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Gateway Discovery in MANET: A Survey

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Abstract---MANET (Mobile ad-hoc network) mitigates the requirement of common control or access point for forming a transient network. The extensive growth of wired and wireless devices due to rapid enhancement in technology has led to more emphasis on this network. The tremendous use of mobile devices by the users forms temporary connection between mobile devices which form MANET. This network is although very effective in the sense that it does not need any prior infrastructure but it has limitation too like low bandwidth, frequent disconnection , limited features and low battery problem. MANET also allows internet connection with the help of Internet Gateways .These Gateways are bridge between infrastructure based and MANET based network. Several mechanisms had been proposed for the Gateway Discovery in ad-hoc network. This paper tries to analyze several Gateway discovery mechanism proposed earlier and gives a critical evaluation of those technique. The survey concludes with future scope in this area.

Keywords: MANET, Transient network, Technological Growth, Gateway Discovery.

I. INTRODUCTION

The unorganized and distributed collection of several different mobile node or terminals form a mobile ad-hoc network (MANET)[1,2] .Every Mobile Node has a connection criteria via which communication is established with the help of Bluetooth and Wi-Fi technologies. The coverage of this temporary network is limited sometimes too extended sometimes with the topological differences of static or dynamic. A multihop architecture is although required due to limitation in transmission range of a mobile node. The architecture is sometimes referred as "multi-hop wireless interconnection network". The mobile nodes also perform the task of routing with the capability of route discovery and maintenance.

With the incremental growth of handheld and wireless devices use of ad-hoc network is tremendously multiplied. As a category if we go with MANET then it is useful in high altitude and remote areas were proper infrastructure establishment is very costlier. Some of well-known applications of MANETs are military mission, crisis management application, collaboration of task and personal area network [3-11].

Ad-hoc boundary is limit of the mobile node for communication. Mobile Node face the low connectivity to the different network, therefore we can say that the user of MANET are isolated at all. The rapid growth of internet technology which is most frequently used in many application of everyday life, made it very much crucial to attach the MANET with internet to provide the user with internet feature. This in term enhances the coverage area. A Large number of researches have done to integrate MANET and internet in last few years. The

concept called Mobile-IP concept was overridden with other one. So, introduction of internet gateway for providing connectivity came into existence which was with feature ad-hoc protocol. The bridge between internet and MANET was internet gateway now the user of MANET can easily access the service of internet. This networking phenomenon is called Hybrid networking and the network is called Hybrid network. The real problem arise when the mobile node move from one internet Gateway to other. This frequent switching from one gateway to other may result into disconnection problem which is not suitable in internet processing environment. The paper give more challenging area including the earlier solution provided by various author and tries to evaluate all those after prior comparison.

