its existing parameter values like P_{GE_ADV}, *e*(epoch), *v*, *x*, *y*, θ, timestamp, Time-To-Live with available ability C values. If any node *u* receives a gateway advertisement message with (TTL < *k*) then it must be calculated parameters L_u and C_u and if these values is smaller than the L_{GW_ADV} and C_{GW_ADV} respectively then these values are updated in routing table of node u as well as gateway advertisement message. After this updating procedure this message is further forwarded to MANET until the TTL < *k*, which is represent in Procedure described in Phase I. where *e* = epochs which is sequences of arbitrary distance pauses also known as movement of node.

Θ = constant direction, *v* = constant speed.

In case of reactive zone node *i* discover a gateway node by help of sending a gateway discovery message with its existing parameter value i.e. e_i, v_i, x_i, y_i, θ_i timestamp, $R_{GW\text{-}DISC,}$ and $C_{GW\text{-}DISC}$ as shown in algorithms in Phase II. Forwarding of minimum valued path attributes until the receiving of gateway discovery message via GW or nodes belongs to table driven zone. Unicast of advertisement message to the dispatcher of discovery procedure will be performed whenever a node j receives a GW_DISC message in proactive zone.

Each mobile node must maintain the path entries of all path to the gateway nodes along their QoS parameters. If any node want to send a traffic to the hosting node it must be calculate all possible path parameter value and overall QoS of each path, which is illustrated in algorithm in Phase III

Phase I: Gateway Discovery in Proactive Zone.

Phase II: Gateway Discovery in Reactive Zone.

Phase III: Gateway Selection.

Phase I: Algorithm for Gateway Discovery in Proactive Zone:

Step 1: Gateway node periodically sends GW_ADV message, GW_ADV ($P_{GW\text{-}ADV}$ = null, *e*, *v*, *x*, *y*, θ, timestamp, TTL = 0, L_i & $C_{GW\text{-}ADV}$)

Step 2: When GW_ADV information is received by a node *u*

If (TTL < *k*) then

(a) Mobile node *u* compute the P_u as in (1)

If ($P_{GW\text{-}ADV}$ = null or $P_u < P_{GW\text{-}ADV}$) then

$P_{GW\text{-}ADV} = P_u$;

End If

(b) Compute R_u as in (2)

If (Ru < $R_{GW\text{-}ADV}$) then

$R_{GW\text{-}ADV}$ = Ru;

End If

(c) Replace *e*, *v*, θ, in gateway advertisement message GW_ADV with e_u, v_u, θ_u.

(d) Update the path attributes R, P, L in node *u*'s routing table and set TTL = TTL + 1;

forward the GW_ADV message;

End If

Phase II: Algorithm for Gateway discovery in Reactive Zone:

Step 1: Node *i* sends GW_DISC message

GW_DISC ($P_{GW\text{-}DISC = null}$, e_i, v_i, x_i, y_i, θ_i timestamp, TTL = 0 & $R_{GW\text{-}DISC}$, $C_{GW\text{-}DISC}$ = 0)

Step 2: When node *j* receives the GW_DISC message.

If (node *j* belongs to reactive zone) then

(a) Mobile node *j* compute P_j as in (1);

If ($P_{GW\text{-}DISC}$ = null or $P_j < P_{GW\text{-}DISC}$) then

$P_{GW\text{-}DISC} = P_j$;

End if

(b) Compute R_j as in (2)

If ($R_j < R_{GW\text{-}DISC}$) then

$R_{GW\text{-}DISC} = R_j$;

End if

(c) Compute C_j as in (6)

$C_{GW\text{-}DISC}$ = min {C(*j*)};

(d) Replace e_i, v_i, θ_i, x_i and y_i in gateway discovery message with e_j, v_j, θ_j, x_j and y_j.

(e) Update path attributes P R L and C in node *j*'s routing table and set

TTL = TTL + 1;

End if

Step 3: If (node *j* is gateway node or node *j* is a node in proactive zone) then

Node *j* compute the QoS_j as in (7) from routing table of *j*. where *r* = route to gateway node and Index = max $\{QoS_j\}$;

Generate the GW_ADV message with updated value of P, R, L and C.

$$P = \min (P_{GW\text{-}DISC}, P_{index}),$$

$$R = \min (R_{GW\text{-}ADV}, R_{index}),$$

$$L = L_{index} + delay_{GW\text{-}DISC};$$

$$C = C_{index} + C_{GW\text{-}DISC};$$

Send GW_ADV message to GW_DISC initiator

End If

Phase III: Algorithm for Gateway Selection:

Node figures the QoS_i as in (7) via its routing table.

Where *r* = Route to Gateway node.

Index = max $\{QoS_i\}$

pick the gateway per pathway index.

4. CONCLUSION AND FUTURE SCOPE

Based on number of review, we get a fact that conventional gateway discovery and selection approach mainly define by help of three attributes such as- Availability of path interval, residual ability of node and latency of path. We proposed a hybrid gateway discovery and selection algorithm to integrate MANET to internet that consider QoS attributes such as availability interval, load ability, latency and hop count for path. By using these attributes some improvements in network throughput and in packet delivery ratio have been performed, we can successfully reduce the packet drop ratio and cost of path with less energy consumption per node.

In future, the network throughput can be highly increased and cost of network system is also being reduced in future by using available path parameter in effective and efficient way.

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