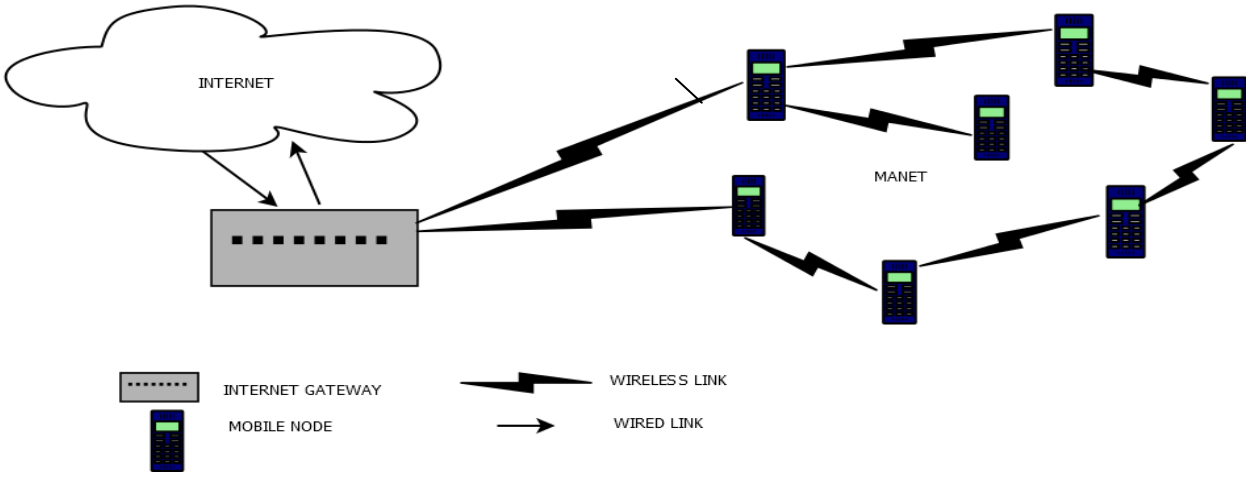

Fig I. MANET connection with Internet

II. MANET ROUTING PROTOCOL

A. Overview

The routing related information cannot disperse across the range of MANET thus the communication or sharing beyond this to internet is not possible. So, to resolve this problem of interrelating operation between both the routing must be taken in a concern.

MANET and Internet are attached with the help of specialized interface called as Internet Gateway, which act as interfacing unit between Internet and MANET. So both MANET and IP stack should be maintained simultaneously. The internet gateway is holding information on both side of gateway i.e. fixed and wireless network. Over internet area it transit like traditional protocols. On second side it uses MANET routing protocol. This Gateway is helpful in determining whether the arriving packet is for other side or for local network. MANET routing protocol are divided into three types reactive, proactive and hybrid protocols.

Table 1 Different Routing Protocol

Routing	Flat/Hierarchical	Protocol	Description
Proactive(table driven)	Flat	DREAM	Distance Routing Effect Algorithm for Mobility based on the use of location information.
		DSDV	The protocol Destination Sequence Distance Vector performs discovery of routes by using RREQ and RREP.
		FSLS [1]	Fuzzy Sighted Link State protocol is a basically chain Dui Standard Link State routing. SLS protocol is becoming most widely used protocol on Internet.
		GSR	Global State Routing is based on Link state. It has benefit of no flooding.

		OLSR	Optimized Link State Routing Protocol is based on IP routing. It is optimized for MANET, which is also used on wireless ad hoc networks.
		STAR [2]	Source Tree Adaptive Routing Protocol is made for use by nodes. Static and mobile node in an ad hoc network or an internet
		TBRPF [3]	Topology broadcast based on reverse-path forwarding is a link-state routing protocol for wireless mesh networks.
		WRP	Wireless Routing Protocol based on modified version of the distance-vector routing protocol, which inherits the Bellman–Ford algorithm to calculate paths.
	Hierarchical	CGRS [4]	Cluster head Gateway Switch Routing (CGSR) uses the DSDV Routing algorithm.
		HOLSR [5]	HOLSR is based OLSR protocol but unlike OLSR, the HOLSR protocol takes advantage of several mobile node capabilities to reduce the routing control overhead in big heterogeneous ad hoc networks
		HSR [6]	Hierarchical state routing (HSR), is based on Scalable Routing Strategies for Ad Hoc Wireless Networks is a typical a hierarchical routing protocol.
		LANMAR [7]	The Landmark Routing Protocol uses the concept of "landmark" for scalable routing in big mobile ad hoc networks.
Reactive(on demand)	Flat	ABR	Associativity-based routing on demand protocol and routes are selected based on temporal stability of wireless link.
		AODV	Adhoc on demand distance vector used when a node does not have a valid route to destination
		DSR	Destination sequence routing uses Route Request packet that carries the path traversed and the sequence number.
		LRR	Link Reversal Routing protocol is used in adhoc network which converge quickly, power saver and adaptive.
		LMR [8]	Label-based Multipath Routing broadcasts a control message throughout the network from several alternate paths.
		LUNAR [9]	Lightweight Underway adhoc Routing Protocol was developed extend novel ad hoc routing strategies and to reconsiders ad hoc routing protocol design inside pragmatic boundaries.
		SSA [10]	Signal Stability based Adaptive Routing use for finding and maintaining stable routes based on signal strength and location stability in an ad-hoc network

		TORA	Temporally ordered Routing Algorithm (TORA) is a hybrid routing protocol also termed as link reversal protocol. It is capable of solving the existing limitations in mobile ad-hoc network. Due to the high mobility of nodes, congestion is serve problem in MANETs.
	Hierarchical	CBRP [11]	Cluster Based Routing Protocol (CBRP) is a designed to use in mobile ad hoc networks which divides the nodes into a number of overlapping or disjoint clusters
Hybrid	Flat	ZRP	Zone Routing Protocol (ZRP) was first given by Haas and Pearlman. It is also a hybrid protocol and to perform operations it divides the total network area into different zones. Zone size or radius depends on the number of hops and does not depend on the distance.
	Hierarchical	ZHLS	Zone-Based Hierarchical Link State is a hybrid routing protocol in which all network nodes construct two tables, an intra-zone table and an inter-zone table, by flooding.
		HARP [12]	Hybrid adhoc routing protocol is a hybrid scheme combining reactive and proactive approaches.

The table describes several types of ad-hoc network protocols on the basis of flat and hierarchical routing technique.

1. Proactive Routing Protocols

This is table based routing protocol. The information related to routing is maintained in table. Every node stores information about how data could be transferred to the destination. The table contains the information associated with cost of route which is going to be followed and the other hop for reaching a node or some subnet. It is very tough to maintain table for each node in a very large network which causes several overhead. So, proactive protocol is not recommended for very large network. Such as DREAM, DSDV, FSR etc.

2. Reactive Routing Protocols

This protocol is based on the fact that it creates route/path when it is required. So, this protocol is also known as on-demand protocol. This protocol work when a source wants to send some data to destination then it will perform the operation of discovering the route and get its desired path. This is a criterion of routing where discovery of route is on demand. The protocol such as: ABR, AODV, DSR, LRR, LMR, LUNAR etc.

3. Hybrid Routing Protocols

This is a combined approach of both proactive and reactive routing protocol where we take the advantage of both the approach is taken. The protocol such as ZRP, SHARP, ZHLS are hybrid one.

B. MOBILITY IN MANET

In MANET mobile node are not fixed they are in state of mobility so exact prediction of their topology is very difficult. So, we go with the concept of dynamic mobility. At any instant of time a mobile node might lose the information of routing between node and Internet

Gateway. Any ongoing communication by this type of node on internet with the help of IGW will be interrupted. The mobility protocols are used for the proper integration of MANETs and the internet. This provides mobility support to the mobile node.

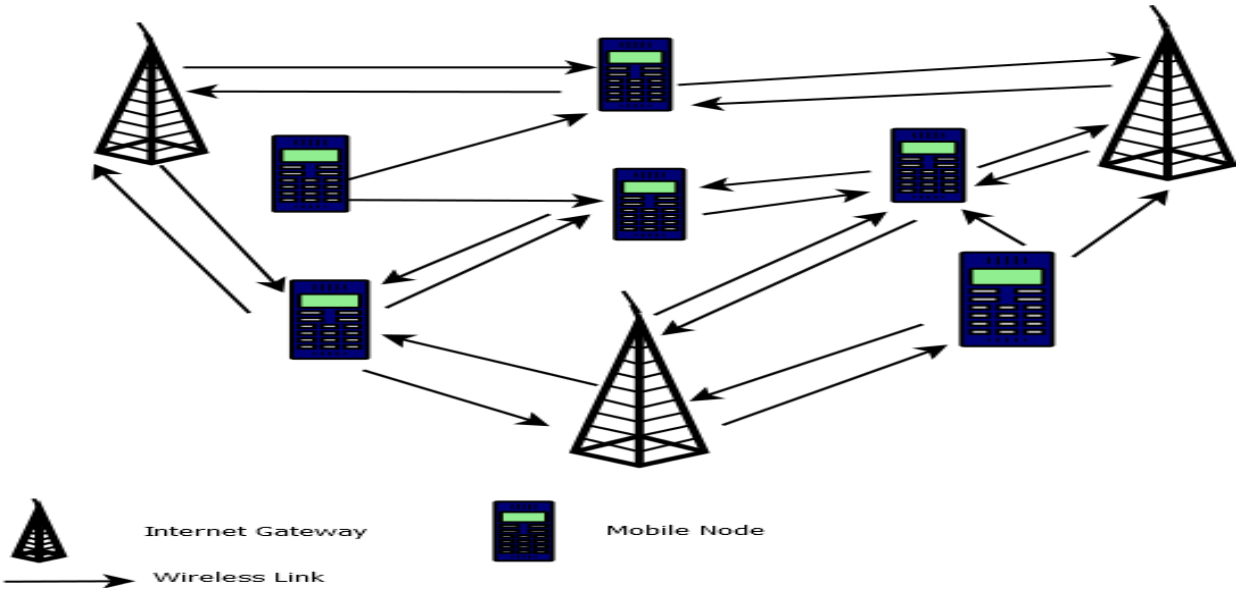

Fig II. Mobility of mobile node in MANET

In the above figure the mobile node is in motion and it goes in contact with several gateways. So the actual position of mobile node cannot be determined. This shows that special protocol is need for this issue of mobility.

C. GATEWAY DISCOVERY IN MANET

The gateway discovery functionality is not provided by the standard protocol so they require some extension. It is crucial to make provision so that wireless mobile nodes in adhoc environment packets to other networks. These extensions are done in three ways:

1. Proactive mechanism

In this scheme the Internet Gateway periodically broadcast Advertisements message (GWADV) which contains address called IP prefix. The mobile nodes that are trying to connect to internet detect this and trying to connect to internet detects this and submits route information for Gateway and redistributes the message. This IP prefix message can be received by a single node may be more than one so the mobile node makes proper tradeoff between these for connection or switching. This mechanism has high connectivity, lesser delay but increased communication overhead. [Table 2]

2. Reactive mechanism

Here the MANET work on demand criterion where the mobile node automatically detects the internet Gateway as when required. In this mechanism a Gateway Solicitation (GWSOL) message may be unicast or broadcast by mobile node to its immediate neighbor on the way of Gateway. After receiving this message the Gateway provide on demand path. This mechanism suffers from route discovery delay. [Table 2]

3. Hybrid mechanism

This hybrid method of Gateway Discovery combines the feature of both above mechanism. This bifurcation is done in such a way that a mobile node in some range in proximity of the IGW proactive discovery is used, while outside the area of coverage reactive discovery is used.[Table 2]

TABLE 2 GATEWAY DISCOVERY APPROACHES IN MANET

PROACTIVE	REACTIVE	HYBRID
Ergen and Puri [4]	Broach et al [7]	Jonsson et al [8]
Xie and Kumar [1]	Ville [6]	Sun et al [9]
Jelger et al [33]	Nilssen et al [9]	Perkins et al [10]
Rosenschen et al [9]	Ammart and EL-Rewine [8]	Tseng et al [12]
Khan et al [6]	Michalak and Brown [6]	2
Kumar et al [5]	Bo et al [7]	Lee et al [16]
	Li and Li [8]	Benzaid et al [27]
	Kassahun [5]	Koch and Schmidt [33]
	Nordstrom et al [15]	Hoang et al [22]
	Syarif et al [3]	Jung et al [3]
	Yan et al [25]	Ruiz and Gomezskarmeta [4]
		Denko and Wei [2]

D. MANET GATEWAY SELECTION

Selecting an internet gateway from large number of IGW's is also an important criterion. It may be on MNs or IGW. In proxy methodology IGW selectively reply to request for route depend up on certain methodology like operator of network not announce gateway service to specific mobile node or stopping of reply message due to load threshold. The internet gateway is selected on the basis of straight forward approach i.e. select the gateway having minimum number of node. There are other criterions too like mobile node select set of IGW for load balancing.

III. RELATED WORK

Several researchers had focused their interest on the Gateway Discovery in MANET and try to reveal the fact and problem in this discovery. They also proposed large number of solution to these shortcomings. Here the works are presented using tables [3,4,5].

Table 3 Proactive Mechanism

Scheme	Approach	Stateless /Stateful	IP Version	Duplicate Address Detection	MANET Routing	Multiple gateway support	Forwarding Approach
Ergen and Puri [4]	Adjust Mobile IP to work with DSDV	-	MIPv4	No	DSDV	No	Default Route
Xie and Kumar [1]	Adjust Mobile IP to work with EDSDV	-	MIPv4	No	EDSDV	No	Default Route
Jelger et al [9]	Combination of IGW discovery and global address	Stateless	MIPv6	No	Proactive	Yes	Default Route
Rosenschon	Based on Hello message	-	-	No	AODV	Yes	Default Route

et al [9]							
Khan et al [6]	Eff-DSDV used to provide bidirectional connectivity	-	MIPv4	No	EFF-DSDV	No	Default Route
Kumar et al [26]	A load aware discovery	-	MIPv4	No	AODV	Yes	Default Route

Table 4 Reactive Mechanism

Scheme	Approach	Stateless /Stateful	IP Version	Duplicate Address Detection	MANET Routing	Multiple gateway support	Forwarding Approach
Broch et al [7]	Heterogeneous network support and provide interfacing using Mobile IP and DSR	-	MIPv4	No	DSR	No	Default Route
Ville [2]	Combination of Cellular IP and AODV	Stateless	Cellular IP	No	AODVv6	Yes	Host Route
Nilsson et al [1]	Combination of IPv6 and AODV to find IGW that is intended for distributing a global prefix	Stateless	MIPv6	Yes	AODV	No	Default Route
Ammari and El-Rewini [30]	A three layer approach that combine Mobile IP and DSDV	-	MIPv4	No	DSDV	Yes	Default Route
Michalak and Braun [19]	Micro-mobility support via adjustment of AODV	-	Micro-mobility	No	AODV	No	Default Route
Ayyadurai and Ramasamy [17]	Combination of ALMA and AODV	-	MIPv6	No	AODV	Yes	Host Route
Setiawan et al [11]	Use SAW method for gateway selection	-	-	No	Any	Yes	Default Route
Bo et al [4]	AODV adjustment for working with MIP	-	Modified MIPv4	No	AODV	Yes	Default Route
Li and Li [8]	MRBDAS based access	-	-	No	Any	Yes	Default Route

Kassahum [10]	Gateway discovery before Gateway route break	-	-	No	AODV	Yes	Default Route
Nordstrom et al [2]	AODV extension	-	MIPv6	No	AODV	Yes	Tunneling
Syarif et al [1]	AODV+ with R-AODV	-	-	No	R-AODV	Yes	Default route
Yan et al [10]	Gateway selection using SAW	-	MIPv4	No	AODV+	Yes	Default Route

Table 5 Hybrid mechanism

Scheme	Approach	Stateless /Stateful	IP Version	Duplicate Address Detection	MANET Routing	Multiple gateway support	Forwarding Approach
Jonsson et al [20]	Adjusting Mobile IP to work with AODV	Stateful	MIPv4	No	AODV	Yes	Tunneling Based
Xi and Bettstetter[16]	Adjustment of IPv6 to work with Routing in MANET	Stateless	MIPV6	Yes	Any Protocol	Yes	Tunneling Based
Sun et al [5]	Adjusting Mobile IP to work with AODV	-	MIPv4	Yes	AODV	Yes	Default Route
Perkins et al [29]	Adjusting Mobile IPV6 to work with AODV	Stateless	MIPv6	Yes	AODV	Yes	Default Route
Tseng et al [7]	Adjusting Mobile IP to work with DSDV	-	MIPv4	No	DSDV	Yes	Default Route
Ratanchandanand Kravets [8]	Adjusting Mobile IP to work with any on demand routing protocol	-	MIPv4	No	Any on demand	Yes	Tunneling to foreign agent
Lee et al [3]	Adjusting Mobile IP to work with any source routing	Stateful	MIPv4	No	Any	Yes	Host Route
Benzaid et al [18]	Adjusting OLSR	-	MIPv4 and micro-mobility	No	AODV	No	Default Route
Kock and Schmit [28]	Adjusting Mobile IP to work with AODV	-	MIPv4	No	AODV	Yes	Tunneling Based
Hoang et al [23]	Several ARs and HMIP	Stateless	HMIP	Yes	Any Protocol	Yes	Default Route

Jung et al [17]	AASI and AALI	-	MIPv4	No	AODV	Yes	Default Route
Ruiz and GomezSkarmeta [24]	Maximal Benefit coverage	Stateless	MIPv6	Yes	AODV	Yes	Default route
Denko and Wei [8]	AODV and MIP extension	-	MIPv4	No	AODV	Yes	Default Route
Rakeshkumar and Misra [26]	Combination of periodic and adaptive gateway advertisement	Stateful	MIPv4	No	AODV	Yes	Default Route
Ros and Ruiz [32]	Adaptive gateway discovery	Stateless	MIPv6 and v4	Yes	AODV	Yes	Default Route
Park et al [37]	Adaptive gateway discovery and selection	-	MIPv4	No	AODV	Yes	Default Route

IV. CONCLUSION

The extensive development in the mobile computing technology enforces the creation of MANET because it does not require any central control and infrastructure for connection establishment. The MANET has limitation of low battery, bandwidth and dynamic topology. This paper has gone through several protocol and approaches and tries to critically analyze those. The area of MANET gateway discovery is very vast,although several work has done but still large work to be done.

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